Electronic Cigarettes in the Perioperative Period of Cardiothoracic Surgery: Views of Australian Clinicians and Patients

Nia Angharad Luxton

MAppSc Physiotherapy

A thesis submitted for the degree of Doctor of Philosophy

Macquarie University

Department of Psychology

Sydney, Australia

November 2018

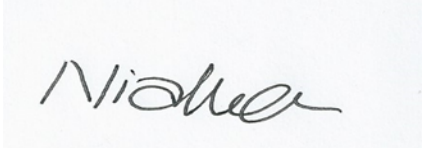
Statement of Candidature

I, Nia Angharad Luxton, hereby declare that the work contained within this thesis titled "Electronic Cigarettes in the Perioperative Period of Cardiothoracic Surgery: Views of Australian Clinicians and Patients" has not previously been submitted to any other university or institution, in part or in whole, as a requirement of a degree or diploma.

I, Nia Angharad Luxton, hereby declare that I was the principal researcher of all work included in this thesis, including the work published with multiple authors. A statement from co-authors confirming the authorship contribution of the PhD candidate is provided in each of the relevant chapters.

I, Nia Angharad Luxton, also hereby declare that this thesis is an original piece of work and it is written by me. I also certify that any sources of information used throughout the thesis are acknowledged, including any help or assistance that I have received in my work and preparation of this thesis. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due reference is made in the thesis itself.

The research presented in this thesis was reviewed and approved by the following ethics committees: Northern Sydney Local Health District HREC reference number: LNR/15/HAWKE/356; Royal North Shore Hospital site specific assessment (SSA) reference number: LNRSSA/15/HAWKE/371; North Shore Private Hospital SSA reference number: NSPHEC 2O15-LNR-O13; Royal Prince Alfred Hospital SSA reference number: LNRSSA/16/RPAH/42; Westmead Public and Private Hospital SSA reference number: LNRSSA/16/WMEAD/48; and Macquarie University Human Research Ethics Committee (HREC) reference number: 5201500797 (including Macquarie University Hospital).

(Signed)  **Date: 28 November 2018**

Candidate's name: Nia Angharad Luxton

Abstract

Smoking cessation has health benefits, particularly before surgery. Diagnosis, hospitalisation and surgery for tobacco-related illnesses such as coronary artery disease or lung cancer are 'teachable moments' in health promotion, an opportunity to promote smoking cessation among patients. However, many smokers find it difficult to quit. Electronic nicotine delivery systems (ENDS), commonly referred to as electronic cigarettes or e-cigarettes, may reduce harm in the perioperative period and offer an alternative method of tobacco reduction or cessation in the short and longer term for patients undergoing surgery. However, they are controversial, due to the unknown health effects of long-term use, their efficacy as a cessation aid, and views that electronic cigarettes will either renormalise smoking or be a gateway to tobacco use in younger people. Compared to other developed countries, such as Canada, New Zealand and the United Kingdom, Australia has taken a more precautionary approach to the regulation of electronic cigarettes, thus there is limited research in clinical settings.

The thesis examines the awareness and opinions of cardiothoracic clinicians about current clinical smoking cessation guidelines and the impact of smoking and of cessation in the perioperative period. It also examines their views on electronic cigarettes, and the potential role to reduce postoperative complications caused by tobacco smoking and create a sustained quit attempt. Furthermore, the thesis examines the awareness, use and beliefs about electronic cigarettes of patients diagnosed with coronary artery disease or lung cancer awaiting cardiothoracic surgery and the potential role of electronic cigarettes as a smoking cessation aid in the perioperative period.

The thesis contains three studies based on empirical research in six hospitals in Sydney, New South Wales, consisting of surveys and interviews with 62 patients awaiting cardiothoracic surgery, and in-depth interviews with 52 cardiothoracic clinicians — surgeons, anaesthetists, nurses and physiotherapists. Study I explores the knowledge and reported delivery of Australian clinical guidelines for smoking cessation care in the perioperative period of surgery by cardiothoracic clinicians. It reveals inconsistent implementation of clinical guidelines due to the diversity of

clinicians' views in delivering smoking cessation, and institutional inadequacies in cessation training, resources and engagement, as categorised using the Behaviour Change Wheel "Capabilities, Opportunity, Motivation and Behaviour" (COM-B) analysis framework.

Two studies explore the opinions of cardiothoracic clinicians and patients towards electronic cigarettes as a potential alternative to tobacco use in the perioperative period. Study II demonstrates a lack of clinician knowledge about electronic cigarettes yet reveals an overall view that, compared to continued tobacco smoking in the perioperative period, electronic cigarette use is regarded as the "lesser of two evils", and a potential bridge to quit for patients who are unable to stop smoking before cardiothoracic surgery. Similar views are expressed by patients awaiting cardiothoracic surgery who smoke or had recently ceased (Study III), particularly those who have previously been unsuccessful with other cessation attempts or are struggling with urges to smoke.

The studies reveal the views and needs of patients awaiting surgery who continue to smoke, and are using, or are interested in using, electronic cigarettes to reduce or quit smoking. Both clinicians and patients alike have a similar pragmatic view that, compared to ongoing smoking, electronic cigarette use could reduce tobacco harm around the time of surgery when other smoking cessation methods have been unsuccessful. The studies also highlight the actions needed by local health authorities, hospitals and clinicians to provide more consistent evidence-based smoking cessation care for patients awaiting cardiothoracic surgery. Importantly, findings from this thesis support a review of current Australian perioperative clinical smoking cessation guidelines to encourage clinicians to provide consistent, tangible cessation support, and be prepared to have an informed discussion with patients on using electronic cigarettes to stop smoking and on the benefits and risks of electronic cigarette use in the perioperative period.

Acknowledgements

I wish to thank all my supervisors for their encouragement as I pursued my desire to help smokers quit in the perioperative period and explored the disruptive technology of electronic cigarettes: Dr Ross MacKenzie and Professor Julie Fitness for their support during my PhD candidature; Dr Muhammad Aziz Rahman for taking over supervision of my candidature, and providing expert guidance on electronic cigarettes and smoking cessation; and Dr Patti Shih for also taking over my supervision, and for her wise words, editing skills and kind phone calls during the journal submission roller-coaster. I also wish to thank Macquarie University for their funding support through a Macquarie University Research Excellence Scholarship, the staff at the HDR office, Avril Moss for budgetary assistance, and Robyn Bishop, Faculty of Human Sciences HDR office, for her unwavering thoughtfulness and support.

Thank you to my wonderful physiotherapy colleagues: Dr Roger Adams and Dr Martin Mackey at the School of Physiotherapy, University of Sydney, for their generous time and assistance; and all at the School of Physiotherapy, Australian Catholic University, for your laughter, support and lollies. In particular I wish to thank Dr Lyndal Maxwell, Dr Jane Butler and Dr Mark Elkins for their unwavering encouragement and inspiration.

I wish to thank all the clinicians who participated in the research and the many hospital staff members who shared their time and clinic space with me during the many months of research. I thank the patients who also gave their time and shared such honest conversations despite the seriousness of their diagnosis and the busyness of their preadmission clinic visits. I also wish to thank Dr Rhonda Daniels for her professional editing services, guidance and support over the last two years.

To my beautiful family, thank you for your understanding, love, hugs, encouragement and belief in me to create and achieve a project that I truly felt needed exploring. It meant putting “the greater good” before your needs for nearly four years. I hope I demonstrated the values of resilience, perseverance and courage no matter what the age.

Thesis by Publication

This thesis has been prepared in the Macquarie University 'thesis by publication' format. Chapters 2 to 4 have been written and prepared as independent publications. Given this, there is some overlap in the literature cited and some unavoidable repetition across chapters. For ease of reading, this repetition has been minimised as much as possible. The formatting of the chapters generally conforms to the Publication Manual of the APA, 6th edition, although tables and figures are inserted within the manuscripts. Before each study, a brief introduction provides a rationale for the study in the context of the thesis, and statement of the contributions by the candidate and co-authors.

Publications

Luxton, N. A., MacKenzie, R. and Shih, P. (2018). Smoking cessation care in cardiothoracic surgery: A qualitative study exploring the views of Australian clinicians. *Heart, Lung and Circulation*, May. doi:10.1016/j.hlc.2018.04.293

Luxton, N. A., Shih, P. and Rahman, M. A. (2018). Electronic cigarettes and smoking cessation in the perioperative period of cardiothoracic surgery: Views of Australian clinicians. *International Journal of Environmental Research and Public Health*, *15*(11), 2481. doi:10.3390/ijerph15112481

Luxton, N. A., Shih, P., Rahman, M. A., Adams, R. and MacKenzie, R. (2018). Use of electronic cigarettes in the perioperative period: A mixed method study exploring perceptions of cardiothoracic patients in Australia. *Tobacco Induced Diseases, 16,* 53. doi:10.18332/tid/98957

Conference Presentations – Oral

Luxton N. A. (2017). Australian clinicians' opinions and practices for encouraging smoking cessation in cardiothoracic surgery. *Momentum.* Australian Physiotherapy Conference, Sydney, NSW. October 2017.

Conference Presentations – Poster

Luxton, N. A. and MacKenzie, R. M. (2017). Electronic cigarettes in Australia: Knowledge, attitudes and potential applications in the perioperative period of cardiothoracic surgery. Society for Research in Nicotine and Tobacco Annual Meeting 2017, Florence, Italy.

Luxton, N. A., Shih, P., Rahman, M. A., Adams, R. and MacKenzie, R. M. (2018). Use of electronic cigarettes in the perioperative period: A mixed method study exploring perceptions of cardiothoracic patients in Australia. Australian Cardiovascular Health and Rehabilitation Association (ACRA) 28th Annual Scientific Meeting, Brisbane, Qld, Australia.

Media

Australian Physiotherapy Association. *In Motion*. (2018, May). Helping to achieve tobacco abstinence with electronic cigarettes. Retrieved from: http://www.printgraphics.net.au/myfiles/InMotion_May_2018/12/

Lambert, J. (2018, 14 November). E-cigs knowledge gap leaves patients in dark. Medical Republic. Retrieved from: http://medicalrepublic.com.au/e-cigs-knowledge-gap-leaves-patients-dark/17787

Macquarie University Newsroom. (2018, May). Clinicians struggling to help patients quit smoking before surgery. Retrieved from: https://www.mq.edu.au/newsroom/2018/05/15/clinicians-struggling-to-help-patients-quit-smoking-before-surgery/

Ultra 106.5fm Tasmania. (2018, May). Quit well before surgery. Retrieved from: https://www.ultra106five.com/quit-well-surgery/

Preface

This thesis consists of three studies and is arranged into five chapters. Chapter 1 is an introduction to the thesis and provides an overview of the relevant literature on smoking and smoking cessation in the perioperative period of cardiothoracic surgery. It also presents international findings of the perceptions and use of electronic cigarettes by patients with coronary artery disease or cancer, and the perceptions and practices of the clinicians who care for them.

Chapter 2 (Study I) presents an empirical paper titled "Smoking cessation care in cardiothoracic surgery: A qualitative study exploring the views of Australian clinicians". It examines the knowledge, views and self-reported practices of 52 cardiothoracic surgical clinicians — surgeons, anaesthetists, nurses and physiotherapists — on the Australian clinical guidelines for smoking cessation care in the perioperative period of surgery, and the recommended smoking cessation methods, such as nicotine replacement therapy (NRT) and behavioural support. The study is based on current knowledge of the barriers and facilitators to the implementation of clinical smoking cessation guidelines, and seeks to respond to the pressing problem of continued patient smoking in the perioperative period of cardiothoracic surgery. This paper is presented as published in *Heart, Lung and Circulation*.

Leading on from Chapter 2, Chapter 3 (Study II) seeks to increase our knowledge of the awareness, knowledge and views of cardiothoracic clinicians about electronic cigarettes as a potential smoking cessation aid in an empirical paper titled "Electronic cigarettes and smoking cessation in the perioperative period of cardiothoracic surgery: Views of Australian clinicians". It examines the opinions of clinicians about electronic cigarettes as a smoking cessation aid for the general population and specifically for patients who are unable or unwilling to quit smoking around the time of cardiothoracic surgery. This paper is presented as published in *International Journal of Environmental Research and Public Health*.

Chapter 4 (Study III) is presented as published in *Tobacco Induced Diseases* and describes the interest in and perceived health benefits and barriers to electronic cigarette use around the time of cardiothoracic surgery in a cohort of 62 patients awaiting cardiothoracic surgery. Study III titled "Use

of electronic cigarettes in the perioperative period: A mixed method study exploring perceptions of cardiothoracic patients in Australia" addresses the second aim of the thesis. It examines the awareness and use of electronic cigarettes of patients diagnosed with coronary artery disease or lung cancer who smoke or have recently quit, and whether they are interested in electronic cigarettes around the time of cardiothoracic surgery.

Chapter 5 concludes the thesis and discusses clinical implications and directions for future research in the use of electronic cigarettes for smoking cessation in the perioperative period.

Appendices published as online supplementary material are presented at the end of the relevant chapter. Ethics approval from the Macquarie University Human Research Ethics Committee and all local health districts and hospitals was granted prior to data collection for the studies presented in this thesis, as shown in Appendix A.

Table of Contents

List of Tables

List of Figures

List of Abbreviations

ABS	Australian Bureau of Statistics
AIHW	Australian Institute of Health and Welfare
ANZCA	Australian and New Zealand College of Anaesthetists
ASH	Action on Smoking and Health
CAD	coronary artery disease
ENDS	electronic nicotine delivery systems
ENNDS	electronic non-nicotine delivery systems
NASEM	National Academies of Sciences, Engineering and Medicine (US)
NRT	nicotine replacement therapy
RACGP	Royal Australian College of General Practitioners
RACP	Royal Australian College of Physicians
RACS	Royal Australasian College of Surgeons
RCP	Royal College of Physicians (UK)
SC	smoking cessation
WHO	World Health Organization

Chapter 1: Introduction

1.1 Overview

"Electronic nicotine delivery systems (ENDS), as a form of NRT, could be useful in helping smokers to reduce their exposure to cigarette smoking in the perioperative period."

(Nolan & Warner, 2017, p. 9)

Tobacco smoking exposes a patient to specific surgical risks that lead to an increase in perioperative morbidity and death. The association between smoking status and surgical risk is clear. The more current the smoking status, the higher the risk of complications (Khullar & Maa, 2012; Sørensen et al., 2010; Turan et al., 2011). Yet not all patients are able or willing to stop smoking in this stressful period around surgery. As electronic nicotine delivery systems do not contain the many chemicals found in cigarette smoke known to cause perioperative complications, they have been suggested as a feasible method to reduce or eliminate perioperative tobacco cigarette use (Kadimpati, Nolan & Warner, 2015; Lee et al., 2018; Nolan et al., 2016; Nolan & Warner, 2017).

The emergence of electronic nicotine delivery systems, commonly referred to as electronic cigarettes, in 2006 has split the public health and tobacco control communities, and the spirited debate continues (Fairchild et al., 2018). Concerns have been raised about electronic cigarettes providing a 'gateway' for children or young adults to become addicted to nicotine, renormalising smoking, preventing people who smoke from quitting, or deterring them from using existing, effective cessation aids (Chapman, Bareham & Maziak, 2018; Cobb & Abrams, 2011; de Andrade, Hastings & Angus, 2013; Fairchild, Byer & Colgrove, 2014; Grana, 2013). Proponents of electronic cigarettes acknowledge these factors but frame the benefits of using electronic cigarettes in comparison to the known harm caused by tobacco cigarette smoking. Indeed, early research suggests that nicotine-containing electronic cigarettes assist smokers in a quit attempt, although due to lack of evidence, not necessarily more effective than other forms of nicotine replacement therapy (Hartmann-Boyce et al., 2016). Electronic cigarettes also have the potential to be a novel, consumer-appealing and less harmful

nicotine delivery mechanism, which may contribute to the reduction (or obsolescence) of tobacco smoking (Abrams et al., 2018, McNeill et al., 2018).

Although more research is necessary before the full extent of the risks from electronic cigarette use are known, the extant research suggests that their use is likely to be substantially less harmful than smoking combustible tobacco cigarettes (Farsalinos, 2018; Glasser et al., 2017; Goniewicz et al., 2014; Hecht et al., 2015; National Academies of Sciences, Engineering, Medicine (NASEM), 2018). There remains considerable debate focusing on how much less harmful electronic cigarettes actually are (Glantz & Bareham, 2018).

Electronic cigarette use in Australia was first officially reported in 2010. Adkinson and colleagues (2013) compared the awareness, use and product-associated beliefs in four developed countries: Australia, Canada, the United Kingdom (UK) and the United States (US). A similar study in ten countries, including China and Europe, found that the use of electronic cigarettes was increasing in Australia, with a rise in awareness in Australia from 20% in 2010 to 66% in 2013, and in self-reported use of electronic cigarettes from 1% in 2010 to 7% in 2013 (Gravely et al., 2014). Despite an overall ban on the sale and use of nicotine-containing electronic cigarettes, the rise in use has continued in Australia, with the most common reasons for trying an electronic cigarette are out of curiosity or as a smoking cessation device (Australia Institute of Health and Welfare (AIHW), 2016). In comparison to other developed countries, such as Canada, New Zealand, the UK and the US, where nicotine electronic cigarettes can be legally bought and sold, Australia has maintained a precautionary and complex approach to regulating electronic cigarettes (Australian Government Department of Health, 2018).

Australia's precautionary approach to electronic cigarettes appears to have influenced the uptake and use of electronic cigarettes. In the Australian clinical setting there are few published reports of patient-clinician discussions in comparison to Europe, the UK and the US where frequent discussions appear to be taking place. Patients are asking for advice and opinions about the use of electronic cigarettes as a smoking cessation aid, which has led to an increase in research exploring the beliefs, views and practices of clinicians. Specialty societies and journals have published policy statements,

recommendations, and high-profile opinion pieces on the roles of electronic cigarettes to guide clinicians on how best to respond to patients who ask about electronic cigarettes and whether they should recommend them as a method to reduce the harm caused by tobacco use (Advalovic & Murin, 2015; de Bobadilla et al., 2015; Steinberg, Giovenco & Delnevo, 2015). However, due to differences in the national legislation surrounding electronic cigarettes and opinions of professional societies, the guidance for patient-clinician discussion varies widely. In Australia, information on electronic cigarettes is less available and often confusing to understand due to the complexity of electronic cigarette regulations, the variety of interpretations and applications of current laws. Little or no guidance is available to the assist patient-clinician discussion on the use of electronic cigarettes in the clinical context.

Coronary artery disease and lung cancer are two diseases that are predominantly caused by tobacco use in developed countries, and are leading causes of death in Australia (AIHW, 2017). Cardiothoracic surgery has a fundamental role in the curative management of lung cancer and coronary artery disease, and the clinicians, including anaesthetists, surgeons, nurses and physiotherapists, who care for cardiothoracic patients are highly respected and trusted sources of information and advice. They can be instrumental in helping patients with coronary artery disease or lung cancer change their behaviour, specifically to quit tobacco smoking in order to reduce the development of postoperative complications, recurrence of their primary disease, and occurrence of a secondary disease. However, these patients are often nicotine dependent, have had multiple attempts to quit smoking, and in the UK and US are trying electronic cigarettes to reduce or stop smoking (Busch et al., 2016; Sherratt, Newson & Field, 2016). Yet little is known about whether patients with coronary artery disease or lung cancer in Australia are interested in or are using electronic cigarettes, and how cardiothoracic surgical clinicians respond to their patients who ask about or are using electronic cigarettes to help their perioperative quit attempt.

1.2 Research aims

The aims of this thesis are to:

1. Examine the views and practices of Australian cardiothoracic clinicians about electronic cigarettes, and the potential role of electronic cigarettes to reduce postoperative complications caused by tobacco smoking and create a sustained quit attempt.

2. Examine the awareness, use and beliefs of electronic cigarettes and their potential role as a smoking cessation aid in the perioperative period in patients diagnosed with coronary artery disease or lung cancer awaiting cardiothoracic surgery.

To address these aims, the thesis used two approaches (Table 1.1). Due to the lack of existing research on Australian clinicians' views and practices, Study I and II were exploratory in nature. A qualitative approach was taken to fully explore and understand how electronic cigarettes were viewed by clinicians, whether as an effective cessation aid for both the general and patient populations, or a tool that promoted nicotine addiction and prevented cessation. Furthermore, the extant literature suggested that electronic cigarettes were used by patients with comorbidities to create or maintain a quit attempt due to a lack of smoking cessation support or previous failed quit attempts. Therefore, it was considered important to examine the current smoking cessation advice and support provided by a varied group of professions in the cardiothoracic perioperative period in Sydney, Australia.

The use of a mixed methods study design for Study III provided complementary quantitative and qualitative data in a single study on a previously unexplored topic. This design approach allowed for a better understanding of the reasons for current and future use of electronic cigarettes in patients diagnosed with coronary artery disease or lung cancer awaiting cardiothoracic surgery in Sydney, Australia. It also enabled a deeper exploration of individual patients' experiences about their smoking history, the impact of their diagnosis and surgery on their motivation to quit, and their views about electronic cigarettes as a cessation method around the time of surgery.

Table 1.1 Overview of methodology

Study	Data source	Study type	Analysis
I	Cardiothoracic clinicians – Sydney based	Qualitative: Face-to-face semi-structured interviews	Qualitative thematic analysis: NVivo and COM – B framework
II	Cardiothoracic clinicians – Sydney based	Qualitative: Face-to-face semi-structured interviews	Qualitative thematic analysis: NVivo
III	Patients scheduled for cardiothoracic surgery – Sydney based	Mixed methods: Online survey and face-to-face semi-structured interviews	Mixed method: SPSS and content analysis

In this introductory chapter, Section 1.3 presents an overview of smoking and cessation in the areas of coronary artery disease, lung cancer and the perioperative period of cardiothoracic surgery. Section 1.4 discusses the advent, prevalence and reasons for use of electronic cigarettes in the general and patient populations, and the legislation of electronic cigarettes in Australia. It also briefly describes the current debate surrounding electronic cigarettes for harm reduction and smoking cessation, the known physiological effects of their use, and position statements of health organisations about electronic cigarettes that are relevant to the cardiothoracic surgical area. Section 1.5 reviews the literature on electronic cigarettes in the context of surgery, coronary artery disease and lung cancer. Current smoking cessation clinical guidelines are reviewed, and the clinician and patient barriers to the implementation of these guidelines in the perioperative period are discussed. Section 1.6 reviews the extant literature on the views and practices of clinicians involved in the care of surgical patients regarding electronic cigarettes, and Section 1.7 examines the views and use of electronic cigarettes among patients with comorbidities, including coronary artery disease, lung cancer or undergoing surgery. Section 1.8 presents the current guidance for international and Australian clinicians involved in the care of surgical patients about electronic cigarettes. Section 1.9 concludes by presenting the research questions for the thesis.

1.3 Tobacco smoking, coronary artery disease and lung cancer

Tobacco smoking is a major cause of global morbidity and mortality. Two smoking-related diseases which continue to be among the leading causes of ill health and death globally and in Australia are

coronary artery disease and lung cancer (AIHW, 2018; Kyu et al., 2018; Roth et al., 2018). This thesis focuses on these two diseases and their surgical curative management. The term 'smoking' in this thesis refers to the use of manufactured or roll-your-own cigarettes, the most common forms of smoked tobacco in Australia (Bayly, Scollo & Wakefield, 2018).

Coronary artery disease (CAD), also known as coronary heart disease or ischaemic heart disease, is the most common form of cardiovascular disease. In 2014-15, 5.2% of Australians (1.2 million people) were diagnosed with CAD, an increase from 4.7% (1.0 million people) in 2011-12 (Australian Bureau of Statistics, 2015). CAD is a chronic disease that begins in the second and third decade of life and increases with age. Almost one-third (30.7%) of all Australians aged 75 years and over have been diagnosed with the disease in 2014-15 (Australian Bureau of Statistics, 2018).

CAD occurs when the arteries supplying the heart become progressively narrowed by a fatty fibrous plaque. Smoking, and its three principal constituents of nicotine, carbon monoxide and oxidant gases, create an environment that promotes plaque formation, thrombosis and an imbalance in the myocardial blood supply through multiple mechanisms (Benowitz, 2003). The development of CAD from smoking is associated with the duration of cigarette use and the amount smoked (Bjartveit & Tverdal, 2005; Willett et al., 1987). However, even low levels of tobacco cigarette consumption have been found to have harmful effects (Hackshaw et al., 2018).

The benefits of smoking cessation in people with established CAD accrue rapidly and result in a substantial reduction in the risk of disease progression, recurrent events and death (Tonstad and Johnston, 2006). Distinct physiological benefits emerge within weeks of cessation, and within a year of quitting smoking, there is a reduction in the risk of non-fatal reinfarction and mortality (Ambrose & Barua, 2004; Barth et al., 2015; Critchley & Capewell, 2003; Ockene & Miller, 1997). It is suggested that quitting smoking reduces mortality risk more than the application of other secondary prevention measures such as the use of statins, aspirin, beta-blockers or angiotensin-converting enzyme inhibitors (Critchley & Capewell, 2003; Wilson et al., 2000).

Lung cancer is most strongly linked to tobacco use, with the first reports linking lung cancer to cigarette smoking published over 50 years ago (Doll & Hill, 1950). In Australia, lung cancer is estimated to be the fifth most commonly diagnosed cancer in 2018, and most common cause of death from cancer in 2018 (AIHW, 2018). The term lung cancer, or bronchogenic carcinoma, refers to malignancies that originate in the airways or pulmonary parenchyma, and approximately 95% of all lung cancers are classified as either small cell lung cancer or non-small cell lung cancer. The majority of patients with lung cancer have advanced disease at clinical presentation, which may reflect the aggressive biology of the disease and the frequent absence of symptoms until locally advanced or metastatic disease is present.

The risk of lung cancer increases with both the number of cigarettes smoked per day as well as the lifetime duration of smoking. Other factors that may influence the likelihood of developing lung cancer in smokers include the age at onset of smoking, the degree of inhalation, the tar and nicotine content of the cigarettes, and the use of unfiltered cigarettes. Of the thousands of chemicals in tobacco smoke, approximately 69 are carcinogenic including polycyclic aromatic hydrocarbons; tobacco-specific nitrosamines; aromatic amines; and volatile carcinogens such as formaldehyde, acetaldehyde, and benzene (as well as various metals) (US Department of Health and Human Services, 2010).

Smoking cessation decreases the risk of lung cancer, and the reduction in risk becomes evident within five years with a progressive decline associated with an increasing duration of abstinence (Peto, 2011; Samet, 1991). Smoking cessation is also beneficial among patients who have been treated for lung cancer as continued smoking by patients with early- or limited-stage lung cancer is associated with increased likelihood of all-cause mortality, tumour recurrence, and development of a second primary tumour (Parsons et al., 2010).

Tobacco smoking and cessation in the perioperative period of cardiothoracic surgery

Compared with non-smokers, smokers who undergo any form of surgery have longer hospital stays, higher risk of readmission, and an increased risk of in-hospital mortality (Barrera et al., 2005; Delgado-Rodríguez et al., 2003). Continued smoking in the perioperative period (before and after

surgery) has been found to increase mortality and morbidity due to the increase in postoperative complications. These include pulmonary complications, including pneumonia, unscheduled intubation, and ventilation > 48 hours; cardiovascular complications such as cardiac arrest, myocardial infarction, and stroke; impaired tissue and bone healing; superficial and deep wound infections; and sepsis (Khullar & Maa, 2012; Sørensen et al., 2010; Turan et al., 2011). Smoking cessation mitigates these perioperative risks, with longer periods of preoperative abstinence conferring stronger benefits (Theadom & Cropley, 2006). Compared to other forms of major surgery, continued smoking increases the risk of perioperative complications and death after cardiothoracic surgery (Lugg et al., 2016; Schmid et al., 2015).

Coronary artery bypass graft (CABG) surgery is a well-accepted treatment in patients with CAD to relieve symptoms and create venous or arterial graft conduits around the diseased coronary arteries. In patients who undergo CABG surgery, those who continue to smoke tobacco are at increased risk of infection, pulmonary complications, myocardial reinfarction, and mortality (Jones et al., 2011; Saxena et al., 2013; van Domburg et al., 2000; Voors et al., 1996). Sustained (>20 years) postoperative abstinence of tobacco smoking can reduce long-term mortality after cardiac revascularisation and prevent CAD re-occurrence (van Domburg et al., 2000; Voors et al., 1996).

Surgery also offers the best opportunity for long-term survival and cure in patients with resectable non-small cell lung cancer. However, a history of current or recent smoking has been identified as an individual risk factor for adverse outcomes after pulmonary resection (Gajdos et al., 2012; Lugg et al., 2016; Mason et al., 2009; Wright et al., 2008). Compared to never smokers, patients who smoke prior to thoracic surgery have significantly impaired quality of life and higher mortality rates at one to four years postoperatively (Lugg et al., 2016; Wright et al., 2008).

Perioperative smoking cessation and the ‘teachable moment’

The term ‘teachable moment’ has been used to describe “naturally occurring life transitions or health events thought to motivate individuals to spontaneously adopt risk-reducing health behaviors” (McBride, Emmons & Lipkus, 2003, p. 156). A teachable moment can also be co-created through a

clinician-patient discussion (Lawson & Flocke, 2009). A patient undergoing elective cardiothoracic surgery in Australia will have many teachable moments to encourage smoking cessation. For example, hospitalisation may create a temporary disruption in smoking behaviour due to a hospital's no smoking policy, which creates a window of opportunity for clinicians to offer and provide cessation interventions (Glasgow et al., 1991). Likewise, a patient will encounter multiple clinicians such as surgeons, anaesthetists, nurses and physiotherapists before, during and after surgery who can reinforce the same smoking cessation message and offer support. Intentionally linking the risk of continued tobacco smoking to a patient's surgical recovery in a clinician-patient discussion can also serve as a teachable moment and motivate smoking cessation (Webb, Robertson & Sparrow, 2013).

Historically, clinicians have encouraged a patient to quit eight weeks prior to surgery, due to concerns that postoperative pulmonary complications may increase in recent quitters (<8 weeks) more than in those who continue smoking (Warner et al., 1989; Warner, 2006). While longer periods of cessation before surgery are preferable, there is little evidence to suggest that short periods of cessation are less beneficial (Myers et al., 2011). As the diagnosis and surgical treatment of tobacco-related diseases such as CAD or lung cancer provides clinicians with opportunities, or teachable moments, to convey smoking cessation information with "maximal impact" (McBride & Ostroff, 2003, p. 323), it is important that patients are advised and supported to quit tobacco use at any time as often as possible during the perioperative period (Rigotti et al., 2012; Shi & Warner, 2010).

While it is clear that continued tobacco smoking prior to surgery increases the risk of postoperative complications, not all patients are able or willing to stop smoking in the perioperative period. There are efficacious interventions, including behavioural support and pharmacotherapy, available to help patients quit before and after elective surgery (Thomsen, Villebro & Møller, 2014). Yet the ability to engage all patients in a quit attempt and provide them with these interventions in clinical practice is proving to be challenging (Nolan & Warner, 2017). Increasing clinicians' knowledge and awareness of clinical practice guidelines for structuring smoking cessation can help equip and encourage them to offer advice, support and interventions to patients throughout the perioperative period (Fiore et al., 2008; Nolan & Warner, 2017). To improve patient engagement with a quit attempt in the

perioperative period the use of electronic cigarettes as a novel form of nicotine replacement therapy is being considered in the US (Kadimpati et al., 2015; Lee et al., 2018; Nolan et al., 2016).

1.4 Electronic cigarettes

Continued smoking after a diagnosis of CAD or lung cancer reduces the effectiveness of treatment and increases the risk of serious adverse outcomes, particularly for patients undergoing surgery. Patients who smoke, and are unwilling or unable to achieve complete tobacco abstinence after their diagnosis, are turning to electronic cigarettes to reduce their tobacco-related health risks (Busch et al., 2016; Correa et al., 2018; Kalkhoran et al., 2018).

Electronic cigarettes are a part of a broader class of emerging nicotine delivery products known as Electronic Nicotine Delivery Systems and Electronic Non-Nicotine Delivery Systems (ENDS/ENNDS). The terms originated from the World Health Organization (2017) to describe a heterogeneous collection of battery-powered devices that provide doses of nicotine (or non-nicotine) and other additives to the user in aerosol form. ENDS/ENNDS do not burn or use tobacco leaves but instead vaporise a solution that a user then inhales into the respiratory system (vaping). The design, ingredients (including flavours) and product attributes vary according to the manufacturer (Cobb et al., 2015), and since their emergence on the consumer market, different generations of ENDS and more brands have become available, with different sizes, accessories, flavours and variable levels of nicotine (Zhu et al., 2014) (Figure 1.1).

This thesis uses the term electronic cigarettes or e-cigarettes, referring to ENDS as devices that deliver nicotine, and explores the awareness and perceptions of electronic cigarettes without a particular focus on a specific design or brand.

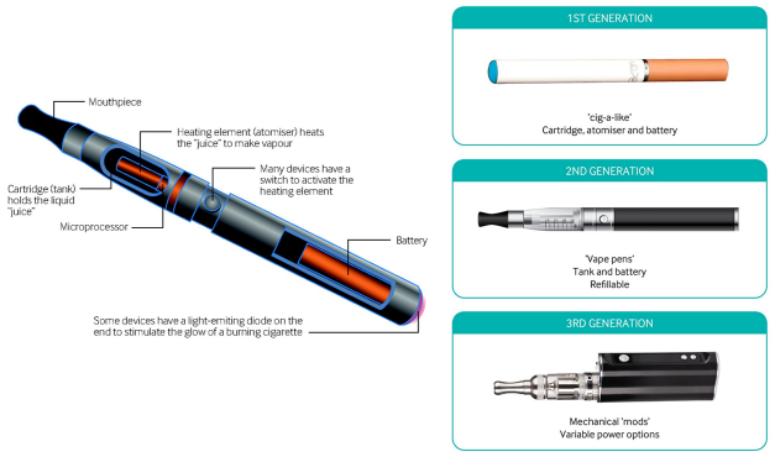


Figure 1.1 Components of an electronic cigarette and different generations of electronic cigarettes. Source: Hartmann-Boyce, Begh and Aveyard (2018).

Prevalence of electronic cigarettes

The prevalence of electronic cigarettes has increased in Australia, Canada, Europe, the United Kingdom (UK) and the United States (US) since their arrival on the consumer market in 2006 (Adkison et al., 2013; Dockrell et al., 2013; Gravely et al., 2014; Laverty, Filippidis & Vardavas, 2018; Pearson et al., 2012; Pepper and Brewer, 2014; Rutten et al., 2015). Awareness and use in Australia is lower than in other high-income countries, such as the UK and US, yet despite the complex regulations surrounding electronic cigarettes, there was a rise in awareness in Australia from 20% in 2010 to 66% in 2013, and in self-reported use of electronic cigarettes from 1% in 2010 to 7% in 2013 (Gravely et al., 2014). More recent national and state-based population surveys have also found that the percentage of people who have ever used an electronic cigarette increased between 2013 to 2016. However currently less than 10% of the Australian population appear to be using electronic cigarettes, compared to 14.5% who are smoking (AIHW, 2017; Cancer Institute NSW, 2017).

Legislation of electronic cigarettes in Australia

There is wide variation in approaches to the legislation of electronic cigarettes around the world, from complete prohibition to the legal sale of all types of electronic cigarettes which has an effect on their

prevalence (Institute for Global Tobacco Control, 2018). Nicotine containing electronic cigarettes can be legally bought and sold in Canada, Europe, New Zealand, the UK and the US, although there are regulations around their marketing and where they can be sold (Institute for Global Tobacco Control, 2018). As this thesis is examining the views of clinicians and patients of electronic cigarettes in Sydney, Australia, the country's complex and unique regulation of electronic cigarettes is discussed.

While there are no national laws specifically addressing the regulation of electronic cigarettes, there are other laws relating to poisons, therapeutic goods and smoke-free places that apply to electronic cigarettes (Douglas, Hall & Gartner, 2015; Yong et al., 2017). Nicotine is classified as a Schedule 7 Dangerous Poison under the Poisons Standard with specific exemptions such as for certain nicotine replacement therapies and tobacco when prepared and packed for smoking (Therapeutic Goods Administration (TGA), 2015). In 2016, an application to allow nicotine, for use in electronic cigarettes, to be sold commercially in Australia for harm reduction purposes was considered by the TGA (New Nicotine Alliance, 2016). The application was rejected. In 2018, an *Inquiry into the Use and Marketing of Electronic Cigarettes and Personal Vaporisers in Australia* (Parliament of Australia, 2018) examined whether electronic cigarettes should be regulated either as a therapeutic or a consumer good. However the Standing Committee on Health, Aged Care and Sport was divided on the appropriate regulatory approach to electronic cigarettes, and the current ruling stands i.e. the sale of electronic cigarettes containing nicotine is illegal in Australia, yet it is lawful for people to import nicotine for use in electronic cigarettes with a prescription for up to three months of personal therapeutic use under the TGA's Personal Importation Scheme (PIS) (Therapeutic Goods Administration, 2018).

Reasons for use of electronic cigarettes

The reasons for use of electronic cigarettes have been and continue to be extensively researched and reviewed (Byrne et al., 2018; El Dib et al., 2017; Farsalinos & Polosa, 2014; Glasser et al., 2017; Kalkoran & Glantz, 2016; Pepper & Brewer, 2014; Pisinger & Dossing, 2014; Malas et al., 2016; McRobbie et al., 2014; NASEM, 2018; Rahman et al., 2015; Romijnders et al., 2018; Villanti et al., 2018). Documented reasons for electronic cigarette use include: curiosity; because a friend or family

member used, gave or offered electronic cigarettes; as a method to quit or reduce smoking; less harmful to themselves and/or bystanders; cheaper than tobacco cigarettes; to prevent relapse and reduce nicotine cravings; and to use in places where tobacco smoking is not allowed. In Australia, the main reason for use of electronic cigarettes among adolescents and young adults is curiosity, and most experiment and cease using them (AIHW, 2017; Cancer Institute NSW, 2017). However, for older adults, the reason for use is related to wanting to stop, cut down or avoid recommencing regular cigarette smoking (AIHW, 2017; Byrne et al., 2018; Cancer Institute NSW, 2017; Fraser et al., 2015).

The prevalence and reasons for use of electronic cigarettes among patient populations is less well established. Data on the interest, prevalence and use of electronic cigarettes among hospitalised patients who smoke in the US or people who have medical comorbidities have been reported since 2014. Among hospitalised patients, researchers have found an association between a patient's desire to quit smoking and current use or future of electronic cigarettes (De Genna et al., 2017; Harrington et al., 2014; Hendricks et al., 2015; Herbec et al., 2018; Rigotti et al., 2014, 2018). While there was variation in patient demographics and methodology in the US studies, the common perception among patients was that electronic cigarettes were either a viable tobacco substitute or a useful cessation aid. However, US researchers who compared the effectiveness of a post-discharge treatment recommendation with a free comprehensive cessation treatment intervention found that while a patient's use of electronic cigarettes increased their quitting attempt, concurrent use of tobacco and electronic cigarettes (dual-use) was more common than complete tobacco cessation (Herbec et al., 2018; Rigotti et al., 2014, 2018).

Among people with medical comorbidities, the prevalence and reasons for use of electronic cigarettes, i.e. to quit or reduce tobacco use, have been found to be similar to that in the general population. In the US, a National Health Interview Survey (NHIS) of current and former cigarette smokers found that electronic cigarette use (current or past) was higher among those with one or more co-morbidities, particularly among people with chronic diseases such as cancer, chronic obstructive pulmonary disease (COPD), asthma, and cardiovascular disease, including CAD (Kruse, Kalkhoran & Rigotti, 2017). Another large-scale US survey among people with similar comorbidities found that

while electronic cigarettes were used in a quit attempt, they were more likely to try to quit using evidence-based methods, such as counselling and pharmacotherapy (Kalkhoran et al., 2018). However, those with comorbidities had more unsuccessful quit attempts, compared to smokers without comorbidities, suggested to be due to their increased nicotine dependence, low abstinence self-efficacy, and poor treatment adherence (Kalkhoran et al., 2018).

Taken together, these studies suggest that people who smoke and have tobacco-related illness or comorbidities, such as CAD and lung cancer, are motivated to quit smoking and attempt using various means, including evidence-based methods and electronic cigarettes. However, these patient populations are often unsuccessful in achieving complete smoking cessation for many reasons, including a dependence on nicotine. Therefore, it is likely that electronic cigarette use will continue to increase as more patients attempt to quit smoking in any way they can, in order to reduce the known harm of tobacco use.

Electronic cigarettes for harm reduction and smoking cessation

Although nicotine is addictive, it is well-accepted that combustible tobacco cigarettes are responsible for the morbidity and mortality associated with smoking. The continuum of harm (Figure 1.2) refers to the concept that nicotine-delivering products vary widely in the risks to the individual consumer and to population health (Kalkhoran, Benowitz & Rigotti, 2018). Tobacco cigarettes, on one end of the continuum, are the major cause of tobacco-related disease, and are associated with the highest cause of harm. On the other end of the continuum is medicinal nicotine such as nicotine replacement therapies (NRT) and non-combustible tobacco products such as electronic cigarettes that may reduce tobacco-related disease.

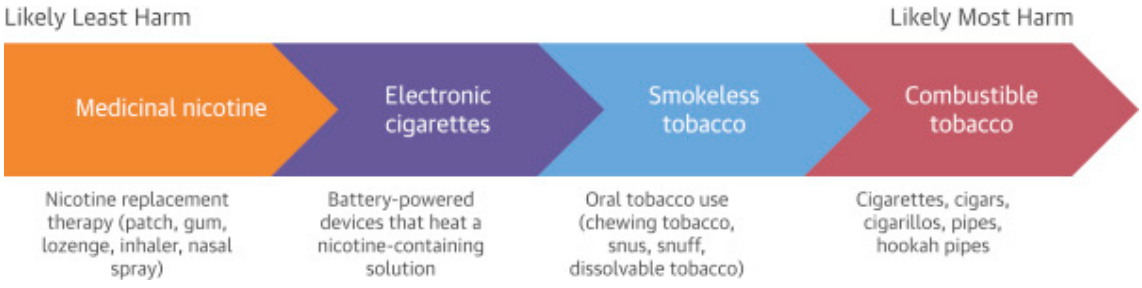


Figure 1.2 Continuum of harm. Source: Kalkhoran, Benowitz and Rigotti (2018).

The emergence of electronic cigarettes has divided the public health and tobacco control communities and the debate continues (Fairchild et al., 2018). Two of the central pillars for the harm reduction argument are that: (a) the use of electronic cigarettes is less harmful than smoking tobacco cigarettes and (b) the use of electronic cigarettes leads to higher population-level smoking quit rates (Bhatnagar, 2016; Drummond & Upson, 2014; Glantz & Bareham, 2018; Pisinger, 2014). Yet there are concerns about electronic cigarettes providing a 'gateway' for children or young adults to become addicted to nicotine, who will either continue with their use and create a new culture of vaping, or transition to tobacco smoking (Chapman, Bareham & Maziak, 2018; Grana, 2013). Electronic cigarette use may renormalise smoking or maintain a nicotine addiction, preventing people who smoke from quitting, or deterring them from using existing, effective cessation aids (Cobb & Abrams, 2011; Chapman, 2014; de Andrade et al., 2013; Fairchild et al., 2014). Proponents of electronic cigarettes acknowledge these factors but frame the benefits of using electronic cigarettes in comparison to the known harm caused by combustible tobacco cigarette smoking. Electronic cigarettes are viewed as novel, consumer-appealing and less harmful nicotine delivery mechanisms, which may contribute to the reduction (or obsolescence) of smoking (Abrams et al., 2018; McNeill et al., 2018).

Weighing up the risks and benefits of electronic cigarettes is complex. Firstly, the use of electronic cigarettes in high-income countries has only been over a matter of years rather than decades. As it took many years for the harm caused by tobacco smoking to develop and be recognised, the long-term health effects of electronic cigarettes are yet to materialise. Secondly, electronic cigarettes have evolved from first to third generation devices, with wide variation in the contents of the e-liquids used. The direct health effects of electronic cigarettes are likely to differ according to how they are used, either in conjunction with tobacco smoking (dual use), or exclusively (sole use). Thirdly, the complete replacement of tobacco smoking with electronic cigarette use by a person who smokes, called switching, might be expected to eliminate tobacco smoking and lead to better health outcomes at the individual level, but there is limited evidence to support this view (NASEM, 2018).

While there is no observational data examining the long-term health effects, such as risk of cancer, of electronic cigarettes, there is growing appreciation among governments and medical bodies that the use of electronic cigarettes among adults poses fewer risks than continued smoking (NASEM, 2018). Potential adverse physiological effects of electronic cigarettes related to both nicotine exposure and exposure to other components in the vapour are discussed here. It is considered important to the context of this thesis, as clinician-patient discussions about smoking cessation involve assessing the risks and benefits of the various methods available (Mills et al., 2014). If the use of electronic cigarettes in the perioperative period of cardiothoracic surgery is to be considered by clinicians and patients alike, the known physiological effects need to be described.

Cardiovascular system: Nicotine is considered to be an unlikely contributor to the development of cardiovascular disease (Benowitz & Fraiman, 2017), however, the effects of using nicotine-containing electronic cigarettes have been found to increase cardiac sympathetic nerve activity, blood pressure and arterial oxidative stress (Ikonomidis et al., 2018; Moheimani et al., 2017; Moheimani et al., 2017a). Compared to tobacco smoking, replacing tobacco cigarettes with nicotine electronic cigarette has been found to positively reduce blood pressure and oxidative stress (Ikonomidis et al., 2018).

There is also concern about the cardiovascular effects of the by-products of the constituents of e-liquids, when heated, particularly propylene glycol and vegetable glycerin. Thermal degradation of propylene glycol and vegetable glycerin can generate chemicals such as acetaldehyde, formaldehyde and acrolein, which in tobacco cigarette smoke have been shown to cause vascular injury, endothelial dysfunction and platelet activation in animal models (Benowitz & Fraiman, 2017).

Respiratory system: There is limited evidence on the effects on respiratory function of exclusive electronic cigarette use, however it is suggested that adverse changes in airway respiratory function are smaller than those associated with tobacco (NASEM, 2018; Vardavas et al., 2012). However two large scale reviews suggest that, in the short term, small improvements in lung function have been reported in smokers who switch exclusively to using electronic cigarettes (McNeill et al., 2018; NASEM, 2018).

Toxicity: Electronic cigarettes contain a number of potentially toxic chemical substances that arise from the metals in the heating elements or from the e-liquid (Benowitz & Fraiman, 2017; NASEM, 2018). The consequences of chronic inhalation of electronic cigarette vapour are largely unknown, and levels of toxic and carcinogenic compounds vary in accordance with e-liquid components and the device used (Kosmider et al., 2014). Most e-liquids contain flavours, which might contain alcohol, terpenes and aldehydes, and known toxic chemicals such as diacetyl and benzaldehyde, which cause pulmonary injury (Barrington-Trimis, Samet & Mcconnell, 2014). The threshold dose for toxicity remains to be determined but, when compared to the compounds in tobacco cigarettes, studies have shown there are fewer toxicological effects from electronic cigarette contaminants (Benowitz & Burbank, 2016; Farsalinos, 2018).

Carcinogens: It is speculated that the cancer risk is lower for electronic cigarettes than for tobacco cigarettes, as electronic cigarette vapour does not contain tar, and early generations of electronic cigarettes have been found to produce fewer known carcinogen toxicants (Douglas et al., 2015; Stephens, 2017), yet there are concerns about electronic cigarette use. Firstly, although nicotine itself is not a carcinogen, it may enhance cancer cell growth (Heeschen et al., 2001). Secondly, the known carcinogenic toxicants of formaldehyde, acetaldehyde and acrolein are found in both tobacco and electronic cigarettes (Goniewicz et al., 2017). Third- and fourth-generation electronic cigarettes have been implicated as having higher carcinogenic risk than earlier generations albeit at lower levels than in tobacco combustion (Stephens, 2017).

Nicotine and wound healing: In animal models, the exposure to tobacco cigarette smoke and nicotine containing electronic cigarette vapour was found to produce similar rates of surgical flap necrosis (Troiano, Jaleel & Spiegel, 2018). There is a paucity of clinical evidence in humans, with case reports from the area of plastic surgery of poor wound healing in patients using electronic cigarettes (Fracol et al., 2017). However, the negative effect of nicotine on wound healing is not limited to tobacco or electronic cigarettes, and in preclinical studies, the use of NRT has been found to reduce the viability of surgical flaps (Nolan et al., 2015).

Thus, electronic cigarettes are clearly not harmless, and current scientific evidence is insufficient to allow reliable conclusions on the longer-term health risks and benefits of electronic cigarettes for smoking cessation (McNeill et al., 2018; NASEM, 2018). Patients with CAD and lung cancer who use an electronic cigarette as a cessation aid before or after cardiothoracic surgery may be at risk of an acute cardiovascular event or exposure to compounds that may cause proliferation of their cancer (Benowitz & Fraiman, 2017). However, a number of international health organisations, such as the American Cancer Society (2018), the American Heart Association (Bhatnagar et al., 2014), and the UK Royal College of Physicians (2016), consider that the actual and potential damage caused by electronic cigarettes is deemed less detrimental for patients who are unable or unwilling to quit combustible tobacco smoking. Switching to an electronic cigarette is regarded as a viable means to reduce tobacco harm. This view is not endorsed by other international health organisations, including those in Australia, as shown in Table 1.2. Organisations relevant to clinicians in the areas of coronary artery disease, lung cancer, and surgical patient care are included in the table.

Table 1.2 Position statements of health organisations on electronic cigarettes in the context of coronary artery disease, lung cancer and surgery (in alphabetical order of country)

Australia and New Zealand	
Cancer Council Australia, National Heart Foundation of Australia, & the Royal Australasian (Australia and New Zealand) College of Physicians, 2018	The various health and medical organisations included in these position statements support a precautionary approach to the promotion and availability of electronic cigarettes in Australia, as the potential benefit of electronic cigarettes on smoking cessation is considered to be unproven, and there is increasing evidence of health harms.
Cancer Society of New Zealand, 2018	Due to the recent change to the legislation around nicotine containing electronic cigarettes, new recommendations include: improved access to quality-controlled nicotine-containing electronic cigarettes/e-liquid for smokers; the formation of formalised electronic cigarette cessation pathways; and regulations to minimise harm and use by non-smokers, particularly young people.
Royal Australian College of General Practitioners & Royal Australasian (Australia and New Zealand) College of Surgeons, 2017	Neither society supports the use of electronic cigarettes for therapeutic use due to inconclusive evidence of their effective use as a means for smoking cessation, health effects and impact on surgery (Parliament of Australia, 2017a, 2017b).
Canada	
Heart and Stroke Foundation, 2018	Due to the recent change to the legislation around nicotine containing electronic cigarettes, new recommendations include: prohibition of the use of electronic cigarettes in public spaces and workplaces; ban of sales to minors; increase minimum age of

	purchase for tobacco and electronic cigarettes to 21 years of age; regulate product to minimise toxic additives in e-liquids; and research funding to enable an understanding of the usage, potential risks and benefits of electronic cigarettes as a cessation device.
International (multiple countries)	
Forum of International Respiratory Societies, 2017	The potential benefits of electronic cigarettes to an individual smoker should be weighed against the potential harm to the population of increased social acceptability of smoking and use of nicotine, the latter of which has addictive power and untoward effects. As a precaution, electronic cigarettes should be restricted or banned until more information about their safety is available. If they are allowed, they should be closely regulated as medicines or tobacco products.
WHO Framework Convention on Tobacco Control, 2016	While the magnitude of health risks associated with electronic cigarettes was considered to be lesser as compared to tobacco cigarettes, the dearth of evidence to quantify the relative risk between electronic cigarettes and tobacco cigarettes is highlighted.
United Kingdom	
Cancer Research UK, 2017	A 'light touch' regulation of electronic cigarettes is suggested to maximise their potential to help people quit smoking, while the risks of unintended consequences such as promotion of smoking are minimised.
Royal College of Physicians, 2016	Electronic cigarettes are likely to have a role in smoking cessation and their use neither serves as a gateway to smoking nor renormalises smoking. Smokers should therefore be encouraged to use electronic cigarettes as a substitute for smoking. The report also suggests a balanced approach to electronic cigarette regulation.
United States	
American Association for Cancer Research & American Society of Clinical Oncology, 2018	Electronic cigarettes are acknowledged as potentially beneficial if proven to reduce smoking rates or prevent or reduce the health effects of smoking. Due to the lack of data on their safety and efficacy as cessation products, clinicians are advised not to recommend them to patients with chronic diseases, such as cancer.
American Cancer Society, 2018	The current generation of electronic cigarettes are identified as less harmful than tobacco cigarettes. As their long-term health effects are unknown, public health policies such as taxation and raising the minimum age of purchase to 21 years prevent the initiation and use of all tobacco products including electronic cigarettes as suggested. Clinicians are encouraged to support all methods of quitting tobacco, including electronic cigarettes.
American Heart Association, 2014	Although there is limited evidence for clinicians to counsel their patients to use electronic cigarettes as a primary cessation aid, if a patient has failed initial treatment, has been intolerant to or refuses to use conventional smoking cessation medication, and wishes to use electronic cigarettes to aid quitting, it is considered reasonable to support their attempt.

Source: Adapted from Royal Australian College of Physicians, 2018.

1.5 Electronic cigarettes in the perioperative period of cardiothoracic surgery

Clinicians are viewed as credible sources of health information, and advice from various interdisciplinary clinicians to stop smoking can create successful patient quit attempts (An et al., 2008; Raw, McNeill & West, 1999; Stead et al., 2013). Indeed, it is recommended that all clinicians should ask all patients about their smoking status and should offer an intervention and support to patients who smoke to help manage their nicotine dependence (Fiore et al., 2008). However, there are many barriers to the implementation and acceptance of clinical guidelines for smoking cessation among surgical clinicians and patients, including their lack of knowledge, awareness and use of cessation support and pharmacotherapy (Nolan & Warner, 2017).

Experts in the field of perioperative smoking cessation suggest that these barriers have created a place for electronic cigarette use in the patient population. For example, inadequate clinician provision of cessation support and pharmacotherapy for patients on hospital discharge was associated with an increased use of electronic cigarettes, possibly to sustain the tobacco abstinence achieved in hospital (Rigotti et al., 2018). Similarly, limited patient uptake of and adherence to cessation support and pharmacotherapy has led to research into the feasibility of electronic cigarette use in the perioperative period to achieve smoking cessation (Lee et al., 2018; Nolan et al., 2016). This section introduces the recommended clinical guidelines for smoking cessation, and discusses the current evidence for electronic cigarette knowledge, beliefs and practices among patients with CAD, lung cancer and those undergoing surgery, and the clinicians who care for them.

Clinical practice guidelines for smoking cessation

Clinical guidelines act as a comprehensive resource of high-quality information and assist clinician and patient decisions about appropriate health care for specific circumstances. The "5A's" approach to smoking cessation — Ask, Assess, Advise, Assist, Arrange follow-up — was originally proposed by the US Clinical Practice Guideline in 2000 (Fiore et al., 2008) (Table 1.3). It has been adopted into guidelines in Australia (Royal College of General Practitioners (RACGP), 2014), Canada (CAN-ADAPPT, 2012a) and Europe (Raw et al., 2002).

Table 1.3 The "5 A's" approach to smoking cessation interventions

Ask about tobacco use.	Identify and document tobacco use status for every patient at every visit.
Advise to quit.	In a clear, strong, and personalised manner, urge every tobacco user to quit.
Assess willingness to make a quit attempt.	Is the tobacco user willing to make a quit attempt at this time?
Assist in quit attempt.	For the patient willing to make a quit attempt, offer medication and provide or refer for counselling or additional treatment to help the patient quit. For patients unwilling to quit at the time, provide interventions designed to increase future quit attempts.
Arrange follow-up.	For the patient willing to make a quit attempt, arrange for follow-up contacts, beginning within the first week after the quit date. For patients unwilling to make a quit attempt at the time, address tobacco dependence and willingness to quit at next clinic visit.

Source: Adapted from Fiore et al., 2008.

Other approaches have been created and embedded into Australian professional and international guidelines (Australia and New Zealand College of Anaesthetists (ANZCA), 2014; National Institute of Clinical Excellence (NICE), 2013; New Zealand Ministry of Health, 2014; Royal Australasian College of Surgeons (RACS), 2015).

The "Assist" element of the clinical guidelines refers to clinicians offering and providing referrals to a telephone cessation helpline, a smoking cessation specialist, and/or pharmacotherapy. First-line medications for smoking cessation are either varenicline, bupropion, or nicotine replacement therapy (NRT) which have been found to be effective and safe for most patients, despite concerns that nicotine use in the perioperative period may increase the risk of wound-related and cardiovascular complications (Fiore et al., 2008; Kalkhoran, Benowitz & Rigotti, 2018; Nolan & Warner, 2015). For patients who are unable or unwilling to completely quit smoking, reducing the number of tobacco cigarettes smoked per day is recognised as a potential pathway coupled with offers of counselling or pharmacotherapy, such as NRT patches that may lead to eventual cessation. However, as reducing tobacco consumption does not have the same benefits for surgical outcomes as complete tobacco

cessation in the perioperative period, electronic cigarettes may appeal to these patients and help achieve smoking cessation before surgery (Lee et al., 2018; Nolan et al., 2016).

Despite this evidence, few countries have created national clinical smoking cessation guidelines specific for the perioperative period (Nolan & Warner, 2017). Furthermore, assessment of practices of various clinicians involved in the surgical pathway suggest that few clinicians consistently deliver all elements of the "5 A's" approach and that patient factors may influence a clinician's decision to address perioperative smoking cessation (Nolan & Warner, 2017).

Barriers to implementing cessation guidelines in the perioperative period

A systematic, unified multidisciplinary approach to providing smoking cessation throughout the perioperative period can lead to greater perioperative smoking abstinence and superior surgical outcomes (An et al., 2008; Khullar & Maa, 2012). Unfortunately, the implementation of the clinical smoking cessation guidelines has been found to be inconsistent internationally and in Australia due to a variety of factors including the lack of time, workload pressure, lack of skills, lack of hospital resources and a patient's willingness and self-efficacy to quit in the perioperative period (Nolan & Warner, 2017; Wolfenden et al., 2009).

The views and attitudes of anaesthetists, surgeons, nurses and physiotherapists towards smoking cessation care, as well as their self-efficacy or confidence in their ability to provide such care, has been found to influence what they offer a surgical patient. For example, international surveys among anaesthetists and surgeons, in various areas of specialties, found that few clinicians go beyond "Ask" and "Advise" in the "5A's" approach due to perceived time constraints, a lack of familiarity with adjunct cessation resources such as telephone quitline or forms of NRT; doubt in the efficacy of their own advice; discomfort with counselling; a lack of training or education on smoking cessation; and misperceptions regarding the harmful potential of NRT on wound healing (Krupski et al., 2002; Newhall et al., 2016; Nickels et al., 2017; Raupach et al., 2011; Shi et al., 2010; Warner et al., 2004; Zaballos et al., 2015). Similar barriers were reported from surveys of US and Canadian surgical ward nurses and physiotherapists. In particular, a physical lack of cessation resources, low self-confidence,

and perceptions that patients were not interested in quitting meant neither cessation advice nor assistance was offered (Bodner et al., 2011, 2012; Duffy et al., 2008; McCarty et al., 2001, 2001a; Sarna et al., 2001, 2009; Schultz, Johnson & Bottorff, 2006).

The only studies that specifically involved cardiothoracic surgical clinicians were two surveys (Kai et al., 2008; Warren et al., 2013), and an interview study (Wells et al., 2017). Kai et al. (2008) found a difference between Japanese cardiothoracic surgeons and anaesthetists, in that cardiothoracic surgeons reported higher levels of knowledge, practices and more positive attitudes about the smoking cessation interventions compared with anaesthetists. The authors suggested that the differences were due to the transient clinician-patient contact of an anaesthetist compared to the longer-term care of a surgeon, and the surgeons' heightened awareness that tobacco smoking was directly related to a patient's need for surgery, which may better motivate cardiothoracic surgeons to intervene.

In a survey of members of the International Association for the Study of Lung Cancer (IASLC) from Australia, Canada, China, Europe, Japan, the UK and the US, Warren et al. (2013) found that while most clinicians used the first of the "5'A's" approach (Ask), fewer offered assistance, discussed pharmacotherapy, or followed up with their patients about their smoking status and quit attempt. Barriers to providing cessation interventions to their cancer patients were similar to those previously mentioned in other surgical specialties, such as a lack of training in cessation interventions, resources and time; an inability to get patients to quit; and patient resistance to treatment. Wells et al. (2015) explored, in depth, the barriers and facilitators to smoking cessation practices of multiple disciplines involved in the care of patients with head, neck, colorectal and lung cancer, including surgeons and nurses. Again the barriers of limited consultation time and knowledge of cessation services and referral methods were cited, and similar confusion over whose responsibility it was to provide support beyond advising patients to quit. A minority of clinicians had created strategies to overcome the deficits in resources, and strived to reduce patient barriers to engage patients in a cessation discussion.

Clinicians are unable to implement clinical guidelines to help a patient stop smoking in the perioperative period if they have pre-existing beliefs about the lack of effectiveness of their advice and the interventions recommended, or if they lack the necessary knowledge, time and resources to

offer patients the recommended cessation support. As found by Rigotti et al. (2012, 2018), inadequate provision of cessation support and pharmacotherapy can lead to hospitalised patients resuming either tobacco smoking or electronic cigarette use on discharge. If more consistent implementation of all elements of the guidelines is achieved, such relapse may be avoided. However, this will not lead to all patients engaging with smoking cessation, as there are patients who are resistant to quitting or have been unsuccessful with other methods of smoking cessation and are unwilling to try the same method again.

Nolan and Warner (2017, p. 6) stated: "The surgical patient seeks care to tackle the underlying condition necessitating surgery, not tobacco dependence". For some patients, their willingness and views of quitting smoking are influenced either by past quit experiences, repeated relapses or lack of confidence in their ability to quit. Past negative experiences with clinicians, where patients felt they were negatively judged, may also present as a barrier to surgical clinicians who perceive the patient to be indifferent or distant. Other patient factors that often present as barriers to quitting smoking are listed in Table 1.4.

Table 1.4 Patient barriers to quitting

Patient situations and beliefs
High dependence on nicotine and heavy smoking (more than 20 cigarettes per day, short time to first cigarette)
Lack of knowledge of the benefits of quitting or belief that action is not necessary
Enjoyment of nicotine or smoking behaviour
Psychological or emotional concerns (stress, depression, anxiety, psychiatric disorders)
Fear of weight gain
Fear that quit attempt will be unsuccessful
Substance use (alcohol and other drugs)
Living with other smokers
Circumstances that result in the smoker giving quitting a low priority, such as poverty and social isolation

Source: Royal Australian College of General Practitioners, 2014.

In the context of cardiothoracic surgery, many patients diagnosed with CAD or lung cancer are smokers at the time of diagnosis and spontaneously quit, yet there are others who either do not attempt to quit or attempt to quit but relapse after diagnosis and/or cardiothoracic surgery (Benowitz & Prochaska, 2103; Simmons et al., 2013; Wells et al., 2017). Factors that are associated with smoking relapse before surgery in this patient population are anxiety, urge for a cigarette, fear of cancer recurrence, stress, and depression (Connerney et al., 2001; Schnoll et al., 2010; Simmons et al., 2013). Similarly, patients undergoing cardiothoracic surgery are often highly nicotine dependent yet may not use NRT and cessation support in their quit attempt due either to their own preference, or because they are not offered such interventions in the short time period between diagnosis and surgery (Coolley et al., 2009; Gritz et al., 1993; Schnoll et al., 2003; Simmons et al., 2013).

Continued smoking or smoking relapse postoperatively appears to occur between two to eight weeks after surgery (Cooley et al., 2009; Walker et al., 2006). Patients suffering from elevated anxiety and depression symptoms before CABG surgery have been found to experience worsening symptoms after CABG, which are related to poorer physical and psychosocial functioning, poorer quality of life and poor adherence to smoking cessation (Blumenthal et al., 2003; Connerney et al., 2001; Tully et al., 2008). After thoracic surgery, studies have found that the shorter the time a patient had quit smoking before surgery, the more likely they would return to smoking postoperatively (Cooley et al., 2009; Guimond et al., 2016).

Therefore for patients diagnosed with CAD or lung cancer, it has been suggested that different interventions or more innovative therapies are needed to help patients who have quit to remain abstinent and prevent smoking relapse. For example, while the optimal period of preoperative cessation has been established (four to eight weeks) to reduce postoperative complications (Thomsen et al., 2014), certain cardiothoracic surgical patients may require extended smoking cessation interventions and support for a longer duration in the perioperative period (Cooley et al., 2009; Fu et al., 2006; Guimond et al., 2016). Similarly, smoking cessation interventions for patients with depression or depressive symptoms in the perioperative period could be more targeted with intensive

cessation interventions to avoid patients returning to smoking after cardiothoracic surgery (Busch et al., 2017; Rigotti et al., 2012).

Not all patients, even in the face of disease and surgery, want to stop smoking. While a large proportion of patients would like to stop smoking, particularly if they have developed a disease due to or worsened by smoking, there remains a significant minority of smokers who have no desire to quit (Baumeister, 2017). The reasons for this are not completely clear and may be related to the addictive nature of tobacco smoking and/or nicotine, or that some patients perceive that, at least for them, the 'benefits' of smoking outweigh the 'risks' (Baumeister, 2017), the risks being the psychological and physiological adverse effects of nicotine withdrawal (Benowitz, 2009; Hughes, 2007). In the context of surgery, it is suggested that more patients would quit smoking if they knew of the surgical risks created by their continued tobacco smoking (Bortoff, Seaton & Lamont, 2015; Khullar, Schroeder & Maa, 2013; Nolan & Warner, 2017; Webb et al., 2013).

In summary, the inconsistent implementation of clinical guidelines for smoking cessation in the perioperative period is multifactorial, and due in part to clinicians' perceived barriers to providing cessation support, failure to recognise the negative influences of depression or anxiety, and the extended time period of cessation support required for some patients. Similarly, smoking cessation may not be perceived as achievable or sustainable by patients undergoing cardiothoracic surgery. While improvements in the implementation of clinical guidelines can be achieved through clinician training and access to resources for clinicians (Nolan & Warner, 2017), there will always be some patients who are unwilling or unable to quit or even abstain from tobacco cigarettes during the perioperative period (Shi & Warner, 2010). For these patients, electronic cigarettes could be useful to reduce or eliminate their smoking in the perioperative period.

1.6 Clinicians' views and practices on electronic cigarettes

This thesis explores the views and practices of clinicians involved in the perioperative period of cardiothoracic surgery in Australia about electronic cigarettes. The typical interdisciplinary team includes anaesthetists, nurses, physiotherapists and surgeons (Agency for Clinical Innovation, 2016).

However, there are no published studies on electronic cigarettes that involve these professions in Australia, and few studies that involve the range of interdisciplinary professions. Therefore studies on the views and practices of clinicians in specialties that have regular interaction with patients who smoke and have an important role in tobacco cessation and treating tobacco-related diseases are reviewed, such as cardiology, pulmonary medicine and oncology.

Internationally, research has examined the knowledge and perceptions about electronic cigarettes among clinicians in various healthcare settings and of different professions and specialties using predominantly quantitative survey methodology. For example, many studies have included various medical professionals in Europe (Belgium and Greece), Republic of Korea, the UK and US (Baldassarri et al., 2018a; Egnot et al., 2016; El-Shahawy, Brown & Elston Lafata, 2016; Kanchustambham et al., 2017; Kandra et al., 2014; Moysidou et al., 2016; Nickels et al., 2017; Nickels et al., 2017a; Sherratt, Newson & Field, 2016; Shin et al., 2017; Singh et al., 2017; Steinberg, Giovenco & Delnevo, 2015; Van Gucht & Baeyens, 2016; Wackowski, Bover Manderski & Delnevo, 2015). Less research has been published on the knowledge and beliefs about electronic cigarettes of nurses (Moysidou et al., 2016, Sherratt et al., 2016) and none on physiotherapists. Overall findings show that the frequency of clinician-patient discussion is increasing, with variations in how clinicians respond to patients asking about electronic cigarettes as a smoking cessation aid.

Four studies have examined the knowledge, perceptions and practices about electronic cigarettes among physicians that included surgeons and anaesthetists. Nickels et al. (2017) conducted the largest US mail survey of 561 family practice physicians, internal medicine specialists, pulmonary specialists, general surgeons and anaesthetists. Surgeons and anaesthetists were grouped together as surgical care providers due to previous evidence demonstrating similar beliefs about the importance of smoking cessation in the perioperative setting (Warner et al., 2004), and represented 19.1% of the physicians who responded. While there was an overall consensus among physicians that electronic cigarettes would have some adverse health effects, for patients who smoke, the use of electronic cigarettes may reduce cigarette consumption and tobacco-related harm (Nickel et al., 2017).

The views of surgeons and anaesthetists on electronic cigarette safety and efficacy differed from other physicians. In particular, compared to pulmonary specialists, surgeons and anaesthetists were less likely to recommend or endorse the use of electronic cigarettes to reduce tobacco consumption to reduce the risk of perioperative complications. This surprised the authors who presumed that any method that would reduce the known tobacco harm on surgical outcomes would be regarded more positively by surgical clinicians. It was notable that few surgical clinicians recommended or provided any evidence-based cessation support, suggesting they were influenced by the barriers mentioned previously, such as time constraints, a lack of familiarity with adjunct cessation resources and perceptions of the adverse effect of nicotine on wound healing.

In a similar large-scale survey of members of the American College of Chest Physicians (ACCP), which included international and US pulmonary specialists and surgeons, Baldassari et al. (2017) found that perceptions regarding potential harms and benefits of electronic cigarettes and their efficacy in promoting cessation varied widely. The desire for more knowledge and scientific evidence before routinely recommending electronic cigarettes to patients was universal in this study and others, as many clinicians reported being regularly questioned about electronic cigarettes by their patients who wanted to quit smoking. Yet the majority of these studies mentioned here also reported clinicians who perceived electronic cigarettes as a harm-reduction tool, despite the lack of scientific evidence and standardisation of electronic cigarettes.

For example, in an online cross-sectional survey of 115 cardiologists, pulmonary specialists and surgeons in a US hospital, despite a widespread unfamiliarity with electronic cigarettes and their constituents, 51% viewed electronic cigarettes as a harm-reduction tool (Kanchustambham et al., 2017). Similarly, a survey of 142 US resident physicians found that most were open to adopting electronic cigarette use in clinical practice as a means of harm reduction if they had guidance or evidence to refer to (Egnot et al., 2017). In the only qualitative study of US clinicians, 35 cardiologists, pulmonary specialists and oncologists reported they did not discourage patients' use of electronic cigarettes, particularly for patients who had been unsuccessful with other evidence-based cessation methods or were currently using electronic cigarettes for cessation (Singh et al., 2017).

Only three studies have explored the views and practices of related clinicians outside of the US. Shin et al. (2017) undertook a nationwide survey of thoracic surgeons, oncologists and pulmonary specialists who were members of the Korean Association for Lung Cancer. In contrast to the US studies, most physicians believed that electronic cigarettes were not safer than tobacco cigarettes and physicians preferred to avoid discussing electronic cigarettes for fear it would encourage patient use, make complete tobacco cessation more difficult, or lead to resumption of tobacco cigarette use by patients. The authors attributed the negative perceptions to the predominantly subdued views of Korean regulatory and health authorities towards electronic cigarettes (Shin et al., 2017). Similarly pessimistic views about the benefits of electronic cigarettes to reduce or cease patient tobacco use were found in a survey of 262 cardiologists, pulmonary specialists and nurses in Greece (Moysidou et al., 2016).

In contrast, in a survey of members of the British Thoracic Oncology Group, including thoracic surgeons (N=10), oncologists and nurses, Sherratt et al. (2016) found that electronic cigarettes were considered safer than tobacco cigarettes, and many clinicians had engaged in patient-clinician discussions about electronic cigarettes to quit smoking. However, the advice to patients varied from recommendations to discouraging the use of electronic cigarettes, in part due to their lack of self-confidence and workplace guidance on the devices. The results show that even in the UK, a nation where the views of electronic cigarettes as a means of harm reduction are positive (House of Commons, 2018), the views and practices of clinicians involved in the care of lung cancer patients differed.

The extant literature on clinicians involved in cardiology, cancer care, pulmonary medicine and surgery who have regular interactions with patients who smoke highlights a diversity in views and practices, with most research emerging from the US and UK. The impact and influence of such diverse views both on the content of patient-clinician conversations about electronic cigarettes and on patients' own views and use of electronic cigarettes is unclear.

1.7 Patients' views and use of electronic cigarettes

The thesis explores the views of patients who smoke or have recently quit about electronic cigarettes, including their reasons for use, and whether electronic cigarettes are considered a means to quit or reduce smoking around the time of cardiothoracic surgery. Due to the lack of research in the area, non-surgical patients with CAD and lung cancer have been included in this review.

The majority of patients with CAD or lung cancer spontaneously quit smoking, with the greatest proportion of quit attempts occurring at diagnosis (Parsons et al., 2010; Tofler et al., 2015; Westmaas et al., 2015). For certain patients, electronic cigarettes may provide an alternative method to reduce their risks or recurrence of cardiovascular disease or cancer, and help patients undergoing cardiothoracic surgery to abstain from tobacco use prior to surgery and reduce their surgical risk. International data exists on the use and perceptions of electronic cigarettes internationally among hospitalised patients and among patients diagnosed with cancer and cardiovascular disease, and awaiting elective non-cardiothoracic surgery, but there is little data for Australia.

Beliefs and use of electronic cigarettes by patients with CAD and lung cancer

Surveys of people diagnosed with comorbidities such as CAD and lung cancer are important to determine the prevalence of electronic cigarette use (Borderund et al., 2014; Kalkhoran et al., 2018; Kruse et al., 2017). In one of the first studies exploring the use of electronic cigarettes among patients diagnosed with cancer, Borderud et al. (2014) found an increase in prevalence from 2012 to 2015. Patients with recent electronic cigarette use (N=285) were found to be more highly nicotine-dependent, were diagnosed with lung, head or neck cancer, and were twice as likely as never-users to continue to smoke. However, compared to never-users, many ever-users of electronic cigarettes dropped out of tobacco treatment and were lost to follow-up (66.3% vs 32.4%). Although the study did not assess patients' perceptions of electronic cigarettes, the authors suggested that patients with cancer considered electronic cigarettes to be less harmful than tobacco use, and a potential cessation aid in a motivated cohort of patients.

More recent studies have explored patients' perceptions and reasons for use to determine what leads patients, diagnosed with a tobacco-related disease such as cancer, to try electronic cigarettes. Correa et al. (2018) reported that among patients diagnosed with lung cancer, a third of the 1801 patients reported current or prior use of electronic cigarettes, and that many patients initiated electronic cigarette use after their cancer diagnosis. Electronic cigarettes were mainly perceived positively as a cessation aid, particularly when compared to NRT, which many patients had used unsuccessfully in prior quit attempts, or continued tobacco smoking (Correa et al., 2018). Electronic cigarettes were also perceived to be better at relieving cancer-related stress compared to NRT, and compared to tobacco smoking, were regarded as less addictive, less likely to be associated with health risks, and less detrimental to their cancer treatment effectiveness compared to tobacco cigarettes. Compared to the study of Borderund et al. (2014), more patients reported having successfully quit smoking using electronic cigarettes, which may be attributable to the different methods of using electronic cigarettes, such as a more frequent vaping pattern, and use of later generations of electronic cigarettes which deliver higher nicotine levels (Hajek et al., 2017; Talih et al., 2014).

Initial studies also suggest that some patients with CAD are trying electronic cigarettes as a harm reduction approach (Kalkhoran et al., 2018), with use being driven by having a new cardiac event (Busch et al., 2016). Busch et al. (2016) reported that all 28 patients hospitalised for an acute coronary event who had used an electronic cigarette reported lower confidence in their ability to quit smoking and had reported a greater number of previous failed quit attempts. These patients perceived the harm of electronic cigarettes to be similar to that of NRT, but less than prescription cessation medications and tobacco smoking. Reasons for use of electronic cigarettes, prior to or after hospitalisation, were either to reduce or quit smoking, with some using them to replace tobacco use, having relapsed back to smoking after discharge. This quick rate of relapse is commonly observed among patients with CAD following hospital discharge (Colivicchi et al., 2011).

While an acute coronary event is a common reason to attempt to quit smoking, it does not necessarily lead to sustained cessation of tobacco use or initiation of electronic cigarette use. A large US population-based survey found that even though tobacco use was recognised as a factor that worsens a

person's health problem, having a recent myocardial infarction did not lead to increased long-term reduction in tobacco smoking, or uptake of electronic cigarette use compared to the general population (Gaalema et al., 2018).

The general consensus is that patients recently diagnosed with diseases strongly related to tobacco use are motivated to quit smoking. The literature suggests that patients with CAD or lung cancer are making initial attempts to reduce or quit smoking, and are searching for alternatives to replace tobacco use. However, complete substitution of tobacco use rarely seems to occur, with patients frequently reporting either dual use or a return to smoking. The characteristics of patients with CAD or lung cancer may reduce the probability of quitting smoking successfully, due to their nicotine dependence, or long-term use of tobacco. For some patients the use of a novel nicotine delivery device such as an electronic cigarette may be a result of previous unsuccessful quit attempts. For others, switching to other less harmful products such as electronic cigarettes may be seen as a final attempt or effort to follow the advice of clinicians and quit tobacco, such as in the lead up to cardiothoracic surgery.

Beliefs and use of electronic cigarettes by patients in the perioperative period of surgery

The first study of three US-based studies explored the interest in and perceived benefits and barriers to using electronic cigarettes in 112 patients awaiting surgery (Kadimpati et al., 2015). More than half of the patients surveyed in the preadmission clinic had previously tried an electronic cigarette, and 21% of the 112 patients were still using them prior to surgery to quit smoking. Interest in using electronic cigarettes in the future to quit smoking was highest among those who had never used electronic cigarettes.

Following on from this study, Nolan et al. (2016) performed a cohort study involving 67 patients at the same hospital (Mayo Clinic Rochester, US). Patients who had never used an electronic cigarette, self-reported as a current smoker and were scheduled for elective surgery received a brief cessation intervention in the perioperative period and electronic cigarettes (with instructions) for three weeks of use (one week before and two weeks after surgery). Of the 67 patients, most (87%) used the electronic

cigarettes in the perioperative period, and over half planned to continue using them in the future. Using the same survey questions as Kadimpati et al. (2015), patients had similar perceptions about electronic cigarettes, that they could either help them cope with not smoking or quit or cut down on regular cigarettes. However, only 17% of patients had stopped smoking postoperatively (at 30 days) while others reduced their tobacco use. It appears that the first-generation electronic cigarettes used were ineffective at replacing a patient's desire for tobacco or nicotine and may have inhibited the effect of the 'teachable moment' of surgery that leads some patients to quit completely.

In the only randomised control trial among patients undergoing surgery to date, 30 patients were given a six-week supply of NRT patches (N=10) or electronic cigarettes (N=20) and followed up for six months (Lee et al., 2018). The first-generation electronic cigarettes or prescription for NRT patches from the hospital were given in tapering doses of nicotine concentration at the preadmission clinic visit which was approximately three days to one week before surgery. No patients in the NRT group had biochemically verified smoking cessation, compared to three patients in the electronic cigarette group, and more patients (N=14) had quit or reduced tobacco cigarette use in the electronic cigarette group compared to the NRT group (N=4). Self-reported long-term smoking cessation, assessed at six months, was achieved by more patients using electronic cigarettes (N=5) than NRT (N=1), but both numbers were small.

In summary, research suggests that electronic cigarettes and NRT are more effective than no intervention in engaging and assisting patients in a quit attempt before and after surgery (Lee et al., 2018; Nolan et al., 2016). As previously mentioned, patients diagnosed with CAD and lung cancer have characteristics of high nicotine dependence and long-term tobacco use, and may be unable to achieve or maintain a quit attempt even when faced with surgery, despite their best intentions. Such patients may be more inclined to use electronic cigarettes, particularly if they have previously been unsuccessful with other cessation methods, such as abrupt cessation or pharmacotherapy. However, limited research exists in the specific area of cardiothoracic surgery on the interest and views of patients on electronic cigarettes as an aid to reduce or quit smoking in the perioperative period. Furthermore, little is known of the views on smoking and electronic cigarettes, and the cessation

practices of a patient's multidisciplinary clinicians, and what guides the content of patient-clinician discussions about electronic cigarettes before and after cardiothoracic surgery.

1.8 Guidance for clinicians on electronic cigarettes in the perioperative period

Current evidence demonstrates that clinicians lack knowledge about electronic cigarettes and their constituents, and have diverse beliefs of the safety and efficacy of electronic cigarettes, which results in a variation in their advice to patients. Clinicians consistently report a desire for guidance about electronic cigarette use, yet they are often unaware of their professional society's position statement and advice (Sherratt et al., 2016). Clinicians inconsistently ask about electronic cigarette use, and patients do not always mention their use of them (Baldassari et al., 2018; Correa et al., 2018). Equally, patients may try an electronic cigarette in their quit attempt if the clinicians are unable to or unwilling to offer guidance on their use (Kanchustambham et al., 2017).

Guidance for clinicians on endorsing, tolerating or recommending for or against the use of electronic cigarettes varies. In the context of heart disease, lung cancer and surgery the statements and recommendations differ between and among countries, professions and focus, with some providing clinician guidance and others discussing policy considerations and recommendations for sale and research, as noted earlier in the introduction in Table 1.2. More importantly to this thesis, the inclusion of electronic cigarette advice, for or against, in specific clinical guidelines for smoking cessation is limited, particularly for surgical clinicians. The most comprehensive advice for the multiple disciplines that are involved in the perioperative period is from the UK National Institute for Health and Care Excellence guidelines (NICE, 2018); the New Zealand Ministry of Health (2014); and in professional guidelines, from a joint collaboration with the Royal College of Anaesthetists (RCoA), the Royal College of Surgeons of Edinburgh (RCEd), and Action on Smoking and Health (ASH, 2016) (Table 1.5).

The published professional guidance available for surgeons, anaesthetists, nurses and physiotherapists varies in what the guidance discusses and/or recommends (Table 1.5). For example, compared to the UK (Royal College of Anaesthetists, Royal College of Surgeons of Edinburgh, & Action in Smoking

and Health, 2016), where an open patient-clinician discussion about electronic cigarettes is recommended, the American College of Chest Physicians (ACCP), National Comprehensive Cancer Network (NCCN, 2015) and the Forum of International Respiratory Societies (FIRS, 2014) recommend clinicians discourage the use of electronic cigarettes. This worldwide diversity of views among experienced clinicians and academics is highlighted by the members of the French Society of Anaesthesia and Intensive Care and the French College of Surgeons, who were unable to reach a consensus on the role of electronic cigarettes in the perioperative period, thus no recommendations were made, and no clinical guidance was provided for their members (SFAR, 2017).

In summary, there is an urgent need for rigorous high-quality research on the potential risks and benefits of electronic cigarettes in order to inform both clinician and patients. This will reduce the discrepancies and inconsistencies in national and professional society guidelines and allow an informed patient-clinician discussion on electronic cigarettes as a method to reduce or quit smoking in the perioperative period.

Table 1.5 Summary of current international guidelines for smoking cessation and electronic cigarette use in the perioperative period

Country, organisation and year, smoking cessation approach, and perioperative smoking cessation advice	Electronic cigarette guidance (perioperative)
Australia: The Royal Australian College of General Practitioners (2014) (all clinicians)	
5"A's" approach to smoking cessation General recommendation to use the surgical opportunity to enhance patient motivation to quit smoking.	Considered an unproven approach to smoking cessation. No specific guidance for clinician-patient discussion provided.
New Zealand: Ministry of Health (2014; 2018) (all clinicians)	
ABC pathway approach (**A**sk, give **B**rief advice, encourage use of **C**essation support) for patients undergoing surgery, plus multi-session intensive support, medication as an inpatient and for at least one month after discharge.	Information provided on the Ministry of Health website for clinicians: *Electronic cigarettes: Information for health care workers.*
Australian and New Zealand College of Anaesthetists (2014); Royal Australasian College of Surgeons (2015)	
AAR (**A**sk, **A**dvice, **R**efer) approach with extensive guidance for anaesthetists and surgeons on how to help patients achieve smoking cessation.	No information on electronic cigarettes included in the current guidance.
Canada: CAN-ADAPTT (2012a, 2012b, 2014) (all clinicians)	
"5A's" with background education and information for clinicians to use the surgical opportunity to enhance patient motivation to quit smoking.	Considered an unproven approach to smoking cessation. Clinicians encouraged to ask about tobacco use including electronic cigarettes. No guidance for clinician-patient discussion; links provided to studies on electronic cigarettes.
France: Anaesthetists, surgeons and other relevant surgical clinicians (SFAR, 2017)	
No formal approach recommended. Extensive guidance for all clinicians on how to help patients achieve smoking cessation.	No consensus was reached, thus neither recommendations nor guidance for clinician-patient discussion on electronic cigarettes provided.
UK: National Institute for Health and Care Excellence guidelines (2013, 2018) (all clinicians)	
VBA (**V**ery **B**rief **A**dvice) approach. Extensive guidance for clinicians in the form of an interactive flowchart. Nicotine (as NRT) for certain forms of surgery recommended to be ceased 24 hours prior to surgery. Clinicians recommended to refer surgical patients for stop smoking support (an opt-out approach) rather than being offered a referral (an opt-in approach).	Guidance for clinician-patient discussion about electronic cigarettes: *Stop smoking interventions and services* (Section 1.5 electronic cigarettes). Online links provided. No specific reference to electronic cigarettes in perioperative period to guide surgical clinicians.

UK: Royal College of Anaesthetists, Royal College of Surgeons of Edinburgh & Action in Smoking and Health, 2016 (including anaesthetists, surgeons, nurses and physiotherapists)	
VBA (**V**ery **B**rief **A**dvice) approach. Extensive guidance. Perioperative risks to patients of continued smoking and importance of integrated multidisciplinary roles emphasised. Reference to prior NICE guidance (2013) to support patients when admitted and on discharge and to support temporary abstinence or smoking reduction.	Clinicians are recommended to engage with patients on the use of electronic cigarettes around surgery but no guidance on how to address patient use or whether to recommend as a cessation method given. Online links provided for further information.
UK: British Thoracic Society, 2012 (including surgeons, nurses and physiotherapists involved in thoracic surgery)	
"5A's" approach. No specific advice for perioperative period.	Considered an unproven approach to smoking cessation. No guidance for clinician-patient discussion but links to studies on electronic cigarettes were provided.
US: US Preventive Services Task Force, 2015 (all clinicians)	
"5A's" approach. No specific advice for perioperative period.	Lack of regulatory oversight and current limited evidence on electronic cigarettes is insufficient to recommend their use. Clinicians should recommend evidence-based cessation methods.
US: American Society of Anesthesiologists, 2013 (anaesthetists)	
No formal approach. Very minimal guidance. Recommendations to use surgical opportunity to enhance patient motivation to quit smoking, and link patients to resources such as telephone quitlines. Extensive smoking cessation research published in their professional journal.	None included.
International: American College of Chest Physicians (2013), Forum of International Respiratory Societies, 2014 (including surgeons, nurses and physiotherapists involved in thoracic surgery)	
No formal approach. Perioperative cessation pharmacotherapy/cessation counselling if pharmacotherapy contraindicated or refused. All interventions to be initiated in preoperative period or at outset of surgery.	Lack of evidence on electronic cigarettes is insufficient to recommend their use. Clinicians should recommend evidence-based cessation methods.
International: National Comprehensive Cancer Network, 2016 (including surgeons, nurses and physiotherapists involved in cancer surgery)	
No formal approach. Extensive guidance for patients with cancer. Preoperative smoking cessation interventions that combine pharmacotherapy with behavioural therapy, with advice to patients to quit as far in advance as is feasible.	Electronic cigarettes are not a recommended smoking cessation method, due to lack of evidence of sufficient quality and consistency.

1.9 Research questions

Coronary artery disease and lung cancer are the most common tobacco-related diseases in Australia, and cardiothoracic surgery plays an important role in the management of these diseases. However, the efficacy of surgical curative treatment is reduced if patients smoke before and after surgery. Internationally, electronic cigarettes have been suggested as a feasible and acceptable method to assist patients to reduce or quit smoking in the perioperative period. Yet there is little research on electronic cigarettes in the area of cardiothoracic surgery worldwide, and specifically in Australia.

The research questions are:

1. What is the knowledge and awareness of clinicians involved in patient care in the cardiothoracic perioperative period about electronic cigarettes?
2. What are the views and practices of these cardiothoracic clinicians about the role of electronic cigarettes to reduce or quit smoking for patients undergoing cardiothoracic surgery?
3. What is the knowledge and awareness of patients who have been diagnosed with coronary artery disease or lung cancer, and are scheduled for elective cardiothoracic surgery, about electronic cigarettes?
4. What are the beliefs about and use of electronic cigarettes among patients undergoing elective cardiothoracic surgery as a method to reduce or quit smoking?

Chapter 2: Study I: Smoking cessation care in cardiothoracic surgery: A qualitative study exploring the views of Australian clinicians

Preface to Study I

In Chapter 1, it was recognised that there are barriers to the delivery and implementation of evidence-based smoking cessation guidelines in routine clinical care of surgical patients. A knowledge of the factors that enable successful implementation can help improve care delivered to the patient, yet few studies have examined these factors in the cardiothoracic area of surgery internationally or in Australia. This chapter explores the barriers and facilitators to the implementation of smoking cessation support for patients from the perspective of multidisciplinary clinicians involved in their care in Sydney, Australia.

This chapter consists of the following publication:

Luxton, N. A., MacKenzie, R. and Shih, P. (2018). Smoking cessation care in cardiothoracic surgery: A qualitative study exploring the views of Australian clinicians. *Heart, Lung and Circulation,* May. doi: 10.1016/j.hlc.2018.04.293.

The following conference oral presentation and abstract also relates to the work conducted in this chapter:

Luxton, N. A. (2017). Australian clinicians' opinions and practices for encouraging smoking cessation in cardiothoracic surgery. *Momentum*. Australian Physiotherapy Conference, Sydney, NSW. 19 October 2017. http://www.apamomentum2017.asn.au/wp-content/uploads/2017/09/Abstract_Book%20Revised%20%20Final.pdf (Page 54).

Authorship of Study I

Nia Angharad Luxton was the primary author and contributed 80% to the planning, execution and preparation of the research project and subsequent paper.

Ross MacKenzie contributed 10% to the analysis and interpretation of the research data and contributed to the interpretation of the work by critically reviewing the paper.

Patti Shih contributed 10% to the analysis and interpretation of the research data and contributed to the interpretation of the work by critically revising the paper.

Ethics approval for Study I

Ethics approval for this study was granted by the following ethics committees: Northern Sydney Local Health District HREC reference number: LNR/15/HAWKE/356; Royal North Shore Hospital site specific assessment (SSA) reference number: LNRSSA/15/HAWKE/371; North Shore Private Hospital SSA reference number: NSPHEC 2O15-LNR-O13; Royal Prince Alfred Hospital SSA reference number: LNRSSA/16/RPAH/42; Westmead Public and Private Hospital SSA reference number: LNRSSA/16/WMEAD/48; and Macquarie University Human Research Ethics Committee (HREC) reference number: 5201500797 (including Macquarie University Hospital), and is provided in Appendix A.

Heart, Lung and Circulation (2018) xx, 1–7
1443-9506/04/$36.00
https://doi.org/10.1016/j.hlc.2018.04.293

ORIGINAL ARTICLE

Smoking Cessation Care in Cardiothoracic Surgery: A Qualitative Study Exploring the Views of Australian Clinicians

Nia A. Luxton, MAppSc [a*], Ross MacKenzie, PhD [a], Patti Shih, PhD [b]

[a]Department of Psychology, Macquarie University, Sydney, NSW, Australia
[b]Australian Institute of Health Innovation, Macquarie University, Sydney, NSW, Australia

Received 11 November 2017; received in revised form 2 April 2018; accepted 18 April 2018; online published-ahead-of-print xxx

Background Smoking cessation (SC) care in the perioperative period of cardiothoracic surgery is important to reduce surgical risk and help achieve long-term smoking abstinence in patients who continue to smoke. The implementation of clinical guidelines for SC care in the perioperative period has proved challenging, yet little is known of what influences the inter-disciplinary team involved in the cardiothoracic area. This qualitative study explored the views of the clinicians involved in perioperative period of cardiothoracic surgery in Australia on their SC advice and support.

Methods Semi-structured interviews were conducted with 52 cardiothoracic surgeons, anaesthetists, nurses and physiotherapists in three public tertiary referral hospitals and three private hospitals in New South Wales (NSW). Data was thematically analysed, and categorised using the Behaviour Change Wheel ''Capabilities, Opportunity, Motivation & Behaviour'' (COM-B) analysis framework to understand the factors that influence clinicians' views and perceived abilities to provide SC care.

Results Barriers and facilitators to providing SC care were identified. The most commonly identified barriers in capability were the lack of knowledge, training and institutional engagement. Opportunity was hindered by lack of time, hospital support and resources, yet facilitated by the existence of a collaborative, multidisciplinary team and the ability to follow-up patients long term. In motivation, clinicians' attitudes and experience negatively influenced the initiation of the cessation conversation, while intrinsic attributes of empathy and positivity were drivers to provide SC care.

Conclusions Clinicians' views, together with inadequate SC training, resources and engagement to implement clinical guidelines, contribute to inconsistent SC care. There is a need for hospitals to provide adequate SC resources and training to all clinicians to improve SC care to cardiothoracic surgery patients throughout the perioperative period.

Keywords Tobacco • Coronary artery disease • Lung cancer • Preoperative • Hospital

Introduction

Cigarette smoking is an important risk factor for the development of both lung cancer and coronary heart disease, two leading causes of premature death and disability in Australia [1,2]. Cardiothoracic surgery is important for curative disease management, and active smoking is associated with an increased incidence of postoperative complications, primary disease recurrence and death [3–5]. Evidence-based clinical guidelines recommend offering routine brief cessation

*Corresponding author at: Department of Psychology, Macquarie University, Balaclava Road, North Ryde, NSW, 2109., Email: Nia-Angharad.Luxton@hdr.mq.edu.au

Please cite this article in press as: Luxton NA, et al. Smoking Cessation Care in Cardiothoracic Surgery: A Qualitative Study Exploring the Views of Australian Clinicians. Heart, Lung and Circulation (2018), https://doi.org/10.1016/j.hlc.2018.04.293

advice to quit, appropriate cessation pharmacotherapy (such as nicotine replacement therapy (NRT)), and follow-up support for at least 1 month post hospital discharge, using various approaches such as the 5As (Ask, Assess, Advice, Assess, Arrange follow-up) [6,7]. However, systematic implementation of these approaches in the perioperative period have proved challenging, and there are inconsistencies in the delivery of smoking cessation (SC) care [8].

Internationally, survey-based research has identified organisational and individual factors that impact the implementation of perioperative SC care. Diverse views of responsibility, limited time and knowledge, and low self-efficacy regarding skills to provide SC interventions were consistently reported amongst surgeons and anaesthetists [9–12]. Nurses and physiotherapists in surgical areas had a more positive view of their role, yet a lack of knowledge, training and time, and certain perceived patient characteristics, negatively influenced their provision of SC care [13–16]. Yet there is limited research that collectively includes the views of surgeons, anaesthetists, nurses and physiotherapists involved with patient care in a cardiothoracic perioperative period.

In Australia, understanding the influences and views of clinicians providing SC care in the perioperative period will improve implementation of the recommended guidelines [17–19]. Little is known about the cardiothoracic interdisciplinary context in Australia, as studies surveyed either single professional groups internationally, or in Australia, clinicians in non-cardiothoracic surgical areas, or as a component of intervention studies [20–22]. This study explores the perceived factors affecting SC care throughout the cardiothoracic perioperative period, with two objectives: (i) to examine Australian cardiothoracic clinicians' perspectives on SC care given to cardiothoracic surgery patients who continue to smoke in the perioperative period, and (ii) to identify the barriers and facilitators to the provision of SC care.

The study uses the Behaviour Change Wheel (BCW) framework [23] which enables the systematic development of interventions for supporting behaviour change, the targeted behaviour being the provision of SC care by cardiothoracic clinicians. It is underpinned by the COM-B model which has three interacting conditions for a given behaviour to occur: Capability (e.g. knowledge); Opportunity (e.g. access); and Motivation (e.g. beliefs), and the BCW and model have been used in SC area [24,25]. Exploring cardiothoracic clinicians' SC care using the COM-B components can identify how to improve implementation of clinical guidelines.

Methods

Design and Data Collection

Six hospitals in Sydney, NSW were selected for this qualitative study: three public tertiary referral hospitals employing cardiothoracic surgeons and three private hospitals where the surgeons were affiliated. These hospitals were responsible for approximately 43% of cardiothoracic cases in 2016 in NSW, with patients from urban, rural and remote areas, maximising potential generalisability [26]. This study was part of a larger study on the perceived role of electronic cigarettes in the perioperative period of cardiothoracic surgery [27]. Northern Sydney Local Health District Human Research Ethics Committee (LNR/15/HAWKE/356) approved the study, site-specific ethics approval was gained from each hospital, and participants provided informed consent. A mixed sampling strategy was used. Purposive sampling was used to recruit all cardiothoracic surgeons who operated at the six hospitals. In 'snow ball' sampling, heads of cardiothoracic surgery, anaesthetic, nursing and physiotherapy departments nominated other appropriate staff in their hospital.

One-on-one, semi-structured interviews were conducted between October 2015 and November 2016. An interview guide (Figure 1) was used with questions exploring the views of clinicians on patient use of tobacco and perioperative outcome, and tobacco cessation knowledge and methods. All interviews were conducted by the same researcher (NAL), a senior physiotherapist and academic with over 20 years' international clinical experience in cardiothoracic surgical care. Information about the NSW Health 5As SC approach [28], Quit kits and Quitline fax referrals, and details of local SC services were given to each clinician, if requested, at the end of each interview.

Data Analysis

Interviews were audio-recorded, professionally transcribed and deidentified. Clinicians were assigned a code based on

1. What is your knowledge of the effect of traditional cigarette smoking in the perioperative period of cardiothoracic surgery?
2. What is the importance you place on perioperative smoking abstinence in cardiothoracic surgery?
3. If you see a patient postoperatively, do you ask whether they will or have quit tobacco cigarettes?
4. How do you deliver smoking cessation advice in their interview prior to / after cardiothoracic surgery?
5. Have you received any formal tobacco cessation training?
6. Have you heard of the 5As (Ask, Assess, Advise, Assist, Arrange) approach for smoking cessation recommended by NSW Health?

Figure 1 Interview Guide Questions – adapted by clinician profession.

Please cite this article in press as: Luxton NA, et al. Smoking Cessation Care in Cardiothoracic Surgery: A Qualitative Study Exploring the Views of Australian Clinicians. Heart, Lung and Circulation (2018), https://doi.org/10.1016/j.hlc.2018.04.293

their specialty – surgeons (S), anaesthetists (A), nurses (N) and physiotherapists (P). All data were imported and managed within NVivo 11, QSR international Pty Ltd, Melbourne, Victoria, Australia [29]. Initially, data underwent thematic analysis [30], where data was read and reread, and common ideas and patterns emerging from interviews and field notes were identified and coded by one author (NAL), and then grouped into subthemes, and further abstracted to form broad themes, using both deductive (researcher-driven) and inductive (response-based) methods. Next, themes were reviewed, refined and grouped using the COM-B model [31] in an iterative process with co-authors to ensure the final themes accurately reflected the data for transferability, credibility and confirmability [32].

Results

Fifty-two of the 58 clinicians (90%) approached agreed to participate, with a sample of 15 cardiothoracic surgeons, 15 consultant anaesthetists, three cardiothoracic case managers (nurse), three clinical nurse consultants (two cardiothoracic ward and one preadmission clinic (PAC)), two nurse unit managers, three senior PAC nurses, four cardiothoracic physiotherapy educators, four senior and three junior physiotherapists. Experience varied from recently graduated physiotherapists to nurses, surgeons and anaesthetists with more than 20 years of experience. The mean interview time was 23 minutes (range 12 to 35 minutes).

Barriers and facilitators reported by clinicians to the provision of SC care in the cardiothoracic perioperative period are summarised in Table 1, under the headings of Capability, Opportunity and Motivation.

Capability

In the COM-B model, 'capabilities' refer to an individual's psychological and physical capacity to engage in the activity. Limited awareness and experience in referring to SC resources, beyond a patient's GP, was common as shown in Table 2. No clinician could recount the meanings of all acronyms in the 5As approach to SC, yet a few surgeons and anaesthetists recalled the AAR (Ask, Advice, Refer) model. The perception of personal need for formal education in SC care varied amongst professions, with most physiotherapists and nurses deeming it necessary, and two physiotherapists self-funding external courses. No medical clinician viewed personal education as necessary to provide best patient care. Some surgeons regarded their preoperative discussion and brief advice as sufficient, a view supported by their ability to follow-up a patient for 1 to 10 years.

Despite their personal views, all clinicians considered their hospitals' lack of interest in professional development and staff training led to poor awareness and execution of SC support. Similarly, the absence of SC promotional material and lack of enforcement of the smoking ban outside hospital buildings, noted by clinicians across five of the sites, portrayed a lack of engagement and undermined the clinicians' advice on the importance of SC to patients and families.

> *''The sign that smoking is not permitted within the boundaries of the hospital is there, but walking in this morning, there were three people standing at the front door smoking.''* (A12).

Opportunity

The opportunity afforded by interpersonal influences, social cues and cultural norms that influence the way clinicians think is an important component of the COM-B model. In this study, the lack of opportunity to effectively engage with SC care was due to lack of SC resources, and time constraints, particularly in the initial surgical planning interview.

> *''The discussion of stopping smoking has to be made but invariably the surgeons don't have time to do it. I have a 45-minute consult and invariably I run over. There's a lot to talk about in the management of their disease.''* (S2)

Time constraints in public hospital PACs negatively impacted on the ability of anaesthetists and nurses to discuss SC with patients and offer an intervention. Due to the increasing number of patients with complex medical or mental health histories, interview time was directed at other higher priority risk factors:

> *''I don't have time! When you've got 20 patients to see in clinic, you're there to see whether their health is optimised, and I get that smoking cessation is part of that. But in our population, we've got bigger fish to fry.''* (A15)

Inadequate hospital support included: the lack of accessibility and availability in hospital pharmacies to provide NRT, and the absence of SC care documentation between professionals and hospital environments throughout the patient's perioperative period. Scarce resources such as Quit kits and Quitline referral pads created a feeling of administrative disinterest. The desire to link a patient to specialist face-to-face help was limited by the existence of only two specialist clinics (with limited availability) for the six hospitals.

There were three examples where social influences facilitated a more coherent approach to supporting SC care. First, the existence of a multidisciplinary team of surgeons, anaesthetists and specialist nurses (cardiac and thoracic case managers) at two hospitals (one public, one private) meant all team members delivered and repeated the same SC care, coordinated by the nurse case manager. The team's success was based on interdisciplinary respectful and open communication, together with familiarity with surgical procedures, and the surgeon's view on preoperative smoking abstinence. Second, positive cooperation between hospital administration and the surgeon to reschedule cardiothoracic surgery was required.

> *''The nursing case managers will be aware that they are currently smoking and that they must have ceased. So, when they come up to the case managers in the clinic and they haven't stopped, we'll either discuss postponement or a referral to the cessation clinic.''* (S10)

A third facilitator, the strong network link from surgeon to medical colleagues in rural areas to provide patient

Please cite this article in press as: Luxton NA, et al. Smoking Cessation Care in Cardiothoracic Surgery: A Qualitative Study Exploring the Views of Australian Clinicians. Heart, Lung and Circulation (2018), https://doi.org/10.1016/j.hlc.2018.04.293

Table 1 Summary of barriers and facilitators.

COM components			Barrier	Facilitator
Capability	Psychological	Knowledge	Lack of knowledge of current SC interventions and referral processes	Surgeons' confidence in the effect of their own advice
		Skills	Limited awareness/knowledge of 5As	
	Physical	Skills	Absence of clinician SC education and training Lack of smoke-free hospital enforcement	
Opportunity	Social	Social influences		Established, collaborative multidisciplinary team with mutual goals Hospital-surgeon cooperation for surgery date postponement Strong network link from surgeon-colleagues in rural areas
	Physical	Environmental context/resources	Lack of SC resources Absence of systematic documentation patient SC care Deficiency of onsite/in-house SC services Inadequate allocated time in preoperative interview Lack of accessibility/availability to provide NRT	
Motivation	Reflective	Professional role/identity	Lack of role clarity Perceived responsibility in providing support beyond advice	
		Optimism	Perception of increasing patient distress Patient disinterest	Attributes of positivity and empathy
		Intentions Beliefs	Negative beliefs of NRT Adverse patient circumstances limit patient cessation ability	Experience of adverse patient outcomes
	Automatic	Habit–Desire to help		Duty of care to reduce unnecessary patient complications

Abbreviations: COM, capabilities, opportunity, motivation; SC, smoking cessation; NRT, nicotine replacement therapy; 5As, Ask, Assess, Advice, Assess, Arrange follow-up.

follow-up, created opportunities for more consistent SC long-term support.

Motivation

The COM-B model describes reflective and automatic motivation as processes involving either planning and evaluation, or emotional reactions, desires and impulses respectively. Clinicians primarily encouraged SC based on both their desire to prevent unnecessary patient perioperative complications, and clinical experience of the risks of continued smoking.

> *''I have had patients smoking heavily up to the time of operation without telling anybody. I've had at least a couple of deaths in my career which were clearly related.''* (S14)

Clinicians who self-identified as more positive and empathetic tended to make greater efforts to provide thorough SC care, even if a patient had not acted on a surgeon's advice.

> *''A lot of the time they say, 'I quit as of today or I've quit as of a few days ago in preparation for the surgery, because I've been told to stop smoking.' I tend to just latch onto that, encourage them, congratulate them.''* (P1)

Empathy and sensitivity were deemed important when discussing SC, especially in the period of increased stress between diagnosis and surgery. Clinicians who were ex-smokers, or had family members who smoked, understood that smoking was both a social and physiological addiction. Senior PAC nurses spoke of 'tailoring' the cessation method to the patient, to make it realistic and achievable, or 'pitching'

Please cite this article in press as: Luxton NA, et al. Smoking Cessation Care in Cardiothoracic Surgery: A Qualitative Study Exploring the Views of Australian Clinicians. Heart, Lung and Circulation (2018), https://doi.org/10.1016/j.hlc.2018.04.293

Table 2 **SC resource self-reported awareness and practice (by profession).**

Profession	Identified SC resources (verbally referred to or prescribed)				
	GP	Quitline	Onsite clinic	NRT	None
Cardiothoracic surgeons (n = 15)	8 (8)	2 (2)	3 (3)	1 (0)	1
Consultant anaesthetists (n = 15)	9 (5)	1 (0)	0 (0)	1 (1)	4
Nurses (n = 11)	0 (0)	3 (1)	2 (1)	4 (3)	2
Physiotherapists (n = 11)	5 (0)	0 (0)	0 (0)	3 (0)	5

Abbreviations: SC, smoking cessation; NRT, nicotine replacement therapy.

the idea of the SC clinic to the patient. Overall, no clinician sought to have a 'belligerent' conversation or exacerbate patients' feelings of guilt about smoking.

> *''The first thing I say is I know how hard it is to give up, and you've probably been smoking since you were young. You don't make them feel guilty, that's number one. It's not their fault often, it's just circumstances and it's a highly addictive substance.''* (S5)

Motivational barriers included differing clinicians' views about which professional was responsible for proactively linking a patient to support services or providing NRT.

> *''I think clinicians have a standard by-line 'You should quit smoking as it is bad for you'. In terms of committing to other therapies to help them or directing them to what will help them quit, it's unclear who does that.''* (N10)

Some anaesthetists and surgeons would not prescribe pharmacotherapy, considering it unsafe in the cardiac perioperative period. Other medical clinicians felt that without a cessation coordinator at a hospital, a patient should seek assistance to quit from their cardiologist, respiratory specialist or GP (general practitioner) pre and postoperatively if they were struggling with relapse.

> *''There's patches and gum and electronic cigarettes and cold turkey or whatever. I've got no idea, and I certainly don't prescribe it. So, I advise them to talk to their GP.''* (S2)

Senior nurses and physiotherapists, who had continuous contact with patients throughout their surgical pathway, were keen to have formal responsibility for providing SC care.

The context of the perioperative patient meeting created a barrier to raising cessation. If the meeting was within a week of the surgical date, some anaesthetists and nurses felt that focussing on cessation would increase a patient's anxiety levels prior to surgery. A clinician's personal judgement and clinical experience of a patient's ability and likelihood of quitting influenced SC care. Key factors were perceptions of a patient's circumstances such as inadequate health care or social support; socio-demographic background; diagnoses of mental illness; and poor understanding of the consequences of smoking and the benefits of quitting. For these patients, some surgeons encouraged either preoperative tobacco abstinence of 24 hours or a cut down to quit method, accepting reduced smoking.

Patients' lack of desire to quit hindered SC care as most clinicians, from clinical experience, reported frequent examples of patients' disinterest in preoperative advice usually meant continued tobacco use postoperatively.

> *''I saw one or two such people postoperatively last week who freely admitted that they'd started cigarette smoking again.''* (S13)

Discussion

This is the first Australian study to explore interdisciplinary clinical views and practices that influence the implementation of SC guidelines in the cardiothoracic perioperative period. It revealed more barriers than facilitators to SC care, using the three domains of the COM-B model [23]. Limited time, resources and education were key obstacles to a clinician's desire and capability to create and sustain a patient's preoperative quit attempt. The line of responsibility to proactively provide cessation referrals and pharmacotherapy was unclear, yet the study revealed the positive influences of individual clinicians' optimism and empathy, and exemplars of coherent teamwork that promote perioperative SC care.

Our findings align with previous work on factors that hamper clinicians' capabilities to address SC. The lack of enforcement and promotion of the NSW Health Smoke-free Health Care Policy 2015 [33] has been consistently reported at other hospitals in NSW, and has a negative influence on SC intervention effectiveness, and staff engagement (motivation) [22,34]. Clinicians are unlikely to refer to services unless they are aware of them (capability) and if there are SC resources to connect a patient to (opportunity). The barriers of limited knowledge, time constraints to offer SC care, and inadequate hospital resources and Quitline material to offer patients found in this study have been reported elsewhere [34,35]. This study highlights that the negative interaction between capability and opportunity had a greater impact on anaesthetists, nurses and physiotherapists in public, rather than private, hospital PACs and wards, likely due to the

Please cite this article in press as: Luxton NA, et al. Smoking Cessation Care in Cardiothoracic Surgery: A Qualitative Study Exploring the Views of Australian Clinicians. Heart, Lung and Circulation (2018), https://doi.org/10.1016/j.hlc.2018.04.293

higher numbers of patients with more complex health and socio-demographic issues in the public system. The COM-B analysis identified that clinicians' target behaviour, SC care, can be increased through enablement and education. Interventions implemented and supported by hospitals, such as endorsing smoke-free policies, increasing SC resources and tools such as computer-based interventions [35], and training [36] will increase the likelihood and motivation of clinicians offering SC interventions throughout the perioperative period [8,21,37].

Barriers to the provision of NRT were identified in all components of the COM-B model, with limited knowledge, access and mandate to provide NRT coupled with diverse clinician beliefs, leading to suboptimal use and digression from clinical guidelines. While NRT for nicotine withdrawal is neither required nor appropriate for all cardiothoracic patients, some need pharmacotherapy support to achieve preoperative abstinence and prevent postoperative relapse, particularly early after discharge when cues to relapse are high. Detailed recommendations to ensure more consistent provision of NRT have recently been published by the Cancer Institute NSW [37]. Methods include engaging motivated clinicians as cessation champions, such as those nurses and physiotherapists in PACs/wards found in this study and expanding their coordination, or enabling their delivery, of cessation interventions. Establishing procedures, systematic documentation and access to NRT, in both public and private hospitals, where SC care was also noted to be deficient in prior studies [38], will allow perioperative guidelines to be implemented more efficiently and effectively by all clinicians.

Automatic motivation was the main driver for discussing cessation with patients, possibly due to sample selection bias. Yet, using the COM-B model, many barriers to the provision of SC care were identified, consistent with a recent review [25]. Individual judgements about patient circumstances led to certain priority populations [39] missing out on comprehensive SC care. Similarly, clinicians' beliefs in either the effectiveness of a surgeon's advice, the diagnosis of a tobacco-related illness, the efficacy of patient-GP support, or the preference for unaided preoperative patient quit attempts led to inconsistent SC advice and support. These judgements and beliefs may result in unsuccessful postoperative cessation for some patients. Tailored professional education, performance incentives, and the use of decision aids, such as standardised SC scripts, and simple referral processes to existing onsite clinics or Quitline to support clinician-patient SC interaction, may address the individual motivational barriers that impede perioperative SC care [8,37]. Inter-disciplinary SC leadership, headed by senior clinicians has been recommended to inspire and encourage others [37]. The surgeon-led, nurse-coordinated, multidisciplinary teams found in this study should be used as an example of a strategy to address capability (knowledge of SC interventions), opportunity (social collaboration), and motivation (similar beliefs), and achieve the target behaviour of consistent perioperative SC care to cardiothoracic patients.

The findings of this study are likely to be applicable to other cardiothoracic surgical specialists in Australia due to the variety of disciplines and experience of the clinicians interviewed, plus the high response rate and length of interviews. The recruitment of cardiothoracic clinicians from hospitals in Sydney, NSW, limits generalisability of the study outside of Australia. However, these qualitative findings add to previous quantitative research [21,34] confirming the nature and quality of clinician engagement has an impact in the implementation of SC care.

Conclusions

This study provides an in-depth insight into the factors that influence interdisciplinary cardiothoracic clinicians' provision of SC care. The barriers and facilitators were linked to capability, opportunity and motivation, which require different approaches and interventions to improve the use of evidence-based SC guidelines in routine cardiothoracic perioperative practice. Hospitals should provide ongoing education of clinicians in the provision of SC advice, support and follow-up. Similarly, clinicians must develop clarity in their own practices, and an awareness of the effect their individual beliefs and motivating factors have on the advice and support they offer to patients. Proactive engagement between clinicians and hospitals can enhance the services provided to cardiothoracic patients in the perioperative period and improve long-term SC, which can prevent disease progression and reduce premature mortality.

Disclosures

NAL is a clinician at one of the hospital sites.

Funding

This work was supported by a Macquarie University Research Excellence Scholarship (NAL), and National Cancer Institute, US National Institutes of Health, Grant R01-CA091021 (RM). The funding had no role in the design and conduct of the study, collection, management, analysis and interpretation of the data, or preparation, review or approval of the paper.

Acknowledgements

The authors thank all the clinicians who participated in the study and hospital staff who facilitated the study.

References

[1] Australian Institute of Health and Welfare. Cancer in Australia 2017. Cancer series no.101. Canberra: AIHW Publication CAN 100; 2017, Available from: https://www.aihw.gov.au/reports/cancer/

cancer-in-australia-2017/contents/table-of-contents. [Accessed 30 March 2018].
[2] Australian Bureau of Statistics. Causes of Death, Australia, 2016. Canberra: 2016. ABS publication 3303.0. Update 27 September 2017. Available from: http://www.abs.gov.au/ausstats/abs@.nsf/mf/3303.0. [Accessed 30 March 2018].
[3] Warner MA, Offord KP, Warner ME, Lennon RL, Conover MA, Jansson-Schumacher U, Warner MA, Offord KP, Warner ME, Lennon RL, Conover MA, Jansson-Schumacher U. Role of preoperative cessation of smoking and other factors in postoperative pulmonary complications: a blinded prospective study of coronary artery bypass patients. Mayo Clin Proc 1989;64(6):609–16.
[4] Saxena A, Shan L, Reid C, Dinh DT, Smith JA, Shardey GC, et al. Impact of smoking status on early and late outcomes after isolated coronary artery bypass graft surgery. J Cardiol 2013;61(5):336–41.
[5] Warren GW, Kasza KA, Reid ME, Cummings KM, Marshall JR. Smoking at diagnosis and survival in cancer patients. Int J Cancer 2013;132(2):401–10.
[6] Fiore MC, Bailey WC, Cohen SJ. Treating tobacco use and dependence. Clinical practice guideline. 2008 update. Editor. Rockville, MD: US Department of Health and Human Services, Public Health Service; 2008. https://www.ncbi.nlm.nih.gov/books/NBK63952/. [Accessed 30 March 2018].
[7] Rigotti NA, Clair C, Munafo MR, Stead LF. Interventions for smoking cessation in hospitalised patients. Cochrane Database Syst Rev 2012;16(5):1–88.
[8] Nolan MB, Warner DO. Perioperative tobacco use treatments: putting them into practice. BMJ 2017;358:j3340.
[9] Warner DO, Sarr MG, Offord KP, Dale LC. Anesthesiologists, general surgeons, and tobacco interventions in the perioperative period. Anesth Analg 2004;99(6):1766–73.
[10] Kai T, Maki T, Takahashi S, Warner DO. Perioperative tobacco use interventions in Japan: a survey of thoracic surgeons and anaesthesiologists. Br J Anaesth 2008;100(3):404–10.
[11] Shi Y, Yu C, Luo A, Huang Y, Warner DO. Perioperative tobacco interventions by Chinese anesthesiologists: practices and attitudes. Anesthesiology 2010;112(2):338–46.
[12] Nickels AS, Warner DO, Jenkins SM, Tilburt J, Hayse JT. Beliefs, practices, and self-efficacy of US physicians regarding smoking cessation and electronic cigarettes: a national survey. Nicotine Tob Res 2017;19(2):197–207.
[13] McCarty MC, Hennrikus DJ, Lando HA, Vessey JT. Nurses' attitudes concerning the delivery of brief cessation advice to hospitalized smokers. Prev Med 2001;33(6):674–81.
[14] Schultz AS, Johnson JL, Bottorff JL. Registered nurses' perspectives on tobacco reduction: views from Western Canada. Can J Nurs Res 2006;38(4):192–211.
[15] Sarna L, Bialous SA, Wells M, Kotlerman J, Wewers ME, Froelicher ES. Frequency of nurses' smoking cessation interventions: report from a national survey. J Clin Nurs 2009;18(14):2066–77.
[16] Bodner ME, Miller WC, Rhodes RE, Dean E. Smoking cessation and counseling: knowledge and views of Canadian physical therapists. Phys Ther 2011;91(7):1051–62.
[17] Zwar N, Richmond R, Borland R, Peters M, Litt J, Bell J, et al. Supporting smoking cessation: a guide for health professionals. Melbourne: The Royal Australian College of General Practitioners; 2014, Available from: https://www.racgp.org.au/your-practice/guidelines/smoking-cessation/. [Accessed 30 March 2018].
[18] Australian and New Zealand College of Anaesthetists. Guidelines on smoking as related to the perioperative period 2014. PSB 12. Available from: http://www.anzca.edu.au/getattachment/resources/professional-documents/ps12bp-2014-guidelines-on-smoking-as-related-to-the-perioperative-period-background-paper.pdf. [Accessed 30 March 2018].
[19] Royal Australasian College of Surgeons Cessation of Smoking 2015. Available from: https://www.surgeons.org/media/21553848/2015-10-27_pos_rel-gov-031_cessation_of_smoking.pdf. [Accessed 30 March 2018].
[20] Nagle A, Schofield M, Redman S. Australian nurses' smoking behaviour, knowledge and attitude towards providing smoking cessation care to their patients. Health Promot Int 1999;14(2):133–44.
[21] Freund M, Campbell E, Paul C, Sakrouge R, Lecathelinais C, Knight J, et al. Increasing hospital-wide delivery of smoking cessation care for nicotine-dependent in-patients: a multi-strategic intervention trial. Addiction 2009;104(5):839–49.
[22] McCrabb S, Baker A, Attia J, Balogh Z, Lott N, Palazzi K, et al. Hospital smoke-free policy: compliance, enforcement, and practices. A staff survey in two large public hospitals in Australia. Int J Environ Res Public Health 2017;14(11):1358.
[23] Michie S, Stralen MM, West R. The Behaviour Change Wheel: a new method for characterising and designing behaviour change interventions. Implement Sci 2011;6:42.
[24] Gould GS, Bar-Zeev Y, Bovill M, Atkins L, Gruppetta M, Clarke MJ, et al. Designing an implementation intervention with the Behaviour Change Wheel for health provider smoking cessation care for Australian Indigenous pregnant women. Implement Sci 2017;12(1):114.
[25] Sharpe T, Alsahlanee A, Ward KD, Doyle F. Systematic review of clinician-reported barriers to provision of smoking cessation interventions in hospital inpatient settings. J Smok Cessat 2018;1–11.
[26] Bureau of Health Information. Healthcare Quarterly 2016: Sydney (NSW). Available online: http://www.bhi.nsw.gov.au/BHI_reports/healthcare_quarterly/_nocache. [Accessed 30 March 2018].
[27] Luxton NA, Mackenzie R. Electronic cigarettes in Australia: Knowledge, attitudes and potential applications in the perioperative period of cardiothoracic surgery. In: Annual Meeting — Society for Research on Nicotine and Tobacco Conference; 2017.
[28] NSW Health. Managing Nicotine Dependence A Guide for NSW Health Staff. Available online: http://www.health.nsw.gov.au/tobacco/Pages/managing-nicotine-dependence.aspx. [Accessed 30 March 2018].
[29] QSR International. NVivo Qualitative Data Analysis. Version 11. 2014.
[30] Braun V, Clarke V. Using thematic analysis in psychology. Qual Res Psychol 2006;3:77–101.
[31] Michie S, Atkins L, West R. The Behaviour Change Wheel—a guide to designing interventions. Great Britain: Silverback; 2014.
[32] Pope C, Ziebland S, Mays N. Qualitative research in health care: analysing qualitative data. Br Med J 2006;320(7227):114–6.
[33] NSW Health. Smoke-Free Health Care Policy 2015. Available online: http://www1.health.nsw.gov.au/pds/ActivePDSDocuments/PD2015_003.pdf. [Accessed 30 March 2018].
[34] Slattery C, Freund M, Gillham K, Wolfenden L, Bisquera A, Wiggers J. Increasing smoking cessation care across a network of hospitals: an implementation study. Implement Sci 2016;11:28.
[35] Wolfenden L, Wiggers J, Campbell E, Knight J, Kerridge R, Spigelman A. Providing comprehensive smoking cessation care to surgical patients: the case for computers. Drug Alcohol Rev 2009;28(1):60–5.
[36] Carson KV, Verbiest MEA, Crone MR, Brinn MP, Esterman AJ, Assendelft WJJ, et al. Training health professionals in smoking cessation. Cochrane Database Syst Rev 2012;16(5):CD000214.
[37] Cancer Institute NSW. Smoking Cessation Framework for NSW Health Services. Available online: https://www.cancerinstitute.org.au/how-we-help/cancer-prevention/stopping-smoking/nsw-smoking-cessation-framework. [Accessed 30 March 2018].
[38] Redfern J, Hyun K, Chew DP, Astley C, Chow C, Aliprandi-Costa B, et al. Prescription of secondary prevention medications, lifestyle advice, and referral to rehabilitation among acute coronary syndrome inpatients: results from a large prospective audit in Australia and New Zealand. Heart 2014;100(16):1281–8.
[39] Bonevski B, Borland R, Paul CL, Richmond RL, Farrell M, Baker A, et al. No smoker left behind: it's time to tackle tobacco in Australian priority populations. Med J Aust 2017;207(4):141–2.

Please cite this article in press as: Luxton NA, et al. Smoking Cessation Care in Cardiothoracic Surgery: A Qualitative Study Exploring the Views of Australian Clinicians. Heart, Lung and Circulation (2018), https://doi.org/10.1016/j.hlc.2018.04.293

Chapter 3: Study II: Electronic cigarettes and smoking cessation in the perioperative period of cardiothoracic surgery: Views of Australian clinicians

Preface to Study II

There is international evidence that clinicians involved in the surgical period have limited knowledge about electronic cigarettes yet are frequently asked by patients and give diverse advice and recommendations. To date there are no Australian studies on this topic. This study explored the knowledge, views and patient-clinician discussions of clinician — surgeons, anaesthetists, nurses and physiotherapists — about electronic cigarettes as a potential smoking cessation method in the perioperative period of cardiothoracic surgery.

This chapter consists of the following publication:

Luxton, N. A., Shih, P. and Rahman, M. A. (2018). Electronic cigarettes and smoking cessation in the perioperative period of cardiothoracic surgery: Views of Australian clinicians. *International Journal of Environmental Research and Public Health*, *15*(11), 2481. doi:10.3390/ijerph15112481

The following conference poster presentation and abstract also relates to this chapter:

Luxton, N.A. and MacKenzie, R. M. (2017). Electronic cigarettes in Australia: Knowledge, attitudes and potential applications in the perioperative period of cardiothoracic surgery. *Society for Research in Nicotine and Tobacco Annual Meeting 2017,* Florence, Italy. https://cdn.ymaws.com/www.s017SRNTAnnualMeeting.rnt.org/resource/resmgr/conferences/2017_annual_meeting/2017_SRNT_Rapids_Abstracts_W.pdf (Page 4)

Authorship of Study II

The candidate Nia Angharad Luxton was the primary author and contributed 75% to the planning, execution and preparation of the research project and subsequent paper.

Patti Shih contributed 10% to the analysis and interpretation of the research data and contributed to the interpretation of the work by critically revising the paper.

Muhammad Aziz Rahman contributed 10% to the interpretation of the work by critically revising the paper.

Ross MacKenzie contributed 5% to the analysis and interpretation of the research data and contributed to the interpretation of the work by critically revising the paper.

Ethics approval for Study II

Ethics approval for this study was granted by the following ethics committees: Northern Sydney Local Health District HREC reference number: LNR/15/HAWKE/356; Royal North Shore Hospital site specific assessment (SSA) reference number: LNRSSA/15/HAWKE/371; North Shore Private Hospital SSA reference number: NSPHEC 2O15-LNR-O13; Royal Prince Alfred Hospital SSA reference number: LNRSSA/16/RPAH/42; Westmead Public and Private Hospital SSA reference number: LNRSSA/16/WMEAD/48; and Macquarie University Human Research Ethics Committee (HREC) reference number: 5201500797 (including Macquarie University Hospital), and is provided in Appendix A.

International Journal of
Environmental Research and Public Health

MDPI

Article

Electronic Cigarettes and Smoking Cessation in the Perioperative Period of Cardiothoracic Surgery: Views of Australian Clinicians

Nia A. Luxton [1,*], Patti Shih [2] and Muhammad Aziz Rahman [3]

[1] Department of Psychology, Macquarie University, Sydney 2109, Australia
[2] Australian Institute of Health Innovation, Macquarie University, Sydney 2109, Australia; Patti.Shih@mq.edu.au
[3] Austin Clinical School of Nursing, La Trobe University, Melbourne 3084, Australia; m.rahman2@latrobe.edu.au
* Correspondence: Nia-Angharad.Luxton@hdr.mq.edu.au

Received: 5 October 2018; Accepted: 5 November 2018; Published: 7 November 2018

Abstract: For patients who smoke, electronic cigarettes may offer a pathway to achieve tobacco abstinence and reduce the risk of postoperative complications. Clinicians have a pivotal role in supporting smoking cessation by patients with lung cancer and coronary artery disease throughout the perioperative period of cardiothoracic surgery. However, the views of Australian cardiothoracic clinicians on electronic cigarettes and smoking cessation are unknown. Semi-structured interviews were conducted with 52 cardiothoracic surgeons, anaesthetists, nurses and physiotherapists in six hospitals in Sydney and thematically analysed. Clinicians' knowledge about electronic cigarettes and the regulatory environment surrounding them was limited. Clinicians believed that: electronic cigarettes, though unlikely to be safe, were safer than tobacco cigarettes; electronic cigarettes may have a harm reduction role in public health; and electronic cigarettes were a potential smoking cessation tool for the extraordinary circumstances of surgery. The professional role of a clinician and their views about electronic cigarettes as a perioperative smoking cessation aid had an influence on future clinician-patient interactions. Electronic cigarette use is increasing in Australia and clinicians are likely to receive more frequent questions about electronic cigarettes as a cessation aid. Stronger guidance for clinicians is needed on the topic of electronic cigarettes and cardiothoracic surgery.

Keywords: tobacco; preoperative; surgery; e-cigarettes; surgeons; anaesthetists; nurses; physiotherapists

1. Introduction

Clinicians play a pivotal role in supporting smoking cessation by patients with lung cancer and coronary artery disease undergoing cardiothoracic surgery. Continued tobacco smoking increases the risk of pulmonary and surgical complications, occurrence or re-occurrence of their primary and secondary disease, and death [1–3]. Numerous international and Australian best practice guidelines recommend that all clinicians assess smoking status and offer advice and support to enhance a patient's motivation and cessation, irrespective of a patient's desire to quit [4–6]. Yet the provision of perioperative cessation support by clinicians is negatively affected by factors such as the lack of hospital onsite cessation staff and resources, clinicians' inadequate knowledge of available cessation services, and patients' prior failed quit attempts with cessation pharmacotherapy [7,8]. The need for patients with coronary artery disease and lung cancer to explore different and novel methods to reduce or eliminate their tobacco use, has given rise to an increased number of patient-clinician discussions about electronic cigarettes [9–11]. This has led to a similar rise in studies exploring how clinicians

involved in the care of patients with such tobacco-induced diseases, interact with their patients around this topic [12–18].

Electronic cigarettes are devices designed to deliver an aerosol by heating an e-liquid solution which contains optional flavouring, additives propylene glycol, and vegetable glycerine, and is available with or without nicotine [19]. There is an ongoing worldwide public health debate about the impacts of electronic cigarettes. Those against electronic cigarettes consider them to be potentially harmful devices that will renormalise smoking and provide a gateway to smoking specifically amongst young non-smokers [20–23]. Those for electronic cigarettes view them as a method of tobacco harm reduction, as they do not produce the dangerous combustion by-products of conventional tobacco cigarettes and may help people reduce or quit tobacco when other cessation attempts have failed [24,25]. Indeed, the National Institute for Health Care and Excellence (NICE) guidance in the United Kingdom has endorsed electronic cigarettes as a method of harm reduction, and advises clinicians engaging with patients who smoke to include electronic cigarettes in the discussion of nicotine replacement therapy (NRT) [26]. Electronic cigarette use is lower in Australia, compared to the United Kingdom, however the prevalence is increasing [27,28]. In 2016, an estimated 240,000 people reported using electronic cigarettes in Australia [29], and one of the primary reasons for interest or use in electronic cigarettes was to quit tobacco smoking [29,30]. With this increased popularity in the use of electronic cigarettes amongst people who smoke in Australia, it is important to examine how clinicians perceive the role of electronic cigarettes for smoking cessation, and what they say to patients when asked about the risks and benefits of electronic cigarettes.

Australia has adopted a precautionary approach to electronic cigarettes, and the regulatory framework is more restrictive than other countries such as the United Kingdom, Canada and New Zealand [27,28,31]. In Australia, non-nicotine containing electronic cigarettes can be bought legally. The purchase of nicotine for use as an e-liquid in Australia is illegal; however, it can be imported with a medical prescription for up to three months of personal therapeutic use [32,33]. This precautionary approach towards electronic cigarettes has been echoed in policy documents and recommendations from medical and health authorities in Australia citing concerns about the unknown health risks of electronic cigarettes for the general population [34–37]. However, this approach may place limitations on the use of electronic cigarettes in specific clinical populations and scenarios, such as around the time of surgery to reduce the perioperative harm caused by tobacco smoking [38–40].

Consistent, face-to-face smoking cessation advice and support from a multidisciplinary team of clinicians can engage patients in a quit attempt [41,42], to help them abstain from tobacco in the perioperative period and reduce their surgical risk. In the area of cardiothoracic surgery, the views and practices of anaesthetists [15] and thoracic surgeons [13,16] in the United States, the United Kingdom and Korea have been investigated to better understand how electronic cigarettes are viewed in the context of smoking cessation and the content of their patient discussions. These studies found that while most clinicians had engaged with their patients on the topic of electronic cigarettes, clinicians' views about their safety and efficacy as a smoking cessation aid varied. Some clinicians had concerns about electronic cigarettes, and either did not recommend or discouraged their use [15,16]. Others believed the devices would help patients reduce or eliminate smoking, and either tolerated or recommended their use [13]. However, in Australia, the clinical role of electronic cigarettes as a smoking cessation aid is yet to be thoroughly explored, particularly through the perspectives of cardiothoracic clinicians, who have a crucial role in patient education, smoking cessation advice and support. To the best of our knowledge, the views and practices of clinicians from diverse disciplines, such as surgeons, anaesthetists, nurses and physiotherapists, in the cardiothoracic perioperative period in Australia have not been explored.

2. Methods

2.1. Design and Data Collection

This study was part of a larger study on smoking cessation care provided by cardiothoracic clinicians [8]. The research design included one-on-one, in-depth interviews with cardiothoracic surgeons, anaesthetists, nurses and physiotherapists in six hospitals in Sydney, NSW. These hospitals were responsible for approximately 43% of cardiothoracic cases in 2016 in NSW, with patients from urban, rural and remote areas, maximising potential generalisability [43]. Purposive sampling followed by a snowball sampling technique was used to identify the multidisciplinary clinicians involved in adult cardiothoracic surgery at three public tertiary referral hospitals and three private hospitals in Sydney, where the surgeons were also affiliated.

A formal invitation letter, participant information and consent form were sent (by email) to the head of cardiothoracic surgery at each hospital site, who subsequently identified other cardiothoracic surgeons at the six hospitals, and the heads of cardiothoracic anaesthetic, nursing and physiotherapy. The heads of these departments then nominated other appropriate staff involved in perioperative cardiothoracic care in their hospital. Multi-centre ethics approval was obtained from the Northern Sydney Local Health District Human Research Ethics Committee (LNR/15/HAWKE/356) and each clinician provided informed consent.

A semi-structured, in-depth interview guide (Figure 1) was created, based on a review of the literature of electronic cigarette use in the area of coronary artery disease, lung cancer and cardiothoracic surgery. The interview guide also contained specific discussion topics, based on a previous U.S. study (with author's permission) [15], to explore clinicians' perceptions of electronic cigarettes as an aid to tobacco cessation in the perioperative period of cardiothoracic surgery. The interviews were conducted between October 2015 and November 2016 by one of the authors (NAL), a specialist physiotherapist in the area of cardiothoracic surgery, with 20 years of clinical experience. The mean interview time was 23 min (range 12 to 35). Information about the NSW Health guidelines on the 5A's smoking cessation approach [44] were given to each clinician, if requested, at the end of each interview. The confidentiality and anonymity of participants was maintained at all times [45].

1. Have you seen an electronic cigarette in Australia and/or internationally?
2. What do you know about electronic cigarettes and from where have you received information about electronic cigarettes?
3. What do you know about the availability and current regulations regarding electronic cigarettes in Australia?
4. There is a concept known as the 'continuum of harm'. On the continuum of harm, where tobacco cigarettes are at one end, and medicinal nicotine replacement therapy is on the other, where do you think electronic cigarettes stand?
5. Do you think there are advantages and disadvantages of electronic cigarettes as a means to reduce (harm reduction) or eliminate (smoking cessation) tobacco use:
   a. in the area of public health?
   b. in the perioperative period?
6. Have you ever been asked about electronic cigarettes in a clinician-patient discussion? How comfortable were you / would you be discussing electronic cigarettes when a patient asked about electronic cigarettes or was using an electronic cigarette to quit smoking?
   Hypothetical scenario was given if no prior experience of a patient asking about electronic cigarettes: *"A 60-year-old male, in your preoperative assessment for cardiothoracic surgery scheduled in a few weeks, has told you he is still smoking. You recommend that he quit smoking, but he is not interested in using standard stop-smoking medications such as nicotine patches. However, he indicates he would like to quit before and after surgery and wants to know what you think about electronic cigarettes to help him do so."*
7. What are your views on the possible use of electronic cigarettes as a method of tobacco smoking abstinence prior to cardiothoracic surgery in patients who cannot or will not cease despite advice?

Figure 1. Interview Guide Questions.

2.2. Data Analysis

Interviews were audio-recorded, professionally transcribed and de-identified. Each clinician was assigned a code based on their specialty-surgeons (S), anaesthetists (A), nurses (N) and physiotherapists (P). All data were imported to and managed in NVivo software version 11 [46]. Thematic analysis, as described by Braun and Clarke [47], was chosen as the best data analysis method to identify reoccurring patterns and themes from textual data derived from transcripts of the semi-structured qualitative interviews. As a study examining the views of a cohort from the same population (in this case, cardiothoracic clinicians), this data analysis approach is best able to systematically collate and group relevant responses from a variety of participants in relation to the study question [8,48].

An inductive approach was used, where Nia A. Luxton developed descriptive codes based on patterns observed in the data and conducted a critical analysis of these codes to collate them into major themes. The transcripts were also read by a co-author (Patti Shih) with extensive experience in qualitative methodology and use of NVivo, who developed themes independently. In addition, another member of the research team (Ross MacKenzie) (conducted double-coding of a subset of data in NVivo to ensure the final coding scheme had reliability. There was good agreement about the themes and any discrepancies were discussed among the three researchers until a consensus was reached. Supporting quotations were selected that generally expressed dominant views and demonstrated significant issues but also that reflected 'deviant' or 'negative' views [49]. As recommended when undertaking qualitative analysis [47], the process of analysis was recursive and often involved multiple iterations, particularly when identifying and refining themes from codes and categories.

3. Results

Fifty-two clinicians participated in the study: 15 cardiothoracic surgeons, 15 anaesthetists, 11 nurses, and 11 physiotherapists (Table 1). Their experience varied from recently qualified consultant anaesthetists and newly-graduated physiotherapists, to surgeons, anaesthetists, nurses and physiotherapists with more than 20 years of experience.

Table 1. Characteristics of the participating clinicians (n = 52).

Characteristic	Surgeons	Anaesthetists	Nurses	Physiotherapists
Gender (male), n (%)	15 (100%)	13 (87%)	1 (9%)	1 (9%)
Age (year), n (%)				
<40				5 (45%)
>40	15 (100%)	15 (100%)	11 (100%)	6 (55%)
Current work setting, n (%)				
Public hospital	15 (100%)	15 (100%)	8 (73%)	5 (45%)
Self-reported time working in cardiothoracic surgical area (year), n (%)				
<10	2 (13%)	11 (73%)	4 (36%)	7 (64%)
>10	13 (87%)	4 (27%)	7 (64%)	4 (36%)

The analysis resulted in four themes (Table 2) on clinicians' views towards electronic cigarettes and smoking cessation in the context of cardiothoracic surgery: (1) Electronic cigarettes were unlikely to be safe, but still safer than tobacco cigarettes; (2) Electronic cigarettes may have a harm reduction role in the context of public health; (3) Electronic cigarettes were a potential smoking cessation tool for the extraordinary circumstances of surgery; and (4) Patient-clinician discussions were influenced by clinician views about electronic cigarettes and clinicians' discipline-specific professional role. These four themes were not mutually exclusive, but nonetheless represent distinct patterns in the transcripts.

Table 2. Themes relevant to clinicians' views of electronic cigarettes.

Theme	Sub Theme	Categories	Professions and Frequency			
			Anaesthetists (*n* = 15)	**Surgeons (*n* = 15)**	**Nurses (*n* = 11)**	**Physiotherapists (*n* = 11)**
Electronic cigarettes were unlikely to be safe but still safer than tobacco cigarettes	Limited knowledge of electronic cigarettes	Media was the main source of information	15	15	11	11
		Electronic cigarettes should be banned or regulated until further evidence available	2	5	3	0
		Unsure of how electronic cigarettes should be regulated due to lack of evidence	10	9	8	11
		Electronic cigarettes should be available over-the-counter/tobacconist	2	1	0	0
Electronic cigarettes may have a harm reduction role in the context of public health	Positive views of electronic cigarettes	Electronic cigarettes as the lesser of two evils	8	7	4	6
		Hand to mouth similarities as an alternative form of nicotine replacement therapy (NRT)	4	5	2	2
	Negative views of electronic cigarettes	Electronic cigarettes were too similar to tobacco cigarettes	3	3	5	3
Electronic cigarettes were a potential smoking cessation tool for the extraordinary circumstances of surgery	Electronic cigarettes as an alternative to tobacco smoking	If patients had tried other methods and were unable to quit	5	4	3	4
		As a bridge off tobacco smoking before surgery	4	6	2	2
	Clinicians' preferred methods outweighed potential role of electronic cigarettes	Preference for evidence-based methods of NRT	2	2	5	1
		No nicotine in any form allowed for their patients prior to surgery	1	2	1	0
		Unknown effects of vaping on patients' airways	3	1	0	4
Patient-clinician discussions were influenced by clinician views about electronic cigarettes and clinicians' professional role	Consider patient short-term use of electronic cigarettes before surgery	Comfortable with discussing electronic cigarette short-term patient use to help stop tobacco smoking prior to surgery	8	7	1	2
	Discourage patient use of electronic cigarettes	Comfortable with discussing the lack of evidence being their reason for not recommending electronic cigarettes	1	4	2	1
	Unsure and would seek advice	Emphasis on patient's choice to use electronic cigarettes due to lack of own knowledge	6	4	8	8

3.1. Electronic Cigarettes Were Unlikely to Be Safe but Still Safer than Tobacco Cigarettes

While clinicians were aware of electronic cigarettes, they had limited knowledge of electronic cigarettes, how they worked, where they were made, and current regulations in Australia. The primary source of knowledge of clinicians was news and documentaries on popular media, such as radio and television, with many clinicians recounting media discussions of either tobacco industry involvement or uncertainty about the long-term harm caused by electronic cigarette use:

> *"What have I picked up? From a medical point of view? Nowhere. This is from a media point of view—it's a nicotine replacement, so it deals with cravings."* (S12)

No clinician considered electronic cigarettes to be completely safe, and there were gradients in their views of the harm they would cause. The few clinicians who considered them to be unsafe also felt a complete ban on electronic cigarettes was appropriate. These clinicians considered that the physiological damage to the cardiac or respiratory system by electronic cigarettes would only show after years of use, similar to that of tobacco smoking.

> *"It's going to take years to get a handle on whether they are better or worse. Maybe it will cause other things we don't even know about."* (S1)

Other clinicians considered that electronic cigarettes were most likely safer than tobacco smoking but should be regulated in some manner until more scientific data was available. No clinician knew of the current Australian regulations on the sale or personal use of electronic cigarettes. There were a few clinicians who felt that, despite the uncertainty, electronic cigarettes were a viable form of nicotine replacement therapy (NRT) to help deal with nicotine cravings and should be available over the counter to encourage or enhance a quit attempt.

> *"You can get NRT on a prescription, and over the counter. That could work for electronic cigarettes too."* (A6)

3.2. Electronic Cigarettes May Have a Harm Reduction Role in the Context of Public Health

All clinicians viewed electronic cigarettes as the lesser of two evils compared to tobacco smoking.

> *"Electronic cigarettes are nicotine and flavour. Even if the flavour is poisonous, it's probably better than 3000 other chemicals in a tobacco cigarette."* (A5)

On the continuum of harm with tobacco smoking at one end and NRT was at the other, the clinicians were divided on where electronic cigarettes sat. Those who regarded electronic cigarettes closer to tobacco in risk regarded electronic cigarettes either as a vehicle of the tobacco industry or a tool that hindered cessation, due to the similar mannerisms associated with smoking. This view was predominant among clinicians who were ex-smokers or had family members who currently smoked.

> *"Electronic cigarettes still promote the oral component, so it would be too easy to slip back to smoking. And their use suggests that it's still socially acceptable to put them in your mouth, renormalising smoking again."* (S11)

Others felt electronic cigarettes sat further towards NRT as a cessation tool, as the hand-to-mouth component of electronic cigarettes was an advantage that filled the 'space' left by quitting tobacco cigarettes that NRT patches or gum did not fill.

> *"I think people want to stop smoking. There's those who can do it cold turkey or with nicotine replacement, but some need the hand-to-mouth kind of behaviour to continue. Whichever gets them off the cigarette."* (S6)

The overall consensus was that electronic cigarettes may have a harm reduction role in the context of public health providing a person quit tobacco completely while using an electronic cigarette. However, due to the negative media messages and a likely tobacco industry involvement, electronic cigarettes were not regarded as a viable cessation tool for broader population tobacco control.

3.3. Electronic Cigarettes Were a Potential Smoking Cessation Tool for the Extraordinary Circumstances of Surgery

Electronic cigarettes were viewed by clinicians as a means of harm reduction in the truest sense of the words. All clinicians expressed the desire for a patient to abstain from tobacco prior to surgery for as long as possible to reduce the known harm caused by continued tobacco smoking in the perioperative period of cardiothoracic surgery. Nevertheless, some questioned the need for electronic cigarettes, citing experience of patients successfully quitting with NRT, as a result of the enforced abstinence once hospitalised for cardiothoracic surgery, or quitting 'cold turkey' (abrupt abstinence).

> *"I see so many patients who they stop from 60 a day to nil just by not relenting. That's probably part of the reason, maybe the motivation and the mental attitude to that. So, if they want to do it, they can do it without the electronic cigarette."* (S15)

Clinicians had discipline-specific views about the role of electronic cigarettes as an appropriate cessation method in the perioperative period. Surgeon, anaesthetists and nurses who specialised more in the care of coronary artery bypass surgery patients were opposed to nicotine use in any form, due to the risk of perioperative coronary artery vasoconstriction and tachycardia. For those surgeons, nurses and anaesthetists, abrupt cessation was the preferred method of quitting prior to surgery with continued abstinence postoperatively. Similarly, surgeons, anaesthetists and physiotherapists who specialised more in the care of thoracic surgery patients, or who had first-hand experience of the negative impact of tobacco smoking on postoperative pulmonary complications, were concerned about the adverse effects of the inhaled aerosols from electronic cigarettes, and the risk of bronchospasm or airway harm.

> *"I have concerns about the flavours, because you don't know what's in it. They're inhaling a whole cocktail of things before the anaesthetic."* (A4)

Most clinicians, however, felt that completely switching to electronic cigarettes to achieve tobacco abstinence prior to surgery would reduce the known pathophysiologic consequences of continued tobacco smoking on a patient's surgical outcomes. These clinicians acknowledged that electronic cigarettes could provide a bridge between tobacco smoking and NRT use, a pathway to cessation of all cigarettes, or a novel method for patients who required nicotine delivery in a different manner.

> *"If using electronic cigarettes was a way of getting higher concentrations of nicotine as a single hit, which some people seem to need, that would be worthwhile, because other means of nicotine therapy are delivered too slow, compared to tobacco cigarettes."* (A12)

All clinicians had numerous examples of patients who had been unable, or unwilling, to quit tobacco smoking prior to surgery, or who had resumed smoking after surgery, including: patients who had experienced severe adverse effects of pharmacotherapy, such as varenicline, or nicotine withdrawal, and did not want to try to quit again; patients who relied on smoking as a method to manage stress; patients who had little confidence in their ability to quit; and patients with complex sociodemographic situations or mental illness. Most clinicians, even those with negative views about the safety of electronic cigarettes, conceded that they may have a role to play to create a quit attempt prior to surgery.

> *"I think there are patients who are so habituated to smoking that if electronic cigarette use is the only way they can stop, I accept that."* (S10)

However, no clinician condoned the use of electronic cigarettes postoperatively. The enforced abstinence from smoking in the hospital smoke-free environment and the acuity of a patient's illness and surgery was seen as a teachable moment for patients to quit all forms of cigarettes.

3.4. Patient-Clinician Discussions Were Influenced by Clinician Views about Electronic Cigarettes and Clinicians' Professional Role

No clinician had been asked about electronic cigarettes by a patient awaiting cardiothoracic surgery at the time of this study. Therefore, all clinicians were given a hypothetical scenario (Figure 1, question 6) to explore what they would say if a patient asked about electronic cigarettes to abstain from smoking in the perioperative period. Anaesthetists and physiotherapists who regarded electronic cigarettes as a risk to a patient's respiratory system said they would reiterate the uncertainties about electronic cigarettes compared to other methods and recommend that the patient discuss their use with their surgeon.

> *"I would tell the patient that it's good that they're showing steps to try and stop smoking, but they would need to talk to their surgeon about electronic cigarettes. They're not harmless."* (P5)

Other anaesthetists and nurses who had a direct line of contact with the surgeon in their role, would seek the surgeon's advice.

> *"I would talk to the surgeons and ask what their opinion was. I would have to get more information because I wouldn't want to recommend something that I know nothing about."* (N9)

Surgeons who regarded electronic cigarettes negatively, as an unknown and most likely harmful entity, said they would be unequivocal in their advice to patients, highlighting the risks and unproven efficacy of electronic cigarettes as a smoking cessation tool. Surgeons who regarded electronic cigarettes more positively said they would highlight the current uncertainty about electronic cigarettes' safety but would recommend a patient quit tobacco before surgery using any means.

> *"You have to use whatever means are appropriate to protect the patient from themselves and to optimise their surgical outcome in the short term and their life outcome in the long term."* (S14)

Anaesthetists, nurses and physiotherapists, while uncertain about the risks and benefits of electronic cigarettes, felt they would use the patient's question about electronic cigarettes and guide it to a broader conversation about quitting tobacco use before surgery. Some would guide patients away from electronic cigarettes to evidence-based cessation, such as NRT or Quitline (an Australian telephone services that provides smoking cessation information, advice, and support). Others felt comfortable recommending the patient try electronic cigarettes, as the attempt may achieve the intended tobacco abstinence prior to surgery.

> *"I would be comfortable recommending an electronic cigarette because I think it achieves the outcome that we want for the patient."* (A14)

4. Discussion

This study provides the first in-depth views of Australian clinicians towards electronic cigarettes in the perioperative period of cardiothoracic surgery. It shows that a number of Australian clinicians see a role for electronic cigarettes in a specific clinical setting to achieve tobacco abstinence prior to surgery, for patients who have been unable to quit with other cessation methods. The study reinforces international findings among clinicians involved in the care of patients with tobacco-related diseases: clinicians have a lack of knowledge and familiarity about electronic cigarettes; media is a primary source of clinicians' information; and clinicians perceive that electronic cigarettes were likely to have some adverse effects [15,16]. Whilst there were variations in views among professions, the consensus was that, compared to known physiological harm of combustible tobacco cigarettes, electronic cigarettes were less harmful [13,15].

In Australia, the primary cause of coronary artery disease and lung cancer is tobacco smoking [50], and the need for cardiothoracic surgical management of these diseases will continue. Clinicians are

trusted sources of information and their advice has been found to create higher levels of tobacco quit attempts and cessation success [51–53], particularly among patients who are at their most vulnerable in the perioperative period [54]. Because of the current uncertainty about the safety of electronic cigarettes, and the influence that a clinician's own beliefs about smoking cessation methods can have [8], this study shows that patients may be given mixed messages about electronic cigarettes. For example, certain surgeons, anaesthetists and nurses neither endorsed NRT or electronic cigarette use in the perioperative period of coronary artery bypass surgery, due to the potential adverse effects of nicotine on diseased and newly grafted coronary arteries, whilst others were comfortable recommending any method that would lead to tobacco abstinence. Therefore, the information and acceptance of smoking cessation methods may differ depending on the clinician's views, their profession, and the hospital they attend.

Previous international surveys and interview studies of clinicians in areas related to tobacco-induced diseases have reported both optimism and scepticism about the benefits of electronic cigarettes as a tool to reduce or cease tobacco cigarettes, which influenced the content of their conversations with patients [13,15–17]. The range of views found in these studies were echoed in this Australian study, with clinicians either discouraging, tolerating or encouraging electronic cigarettes, based on uncertainty and concern about electronic cigarettes at one end to the view that whatever helped a patient quit tobacco smoking before surgery was worth considering. This diversity of opinions from such a variety of international and Australian professions—physicians, oncologists, surgeons, nurses and physiotherapists—emphasises the need to provide education and guidance to all clinicians, in order to create consistency in the advice offered to patients, irrespective of a country's regulation or a clinician's personal opinions about electronic cigarettes. Apart from the recent changes in the United Kingdom [26], there is little translation of the extensive position papers and recommendations from professional clinical societies, governments and health authorities to formally guide the patient-clinician discussion about the use of electronic cigarettes to quit smoking [13,15]. Until scientific evidence on the safety and efficacy of electronic cigarettes resolves the current debate, clear and accessible guidance detailing the risks, benefits and uncertainties of using electronic cigarettes should be provided to clinicians who care for cardiothoracic surgical patients. This could take the form of written literature in the hospital pre-admission clinics, surgeons' rooms, or cardiothoracic surgical wards, that clinicians can refer to, or decision aids designed to facilitate clinician-patient discussions regarding tobacco use around the time of surgery [55].

The provision of smoking cessation care to patients throughout the perioperative period is a recognised goal shared by clinicians responsible for the surgical management of patients [7,56–58]. This novel study reports the views of typical Australian interdisciplinary teams of clinicians—surgeons, anaesthetists, nurses and physiotherapists—about a relatively novel consumer product, in a country where electronic cigarettes are tightly regulated. Indeed, no surgeon, anaesthetist, nurse or physiotherapist in the study had experienced a patient-clinician discussion about electronic cigarettes, which differs from the other international studies [13,15,16]. In this study, the clinicians' positive views towards electronic cigarettes as a short-term alternative to tobacco cigarettes prior to surgery was primarily based on both their clinical experience and knowledge of the definite harm caused by continued tobacco smoking on patient outcomes, and their recognition of the difficulties some patients faced in quitting despite imminent cardiothoracic surgery. The view that electronic cigarettes could be used to achieve tobacco abstinence for patients who were not successful in prior quit attempts with approved therapies is consistent with the views of numerous clinicians who care for patients with tobacco-related diseases [12–15,17,18].

The results of this study highlight an absence of real-world clinician experience responding to patients' questions about electronic cigarettes, compared with studies in the United States, United Kingdom, Greece and Korea [12–18]. The lack of surgical patient-clinician discussions on electronic cigarettes at the time of this study (October 2015 to November 2016) suggest that the regulations in Australia had the desired effects, with less use and interest in electronic cigarettes compared to other countries with fewer regulations and higher use [27,28,59]. Additionally, it may also

reflect the characteristics of certain patients who actively smoke, despite their diagnosis and imminent surgery; such characteristics include a high nicotine dependence, a reliance of smoking to reduce anxiety, or a lack of awareness of the immediate risks of tobacco use in the perioperative period [7,60]. While people continue to smoke tobacco, the need for cardiothoracic surgical management will also continue as the population ages and lives longer. As the prevalence of electronic cigarette use is increasing in Australia [29,30], Australian interdisciplinary clinicians may find themselves increasingly involved in discussions about electronic cigarettes, with patients who have tried other methods to quit and are interested in the use of electronic cigarettes in a subsequent quit attempt [61].

There are both strengths and limitations to this study. Firstly, this study draws from a specific sample of clinicians from metropolitan hospitals in Sydney, Australia, who were responsible for 43% of cardiothoracic surgery cases in NSW in 2016 [62]. Therefore, the findings are context specific to the settings and selected individuals involved. While this means that the results cannot be directly generalised to other settings in Australia or internationally, the variety of disciplines and experience of the clinicians interviewed has produced an in-depth and extensive understanding of the perspectives and approaches that arise in their clinician-patient discussion of smoking cessation in cardiothoracic surgical contexts. These findings can therefore provide a point of comparison and contrast for other studies examining similar issues, albeit in different geographic and cultural settings. Secondly, the method of participant recruitment for the anaesthetists, nurses and physiotherapists could lead to selection bias. Yet, this is the most ethically and logistically appropriate approach as the department head is the best person to know the workload of each clinician and their willingness to carve out extra time for study participation. Having said this, at each study site there are a limited number of specialist clinicians involved in the interdisciplinary perioperative care of cardiothoracic patients. By the end of the study, only 10% of the clinicians were not recruited. This, therefore, controlled for some of this possible participant bias. Thirdly, this study did not explore the clinicians' views regarding the efficacy of non-nicotine containing electronic cigarettes as a smoking cessation tool, or their willingness to write a prescription for nicotine e-liquid. These questions could be included in future research of other Australian clinical professions who care for patients with tobacco-related diseases, such as in the areas of oncology or respiratory medicine. Finally, since the interviews were conducted however, there has been an Australian parliamentary inquiry [63] into electronic cigarettes, with submissions by numerous medical and health authorities, and much media about electronic cigarettes. Whilst no changes have been made to current regulations, the intense media discussions may have altered some of the clinicians' views. Nevertheless, these qualitative findings add to previous international quantitative research in cardiothoracic surgery [13,15,16], confirming that the lack of scientific evidence of the safety and efficacy of electronic cigarettes as a smoking cessation aid has an impact on the views of clinicians and patient-clinician discussions.

5. Conclusions

This study represents the only known study of the views and practices of interdisciplinary Australian clinicians involved in the care of cardiothoracic surgical patients, and adds a new perspective to previous surveys of international clinicians, as it is an in-depth, qualitative study in Australia, where the regulatory framework is complex and unique. Whilst the findings of the study reveal the limited knowledge about electronic cigarettes and their uncertainty about the long-term safety of electronic cigarettes, it adds to the evidence regarding positive attitudes of clinicians who care for patients with tobacco-related diseases. In the extraordinary context of the perioperative period, where continued tobacco smoking is known to cause an increase in surgical risk, electronic cigarettes may engage patients in a quit attempt that can be guided and supported with a common aim towards long-term smoking cessation. As the debate about e-cigarettes continues, played out in the media, clinicians are likely to be receiving more frequent questions from patients about electronic cigarettes as a cessation aid. This reinforces the need for clearer and balanced guidelines for Australian clinicians on the topic of electronic cigarettes and cardiothoracic surgery.

Author Contributions: Conceptualisation, N.A.L.; methodology, N.A.L.; formal analysis, N.A.L. and P.S.; investigation, N.A.L.; resources, N.A.L.; data curation, N.A.L.; writing—original draft preparation, N.A.L.; writing—review and editing, N.A.L., P.S. and M.A.R.; supervision P.S. and M.A.R.

Funding: This research was supported by a Macquarie University Research Excellence Scholarship (N.A.L.), and National Cancer Institute, U.S. National Institutes of Health, Grant R01-CA091021 (Ross MacKenzie).

Acknowledgments: The authors thank the cardiothoracic clinicians who participated, the management of the six hospitals for their support, and Ross MacKenzie (R.M.) for his support of the research process, his supervision of NAL as a PhD candidate and funding acquisition.

Conflicts of Interest: N.A.L. is a clinician at one of the hospital sites. The funding had no role in the design and conduct of the study; in the collection, analyses, or interpretation of the data; in the writing of the manuscript, or in the decision to publish the results.

References

1. Warner, D.O. Perioperative abstinence from cigarettes—Physiologic and clinical consequences. *Anesthesiology* **2006**, *104*, 356–367. [CrossRef] [PubMed]
2. Parsons, A.; Daley, A.; Begh, R.; Aveyard, P. Influence of smoking cessation after diagnosis of early stage lung cancer on prognosis: Systematic review of observational studies with meta-analysis. *BMJ* **2010**, *340*. [CrossRef] [PubMed]
3. Rigotti, N.A.; Clair, C. Managing tobacco use: The neglected cardiovascular disease risk factor. *Eur. Heart J.* **2013**, *34*, 3259–3267. [CrossRef] [PubMed]
4. Fiore, M.C.; Bailey, W.C.; Cohen, S.J. Treating Tobacco Use and Dependence. Clinical Practice Guideline; 2008. Available online: https://www.ncbi.nlm.nih.gov/books/NBK63952/ (accessed on 5 October 2018).
5. Royal Australian College of General Practitioners. Supporting Smoking Cessation: A Guide for Health Professionals. 2014. Available online: https://www.racgp.org.au/your-practice/guidelines/smoking-cessation/ (accessed on 5 October 2018).
6. National Institute for Health and Care Excellence. Smoking: Acute, Maternity and Mental Health Services (PH48). 2013. Available online: https://www.nice.org.uk/guidance/ph48 (accessed on 5 October 2018).
7. Nolan, M.B.; Warner, D.O. Perioperative tobacco use treatments: putting them into practice. *BMJ* **2017**, *358*. [CrossRef] [PubMed]
8. Luxton, N.A.; MacKenzie, R.; Shih, P. Smoking cessation care in cardiothoracic surgery: A qualitative study exploring the views of Australian clinicians. *Heart Lung Circ.* **2018**, S1443–9506. [CrossRef] [PubMed]
9. Borderud, S.P.; Li, Y.; Burkhalter, J.E.; Sheffer, C.E.; Ostroff, J.S. Electronic cigarette use among patients with cancer: Characteristics of electronic cigarette users and their smoking cessation outcomes. *Cancer* **2014**, *120*, 3527–3535. [CrossRef] [PubMed]
10. Busch, A.M.; Leavens, E.L.; Wagener, T.L.; Buckley, M.L.; Tooley, E.M. Prevalence, reasons for use, and risk perception of electronic cigarettes among post-acute coronary syndrome smokers. *J. Cardiopulm. Rehabil. Prev.* **2016**, *36*, 352–357. [CrossRef] [PubMed]
11. Kalkhoran, S.; Kruse, G.R.; Rigotti, N.A.; Rabin, J.; Ostroff, J.S.; Park, E.R. Electronic cigarette use patterns and reasons for use among smokers recently diagnosed with cancer. *Cancer Med.* **2018**. [CrossRef] [PubMed]
12. Moysidou, A.; Farsalinos, K.; Voudris, V.; Merakou, K.; Kourea, K.; Barbouni, A. Knowledge and perceptions about nicotine, nicotine replacement therapies and electronic cigarettes among healthcare professionals in Greece. *Int. J. Environ. Res. Public Health* **2016**, *13*, 514. [CrossRef] [PubMed]
13. Sherratt, F.C.; Newson, L.; Field, J.K. Electronic cigarettes: A survey of perceived patient use and attitudes among members of the British thoracic oncology group. *Respir. Res.* **2016**, *55*. [CrossRef] [PubMed]
14. Kanchustambham, V.; Saladi, S.; Rodrigues, J.; Fernandes, H.; Patolia, S.; Santosh, S. The knowledge, concerns and healthcare practices among physicians regarding electronic cigarettes. *J. Community Hosp. Inter. Med. Perspect* **2017**, *7*, 144–150. [CrossRef] [PubMed]
15. Nickels, A.S.; Warner, D.O.; Jenkins, S.M.; Tilburt, J.; Hays, J.T. Beliefs, practices, and self-efficacy of US physicians regarding smoking cessation and electronic cigarettes: A national survey. *Nicotine Tob. Res.* **2017**, *19*, 197–207. [CrossRef] [PubMed]
16. Shin, D.W.; Kim, Y.I.; Kim, S.J.; Kim, J.S.; Chong, S.; Park, Y.S.; Song, S.-Y.; Lee, J.H.; Ahn, H.K.; Kim, E.Y.; et al. Lung cancer specialist physicians' attitudes towards e-cigarettes: A nationwide survey. *PLoS ONE* **2017**, *12*, e0172568. [CrossRef] [PubMed]

17. Singh, B.; Hrywna, M.; Wackowski, O.A.; Delnevo, C.D.; Jane Lewis, M.; Steinberg, M.B. Knowledge, recommendation, and beliefs of e-cigarettes among physicians involved in tobacco cessation: A qualitative study. *Prev. Med. Rep.* **2017**, *8*, 25–29. [CrossRef] [PubMed]
18. Baldassarri, S.R.; Chupp, G.L.; Leone, F.T.; Warren, G.W.; Toll, B.A. Practise patterns and perceptions of chest health care providers on electronic cigarette use: An in-depth discussion and report of survey results. *J. Smok. Cess.* **2018**, *13*, 72–77. [CrossRef] [PubMed]
19. Glasser, A.M.; Collins, L.; Pearson, J.L.; Abudayyeh, H.; Niaura, R.S.; Abrams, D.B.; Villanti, A.C. Overview of electronic nicotine delivery systems: A systematic review. *Am. J. Prev. Med.* **2017**, *52*, e33–e66. [CrossRef] [PubMed]
20. World Health Organization. Electronic Nicotine Delivery Systems and Electronic Non-Nicotine Delivery Systems (ENDS/ENNDS). 2017. Available online: http://www.who.int/tobacco/communications/statements/eletronic-cigarettes-january-2017/en/ (accessed on 5 October 2018).
21. Chapman, S.; Bareham, D.; Maziak, W. The gateway effect of e-cigarettes; Reflections on main criticisms. *Nicotine. Tob. Res.* **2018**. [CrossRef] [PubMed]
22. Glantz, S.A.; Bareham, D.W. E-Cigarettes: Use, effects on smoking, risks, and policy implications. *Annu. Rev. Public Health* **2018**, *39*, 215–235. [CrossRef] [PubMed]
23. National Academies of Sciences, Engineering, and Medicine; Health and Medicine Division; Board on Population Health and Public Health Practice; Committee on the Review of the Health Effects of Electronic Nicotine Delivery Systems. *Public Health Consequences of E-Cigarettes*; Eaton, D.L., Kwan, L.Y., Stratton, K., Eds.; National Academies Press: Washington, DC, USA, 2018.
24. Rahman, M.A.; Hann, N.; Wilson, A.; Mnatzaganian, G.; Worrall-Carter, L. E-cigarettes and smoking cessation: evidence from a systematic review and meta-analysis. *PLoS ONE* **2015**, *10*, e0122544. [CrossRef] [PubMed]
25. Hartmann-Boyce, J.; Begh, R.; Aveyard, P. Electronic cigarettes for smoking cessation. *BMJ* **2018**, *360*. [CrossRef] [PubMed]
26. National Institute for Health and Care Excellence. Stop Smoking Interventions and Services NICE Guideline (NG92). 2018. Available online: https://www.nice.org.uk/guidance/ng92 (accessed on 5 October 2018).
27. Adkison, S.E.; O'Connor, R.J.; Bansal-Travers, M.; Hyland, A.; Borland, R.; Yong, H.H.; Cummings, K.M.; McNeill, A.; Thrasher, J.F.; Hammond, D.; et al. Electronic nicotine delivery systems: International tobacco control four-country survey. *Am. J. Prev. Med.* **2013**, *44*, 207–215. [CrossRef] [PubMed]
28. Yong, H.H.; Borland, R.; Balmford, J.; McNeill, A.; Hitchman, S.; Driezen, P.; Thompson, M.E.; Fong, G.T.; Cummings, K.M. Trends in e-cigarette awareness, trial, and use under the different regulatory environments of Australia and the United Kingdom. *Nicotine Tob. Res.* **2015**, *17*, 1203–1211. [CrossRef] [PubMed]
29. Australian Institute of Health and Welfare. National Drug Strategy Household Survey 2016: Detailed Findings. Available online: https://www.aihw.gov.au/getmedia/15db8c15-7062-4cde-bfa4-3c2079f30af3/21028a.pdf.aspx?inline=true (accessed on 5 October 2018).
30. NSW Smoking & Health Survey 2015, Cancer Institute NSW, Sydney, 2017. Available online: https://www.cancer.nsw.gov.au/how-we-help/reports-and-publications/nsw-smoking-and-health-survey-2015 (accessed on 5 October 2018).
31. Ministry of Health, New Zealand. Regulation of E-Cigarettes and Emerging Tobacco and Nicotine-Delivery Products. 2017. Available online: https://www.health.govt.nz/about-ministry/legislation-and-regulation/regulatory-impact-statements/regulation-e-cigarettes-and-emerging-tobacco-and-nicotine-delivery-products (accessed on 5 October 2018).
32. Therapeutic Goods Administration. Electronic Cigarettes. Available online: https://www.tga.gov.au/community-qa/electronic-cigarettes (accessed on 5 October 2018).
33. The Department of Health. E-Cigarettes. Available online: http://www.health.gov.au/internet/main/publishing.nsf/Content/mc16-031907-reduce-the-harm-from-tobacco (accessed on 5 October 2018).
34. Parliament of Australia. Submission from Cancer Council Australia and the National Heart Foundation of Australia to Standing Committee on Health, Aged Care and Sport Inquiry into the Use and Marketing of Electronic Cigarettes and Personal Vaporisers in Australia. 2017. Available online: https://www.cancer.org.au/content/pdf/CancerControlPolicy/Submissions/Inquiry_into_e-cigarettes.pdf (accessed on 5 October 2018).

35. Parliament of Australia. Royal Australasian College of Surgeons. Inquiry into the Use and Marketing of Electronic Cigarettes and Personal Vaporisers in Australia, Submission 329, 2017. Available online: https://www.aph.gov.au/Parliamentary_Business/Committees/House/Health_Aged_Care_and_Sport/ElectronicCigarettes/Submissions?main_0_content_1_RadGrid1ChangePage=15_20 (accessed on 5 October 2018).
36. The Department of Health. Statement on E-Cigarettes in Australia. Available online: https://canceraustralia.gov.au/sites/default/files/statement_on_e-cigarettes_february_2018_0.pdf (accessed on 5 October 2018).
37. Royal College of Physicians. Policy on E-Cigarettes. 2018. Available online: https://www.racp.edu.au/docs/default-source/advocacy-library/policy-on-electronic-cigarettes.pdf (accessed on 5 October 2018).
38. Kadimpati, S.; Nolan, M.; Warner, D.O. Attitudes, beliefs, and practices regarding electronic nicotine delivery systems in patients scheduled for elective surgery. *Mayo Clin. Proc.* **2015**, *90*, 71–76. [CrossRef] [PubMed]
39. Nolan, M.; Leischow, S.; Croghan, I.; Kadimpati, S.; Hanson, A.; Schroeder, D.; Warner, D.O. Feasibility of Electronic Nicotine Delivery Systems in Surgical Patients. *Nicotine Tob. Res.* **2016**, *18*, 1757–1762. [CrossRef] [PubMed]
40. Lee, S.M.; Tenney, R.; Wallace, A.W.; Arjomandi, M. E-cigarettes versus nicotine patches for perioperative smoking cessation: a pilot randomized trial. *PeerJ* **2018**. [CrossRef] [PubMed]
41. An, L.C.; Foldes, S.S.; Alesci, N.L.; Bluhm, J.H.; Bland, P.C.; Davern, M.E.; Schillo, B.A.; Ahluwalia, J.S.; Manley, M.W. The impact of smoking-cessation intervention by multiple health professionals. *Am. J. Prev. Med.* **2008**, *34*, 54–60. [CrossRef] [PubMed]
42. Prestwich, A.; Moore, S.; Kotze, A.; Budworth, L.; Lawton, R.; Kellar, I. How can smoking cessation be induced before surgery? A systematic review and meta-analysis of behavior change techniques and other intervention characteristics. *Front. Psychol.* **2017**, *8*. [CrossRef] [PubMed]
43. Bureau of Health Information. Healthcare Quarterly, Activity and Performance—Emergency Department, Ambulance, Admitted Patients and Elective Surgery. 2016. Available online: http://search.bhi.nsw.gov.au/s/search.html?query=cardiothoracic+surgery+2016&x=0&y=0&collection=nsw_health_bhi (accessed on 5 October 2018).
44. NSW Health. Managing Nicotine Dependence: A Guide for NSW Health Staff. 2015. Available online: https://www.health.nsw.gov.au/tobacco/Pages/tools-for-health-professionals.aspx (accessed on 5 October 2018).
45. National Statement on Ethical Conduct in Human Research. (Updated 2018). The National Health and Medical Research Council, the Australian Research Council and Universities Australia; Commonwealth of Australia, Canberra, 2007. Available online: https://nhmrc.gov.au/about-us/publications/national-statement-ethical-conduct-human-research-2007-updated-2018#block-views-block-file-attachments-content-block-1 (accessed on 5 October 2018).
46. *NVivo Qualitative Data Analysis Software (Version 11)*; QSR International Pty Ltd.: Melbourne, Australia, 2010.
47. Braun, V.; Clarke, V. Using thematic analysis in psychology. *Qual. Res. Psychol.* **2006**, *3*, 77–101. [CrossRef]
48. Guest, G.; MacQueen, K.; Namey, E. *Applied Thematic Analysis*; Sage Publications: London, UK, 2012.
49. Green, J.; Thorogood, N. *Qualitative Methods for Health Research*; Sage Publications: London, UK, 2018.
50. Australian Institute of Health and Welfare. *Australia's Health 2018*; Australia's Health Series No. 16; AUS 221; AIHW: Canberra, Australia, 2018. Available online: https://www.aihw.gov.au/reports/australias-health/australias-health-2018/contents/table-of-contents (accessed on 5 October 2018).
51. Stead, L.F.; Buitrago, D.; Preciado, N.; Sanchez, G.; Hartmann-Boyce, J.; Lancaster, T. Physician advice for smoking cessation. *Cochrane Database Syst. Rev.* **2013**. [CrossRef] [PubMed]
52. Medical Board of Australia. Doctors the Most Trusted Profession: Board Research. 2016. Available online: https://www.medicalboard.gov.au/news/2016-11-10-media-statement.aspx (accessed on 5 October 2018).
53. Rice, V.H.; Heath, L.; Livingstone-Banks, J.; Hartmann-Boyce, J. Nursing interventions for smoking cessation. *Cochrane Database Syst. Rev.* **2017**, *12*. [CrossRef] [PubMed]
54. Brennan, N.; Barnes, R.; Calnan, M.; Corrigan, O.; Dieppe, P.; Entwistle, V. Trust in the health-care provider–patient relationship: A systematic mapping review of the evidence base. *Int. J. Qual. Health Care* **2013**, *25*, 682–688. [CrossRef] [PubMed]
55. Warner, D.O.; LeBlanc, A.; Kadimpati, S.; Vickers, K.S.; Shi, Y.; Montori, V.M. Decision aid for cigarette smokers scheduled for elective surgery. *Anesthesiology* **2015**, *123*, 18–28. [CrossRef] [PubMed]
56. Warner, D.O. Helping surgical patients quit smoking: Why, when, and how. *Anesth. Analg.* **2005**, *101*, 481–487. [CrossRef] [PubMed]

57. Wolfenden, L.; Wiggers, J.; Knight, J.; Campbell, E. Smoking and surgery: An opportunity for health improvement. *Aust. N. Z. J. Public Health* **2007**, *31*, 386–387. [CrossRef] [PubMed]
58. Wolfenden, L.; Campbell, E.; Wiggers, J.; Walsh, R.A.; Bailey, L.J. Helping hospital patients quit: What the evidence supports and what guidelines recommend. *Prev. Med.* **2008**, *46*, 346–357. [CrossRef] [PubMed]
59. Yong, H.H.; Borland, R.; Balmford, J.; Hitchman, S.C.; Cummings, K.M.; Driezen, P.; Thompson, M.E. Prevalence and correlates of the belief that electronic cigarettes are a lot less harmful than conventional cigarettes under the different regulatory environments of Australia and the United Kingdom. *Nicotine Tob. Res.* **2017**, *19*, 258–263. [CrossRef] [PubMed]
60. Rojewski, A.M.; Baldassarri, S.; Cooperman, N.A.; Gritz, E.R.; Leone, F.T.; Piper, M.E.; Toll, B.A.; Warren, G.W. Exploring issues of comorbid conditions in people who smoke. *Nicotine Tob. Res.* **2016**, *18*, 1684–1696. [CrossRef] [PubMed]
61. Thomas, D.; Abramson, M.J.; Bonevski, B.; Taylor, S.; Poole, S.G.; Weeks, G.R.; Dooley, M.J.; George, J. Quitting experiences and preferences for a future quit attempt: A study among inpatient smokers. *BMJ Open* **2015**, *5*. [CrossRef] [PubMed]
62. Bureau of Health Information. Healthcare Quarterly, Activity and Performance—Emergency Department, Ambulance, Admitted Patients and Elective Surgery. 2016. Available online: http://www.bhi.nsw.gov.au/BHI_reports/healthcare_quarterly (accessed on 5 October 2018).
63. Parliament of Australia. Inquiry into the Use and Marketing of Electronic Cigarettes and Personal Vaporisers in Australia. 2018. Available online: https://www.aph.gov.au/Parliamentary_Business/Committees/House/Health_Aged_Care_and_Sport/ElectronicCigarettes/Report (accessed on 5 October 2018).

Chapter 4: Study III: Use of electronic cigarettes in the perioperative period: A mixed method study exploring perceptions of cardiothoracic patients in Australia

Preface to Study III

Diagnosis of a tobacco-related disease and subsequent need for major surgery are motivating factors for quitting smoking. However, some patients continue to smoke before and after surgery having been unsuccessful with other methods of cessation, unable to sustain a quit attempt, or unwilling to quit. Electronic cigarette use is increasing in Australia, but there is little data on the use of electronic cigarettes in the patient population, and their reasons for use. This aim of this study was to determine the beliefs and practices regarding electronic cigarettes of current and recent ex-smokers scheduled for elective cardiothoracic surgery.

This chapter consists of the following publication:

Luxton, N. A., Shih, P., Rahman, M. A., Adams, R. and MacKenzie, R. (2018). Use of electronic cigarettes in the perioperative period: A mixed-method study exploring perceptions of cardiothoracic patients in Australia. *Tobacco Induced Diseases*, *16*, 53. doi.org/10.18332/tid/98957

The following conference poster presentation also relates to this chapter:

Luxton, N. A., Shih, P., Rahman, M. A., Adams, R. and MacKenzie, R. M. (2018). Use of electronic cigarettes in the perioperative period: A mixed method study exploring perceptions of cardiothoracic patients in Australia. *Australian Cardiovascular Health and Rehabilitation Association (ACRA) 28th Annual Scientific Meeting,* Brisbane, Qld, Australia.

Authorship of Study III

The candidate Nia Angharad Luxton was the primary author and contributed 65% to the planning, execution and preparation of the research project and subsequent paper.

Patti Shih contributed 10% to the analysis and interpretation of the research data and contributed to the interpretation of the work by critically revising the paper.

Muhammad Aziz Rahman contributed 10% to the analysis and interpretation of the research data and contributed to the interpretation of the work by critically revising the paper.

Roger Adams contributed 10% to the analysis and interpretation of the research data and contributed to the interpretation of the work by critically reviewing the paper.

Ross MacKenzie contributed 5% to the design of the study.

Ethics approval for Study III

Ethics approval for this study was granted by the following ethics committees: Northern Sydney Local Health District HREC reference number: LNR/15/HAWKE/356; Royal North Shore Hospital site specific assessment (SSA) reference number: LNRSSA/15/HAWKE/371; North Shore Private Hospital SSA reference number: NSPHEC 2O15-LNR-O13; Royal Prince Alfred Hospital SSA reference number: LNRSSA/16/RPAH/42; Westmead Public and Private Hospital SSA reference number: LNRSSA/16/WMEAD/48; and Macquarie University Human Research Ethics Committee (HREC) reference number: 5201500797 (including Macquarie University Hospital), and is provided in Appendix A.

Use of electronic cigarettes in the perioperative period: A mixed-method study exploring perceptions of cardiothoracic patients in Australia

Nia A. Luxton[1], Patti Shih[2], Muhammad Aziz Rahman[3], Roger Adams[4], Ross MacKenzie[1]

ABSTRACT

INTRODUCTION Electronic cigarettes (e-cigarettes) may reduce tobacco use and achieve tobacco abstinence in the perioperative period of cardiothoracic surgery for patients who smoke. However, research on patients' views on the role of e-cigarettes as a smoking cessation tool is lacking. This mixed-methods study explored perceptions on the use of e-cigarettes among current smokers and ex-smokers awaiting cardiothoracic surgery in Australia.

METHODS A cross-sectional study and semi-structured interviews were conducted with 62 patients who were diagnosed with coronary artery disease or lung cancer and were scheduled for elective cardiothoracic surgery at six metropolitan hospitals in Sydney. Data were collected on demographic characteristics, smoking history, surgical risk index, self-efficacy, interest in, perceived benefits of, and barriers to using e-cigarettes in the perioperative period.

RESULTS Current smokers reported significantly higher interest in the use of e-cigarettes (p=0.008), and perceived fewer barriers (p=0.048) and more health benefits (p=0.079), compared to ex-smokers. Current smokers considered e-cigarettes to be either a safer alternative to tobacco or a novel method for quitting. Recent ex-smokers, defined as those who quit 2–8 weeks, were a distinct group with high nicotine dependency, a long history of smoking, and multiple failed quit attempts. Compared to longer-term ex-smokers (8–52 weeks quit), recent ex-smokers were more interested in e-cigarettes (p=0.029) and considered e-cigarettes a useful aid to prevent relapse in the lead up to surgery and to manage their nicotine cravings.

CONCLUSIONS E-cigarettes may be considered a short-term novel aid and a bridge to evidence-based methods to reduce harm from continued tobacco use for some patients awaiting cardiothoracic surgery for coronary artery disease or lung cancer. This study presents reasons why patients awaiting cardiothoracic surgery may enquire about or use e-cigarettes, which will help clinicians identify those who need more consistent, sustained cessation support.

AFFILIATION
1 Department of Psychology, Macquarie University, Sydney, Australia
2 Australian Institute of Health Innovation, Macquarie University, Sydney, Australia
3 Austin Clinical School of Nursing, La Trobe University, Melbourne, Australia
4 Discipline of Physiotherapy, University of Sydney, Sydney, Australia

CORRESPONDENCE TO
Nia A. Luxton. Department of Psychology, Macquarie University, Balaclava Road, North Ryde, NSW 2109, Sydney, Australia. E-mail: Nia-Angharad.Luxton@hdr.mq.edu.au
ORCID ID: https://orcid.org/0000-0003-2789-2275

KEYWORDS
e-cigarettes, coronary artery disease, lung cancer, preoperative, patient perceptions

Received: 31 August 2018
Revised: 11 October 2018
Accepted: 14 October 2018

INTRODUCTION

Electronic cigarettes (e-cigarettes) may potentially offer a safer alternative to tobacco smoking[1,2] and assist in cessation[3,4]. Methods for smoking cessation are particularly crucial for patients diagnosed with lung cancer or coronary artery disease (CAD) who require cardiothoracic surgery, as continued tobacco smoking increases the risk of postoperative complications, disease recurrence and death[5-7]. Studies in the US involving surgical patients in the

Published by EUEP European Publishing on behalf of the International Society for the Prevention of Tobacco Induced Diseases (ISPTID).

perioperative period suggest that e-cigarettes are a feasible and acceptable way to reduce tobacco use in the perioperative period[8,9]. However, the complex Australian regulations on e-cigarettes, and opposition by government and health authorities, have limited both the use of e-cigarettes and research studies examining e-cigarettes as a smoking cessation tool in the clinical setting[10].

International research shows that inadequate access to cessation support can contribute to hospitalised patients' interest in using e-cigarettes to help quit smoking[11]. In view of the need to reduce the harm caused by tobacco use in patients with cancer or CAD, and the recurrence of primary disease and development of secondary disease, studies have shown that e-cigarettes can address a number of behavioural and psychosocial factors contributing to relapse[12] and are being used to reduce or quit smoking[13-15], reduce the harm of tobacco use[16], and reduce nicotine cravings[17]. In Australia, smoking rates are low, yet smoking prevalence and the incidence of lung cancer and CAD is higher among older, disadvantaged, or lower socioeconomic groups[18-20]. For some of these patients with lung cancer or CAD, e-cigarettes may have a role to help reduce or quit smoking.

The perioperative period is a 'teachable moment' that leads to permanent smoking cessation for many patients[21,22]. However, patients with lung cancer or CAD may continue to smoke due to stress, lower readiness or motivation to quit, lower self-confidence in being able to quit, prior failures to quit using other evidence-based cessation methods, or the lack of smoking cessation advice or support[23,24]. Recent surveys in Australia have shown that current smokers report higher levels of awareness, interest in and use of e-cigarettes as aids to quit smoking compared to ex-smokers[25,26]. Also, a study of hospitalised smokers in Australia found that while few of the 600 participants reported using e-cigarettes in their previous quit attempts, almost one-third showed interest in using e-cigarettes in any future attempts[27]. However, no studies have specifically focused on patients in cardiothoracic surgery.

This mixed-methods study aims to assess the perceptions of patients with lung cancer and CAD on the use of e-cigarettes to reduce tobacco smoking in the perioperative period of cardiothoracic surgery.

METHODS

Design

A convergent mixed-methods study, using a survey and a semi-structured interview, was conducted between October 2015 and November 2016, to assess e-cigarette perceptions in the cardiothoracic surgery perioperative period. Face-to-face interviews added depth to the survey responses and explored patients' views on e-cigarettes to corroborate and interpret the findings[28].

Ethics approval was obtained from the Northern Sydney Local Health District Hospital Ethics Committee (LNR/15/HAWKE/356), and the six Sydney hospitals. The three public tertiary referral hospitals and three private hospitals in the study were responsible for 43% of cardiothoracic surgery cases in NSW in 2016, with patients from urban, rural and remote areas, thereby increasing generalisability[29].

Study population

Inclusion and exclusion criteria

The study population comprised patients aged 18 years or older, who had a self-reported smoking status of either every day, most days, or were recent ex-smokers of < 12 months at time of attendance at either a preadmission clinic (PAC) or inpatient ward, at one of the six hospitals in Sydney. All patients had a diagnosis of lung cancer or CAD and were scheduled for elective coronary artery bypass surgery (CABG) or thoracic surgery related to their cancer. Patients with a current or former history of smoking for one year, or less, at time of preoperative interview were purposefully included, as under-reporting of smoking status is common due to fear of medical judgement[30,31] and surgery cancellation[32] and the period from diagnosis to elective cardiothoracic surgery in NSW can vary from days to months[33].

Eligible patients were identified by clinical personnel, either from a patient's hospital records or from discussions with the patient at the preadmission clinic, or in a cardiothoracic ward. Each patient that was included in the study gave written informed consent. After the survey and interview, each patient was offered participant information and advice in accordance with NSW Health smoking cessation guidelines[34].

Data collection

The patient survey (Appendix A) was modelled on two studies of non-cardiothoracic patients in preadmission

clinics in the US[8,9] with two additional questions and so comprised 39 items. The online survey was administered via a touchscreen tablet computer (iPad, Apple Inc), and recorded using Qualtrics software (Qualtrics, Provo, UT). Immediately after completion of the survey, a semi-structured interview, based on the same questions as the survey, was conducted to gain a deeper understanding of patients' beliefs and perceptions about e-cigarettes, both in general and in the preoperative period of cardiothoracic surgery. Interviews were digitally recorded, and each interview continued until the patient had no new information to add. The mean completion time for the survey and interview in total was 45 minutes (range 27–60 minutes).

Data collection ceased after 62 patients, when 'theoretical saturation' was reached, the point at which no new concepts emerged from reviewing successive data from a sample that is diverse in pertinent characteristics and experiences[28]. All surveys and interviews were administered and conducted in a private area of a PAC or ward by the same researcher (NAL), a senior physiotherapist and academic with over 20 years' international clinical experience in cardiothoracic surgical care. The researcher was independent of the other health professionals involved in patients' perioperative care.

Measures

Participant characteristics

Characteristics recorded included age, gender, ethnicity, education, residential area and baseline smoking history, as well as current smoking status, previous quit attempts and methods, and the Fagerström test for nicotine dependence (FTND)[35].

Self-efficacy, referring to a patient's perceived ability to stop smoking in the perioperative period, was assessed using questions about a patient's intention to quit smoking in the future (yes/no) and the likelihood of abstinence after surgery, using a five-point Likert scale from one (very unlikely) to five (very likely) (Questions 18 and 19, Appendix A). Surgical health risk index (SHI) was used to assess the knowledge of health risks of tobacco smoking related to surgery, and the risks of tobacco smoking on perioperative complications. The four questions of the SHI (Appendix A) were scored by summing the number of 'agree' responses. These measures have been previously used in perioperative patient populations[8,9,36]. Patients' perceptions of e-cigarettes were examined using previously developed questions[8,9] (Appendix A) and included: four items to assess interest in using e-cigarettes to reduce perioperative cigarette use; four items to assess perceived benefits of perioperative e-cigarette use; and four items to assess perceived barriers to perioperative e-cigarette use. Interest referred to patients' beliefs about, and willingness to try, e-cigarettes to help reduce or abstain from tobacco cigarettes around the time of surgery. Perceived benefits referred to whether e-cigarettes could help patients cope without tobacco cigarettes around the time of surgery as well as to do better before and/or after surgery. Perceived barriers referred to safety, cost, difficulty, and whether the patients had other concerns rather than try e-cigarettes around the time of surgery. Items and categories were assessed using a five-point Likert scale from strongly disagree to strongly agree.

Data analysis

The surveys and interviews were initially analysed separately, and then the results compared with the qualitative findings helping to inform and better frame the quantitative survey findings[28]. Characteristics of patients, including smoking history, self-efficacy and SHI, interest in, perceived benefits of and perceived barriers to e-cigarette use are summarised in Table 1. Patients were categorised as current smokers (self-reported smoking occasionally or daily in the 2 weeks prior to research interview), recent ex-smokers (self-reported smoking occasionally or daily until cessation 2–8 weeks prior to interview) and longer-term ex-smokers (self-reported smoking occasionally or daily until cessation 8–52 weeks prior to interview). Patients with prior e-cigarette use were termed ever-users and those with no prior use were termed never-users.

One-way analysis of variance (ANOVA) was used to examine in-group differences on surgical risk, interest, perceived benefits, perceived barriers and FTND according to smoking status (current/recent ex-smoker/longer-term ex-smoker, ever/never e-cigarette use). Self-efficacy in terms of intention to quit after surgery was also examined according to

Table 1. Characteristics of patients (N=62)

Characteristic	Class statistic	Current smoker (n=32)	Recent ex-smoker (n=18)	Longer term ex-smoker (n=12)	Total N=62
Sex	Male	25 (78%)	9 (50%)	11 (92%)	46 (74%)
	Female	8 (35%)	7 (39%)	1 (8%)	16 (26%)
Age (y)	25–40	4 (12%)	0 (0%)	0 (0%)	4 (7%)
	40–54	8 (25%)	4 (22%)	0 (0%)	12 (19%)
	55–64	11 (34%)	2 (11%)	6 (50%)	21 (31%)
	65–84	9 (28%)	12 (67%)	6 (50%)	27 (43%)
Highest level of education	< Year 12	16 (42%)	6 (33%)	3 (25%)	25 (40%)
	Year 12	10 (31%)	11 (61%)	8 (67%)	29 (47%)
	Tertiary	6 (19%)	1 (6%)	1 (8%)	8 (13%)
Age started smoking	< 18 years	21 (66%)	10 (56%)	9 (75%)	40 (65%)
	≥ 18 years	11 (34%)	8 (44%)	3 (25%)	22 (35%)
Location	Metropolitan	17 (53%)	12 (67%)	9 (75)	38 (61%)
	Regional	15 (47%)	7 (38%)	9 (25)	24 (39%)
Ethnicity	Australian	6 (19%)	4 (22%)	2 (17)	12 (19%)
	ABTSI	5 (16%)	1 (5%)	0 (0%)	6 (10%)
	European	16 (50%)	9 (50%)	5 (42)	30 (48%)
	Other	5 (16%)	4 (22%)	5 (42%)	14 (22%)
Type of surgery	Thoracic	8 (25%)	4 (22%)	3 (25%)	14 (22%)
	Cardiac	24 (75%)	14 (78%)	9 (75%)	48 (77%)
Current number of cigarettes	<10/day	23 (72%)	0 (0%)	0 (0%)	23 (37%)
	≥10/day	10 (32%)	0 (0%)	0 (0%)	10 (16%)
Plan to stay off cigarettes after surgery	Yes	28 (90%)	17 (94%)	11 (92%)	56 (90%)
The likelihood of staying off tobacco smoking after surgery (self-efficacy)	Very likely	6 (18%)	10 (56%)	8 (67%)	24 (39%)
	Likely	12 (38%)	4 (22%)	3 (25%)	19 (30%)
	Undecided	8 (25%)	4 (22%)	1 (8%)	13 (21%)
	Unlikely	6 (19%)	0 (0%)	0 (0%)	6 (10%)
	Very unlikely	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Prior quit attempt in last year	Yes	20 (46%)	15 (35%)	8 (19%)	43 (69%)
Prior use of e-cigarettes	Yes	6 (20%)	7 (41%)	2 (13%)	15 (24%)
Current use of e-cigarettes	Yes	0	1 (6%)	0	1 (1%)
Fagerström test for nicotine dependence[a]	Mean (SD)	4.1 (1.9)	4.9 (1.7)	3.0 (1.4)	4.1 (1.9)
Surgical health risk index (four items, max score = 4)[b]	Mean (SD)	2.8 (1.5)	3.2 (1.2)	3.1 (1.3)	2.9 (1.4)
Sum of interest in e-cigarettes around the time of surgery (four items, max score = 20)[b]	Mean (SD)	12.4 (4.1)	9.4 (4.0)	8.3 (2.8)	10.7 (4.2)
Perceived benefits of using e-cigarettes around the time of surgery (four items, max score = 20)[b]	Mean (SD)	12.5 (4.1)	9.6 (4.0)	9.5 (3.0)	11.1 (4.1)
Perceived barriers to using e-cigarettes around the time of surgery (four items, max score = 20)[b]	Mean (SD)	11.8 (2.0)	12.6 (2.0)	13.6 (1.5)	12.3 (2.0)

a Higher scores indicate more nicotine dependence. b Descriptions and indices calculated as described in the methods. ABTSI: Aboriginal or Torres Strait Islander descent.

smoking status and perceptions of e-cigarettes using ANOVA. Chi-squared tests were used to examine association between e-cigarette perceptions and use with demographics and self-efficacy. All tests were performed using SPSS Version 21 (IBM Corporation), and $p<0.05$ was defined as statistically significant.

Analysis of the survey data revealed different perceptions of e-cigarettes in the perioperative period according to patients' smoking status (Table 1) but not by disease or other demographic characteristics. These findings formed the predetermined coding structure for the qualitative interview data to identify

key reasons and explanations of patients' perceptions towards e-cigarette use. This approach to content analysis allowed the integration and connection of the quantitative and qualitative data in the study[37,38]. NVivo 11 (QSR International Pty Ltd, Melbourne, 2018) was used for interview data organisation and retrieval[39]. The following techniques were used for scientific rigour: audiotaping and independent preparation of the transcripts; standardised coding and data analysis; use of researchers with diverse clinical and statistical backgrounds; and the creation of an audit trail to document analytic decisions[40].

RESULTS

Baseline characteristics of patients

Most patients were male, older than 65 years, and had started smoking under the age of 18 years (Table 1). Of the 62 patients, over half were current smokers, and one-third of all patients had quit tobacco smoking less than eight weeks ago (recent ex-smokers). Most patients had made at least one quit attempt previously, primarily through abrupt cessation, with over a third of patients making multiple attempts using other methods such as medical advice from their general practitioner, NRT (patches, gum or inhaler) and varenicline. Eleven patients had never previously made a quit attempt. Of the 15 patients who had prior experience with e-cigarettes, six had bought them to try to quit tobacco, and eight had been given them by family or friends. Almost all patients (94%) were recruited from public hospitals, as patients in the private hospitals self-reported quitting more than a year before their preadmission interview.

Patients were scheduled for cardiothoracic surgery within 4 weeks (±4 weeks) at the time of research interview. Over half reported being current smokers (1±0.2 days), one-third were recent ex-smokers (7±1.5 weeks), and a fifth were longer-term ex-smokers (34±10.5 weeks). Most patients (90%) intended to stay off smoking after surgery, however, current smokers had lower self-efficacy to abstaining from tobacco cigarettes after surgery, with fewer current smokers reporting that they were likely or very likely to remain abstinent after surgery (56%) compared to longer-term ex-smokers (83%) (p=0.021, OR=0.26, 95% CI: 0.078–0.843).

Interestingly, the perceived benefits of, barriers to and interest in e-cigarette use in the perioperative period of surgery significantly differed according to a patient's smoking status (Figure 1) and prior experience with e-cigarettes. Appendix B summarises the perceptions of and interest in e-cigarettes during the perioperative period by smoking status, in a similar manner to the US studies on which this study was modelled[8,9].

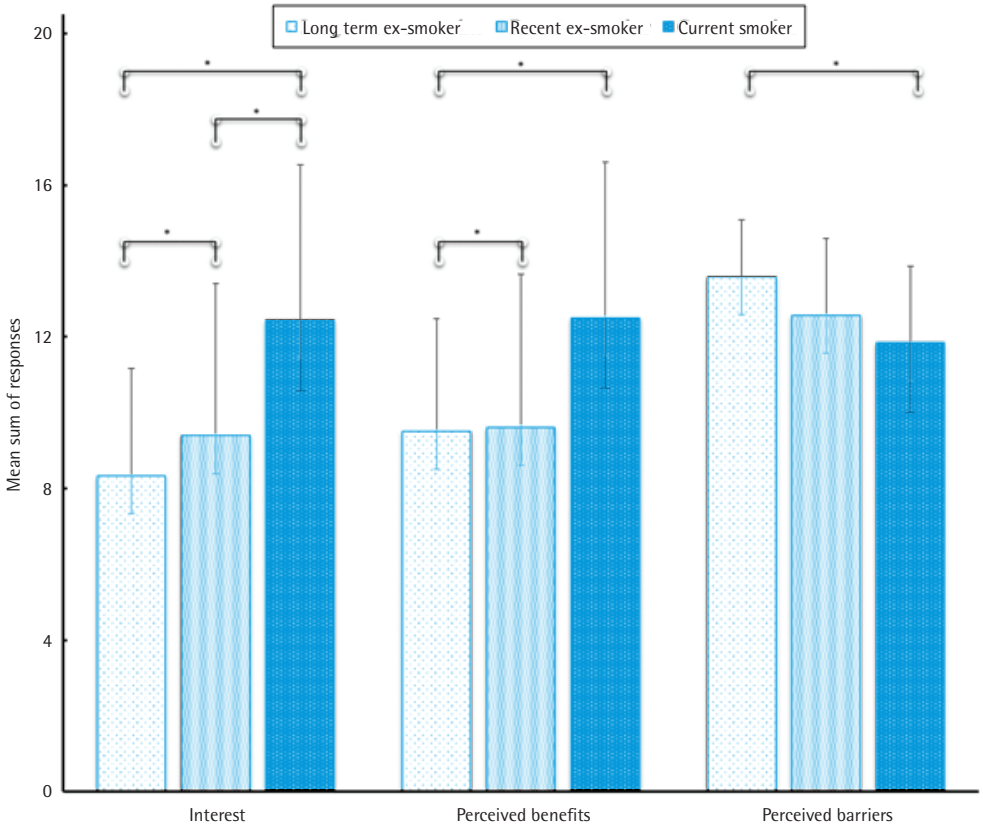
Interest in e-cigarette use in the perioperative period

Both current smokers and recent ex-smokers had significantly higher levels of interest in the use of e-cigarettes around the time of surgery compared to longer-term ex-smokers (Figure 1). The interviews revealed that the interest in e-cigarettes by patients who were either smoking or had recently quit reflected their desire to stop smoking in the perioperative period. The primary reason for interest in e-cigarettes was their novelty compared to other cessation methods. Many patients had tried to quit using abrupt cessation, NRT in its various forms, or pharmacotherapy in previous years and following their recent diagnosis, surgeon-patient interview, or hospitalisation. Of the 32 current smokers, 12 (38%) had been unsuccessful with their previous chosen method, which included: varenicline (stopped due to reported adverse psychological effects); over-the-counter NRT patches without assistance; or abrupt cessation (the most common method previously used). Of the 18 recent ex-smokers, 12 (67%) were not confident in their ability to abstain using their current method, which was predominantly abrupt cessation and over-the-counter NRT patches without assistance. For eight of the 12 recent ex-smokers, this was their second or third attempt at quitting, but none reported seeking or being offered any formal support, such as from a Quitline telephone service or from a tobacco cessation counsellor.

Eleven (34%) of current smokers felt that the benefit of e-cigarettes was the potential to fill the void created by quitting tobacco cigarettes, replicate the hand-to-mouth action or continue the habits associated with smoking, as highlighted by a patient still smoking at the time of the PAC interview:

'It's the holding thing that e-cigarettes might help me with. That's what I've missed with the other [NRT].

Figure 1. Interest in, perceived benefits of and barriers to the use of e-cigarettes in the perioperative period of cardiothoracic surgery



(SD bars included; *=p<0.05)

When I was in hospital I was in acute [coronary] care – every ten minutes I was getting up and going out for a cigarette.' (P.15)

Recent ex-smokers reported higher nicotine dependency (FTND=4.89±0.39, p=0.03) in the survey, compared to current smokers or longer-term ex-smokers. Of the 18 recent ex-smokers, eight (44%) expressed strong feelings of nicotine cravings during the interviews, and were interested in the role of e-cigarettes to reduce their risk of relapse back to tobacco smoking before surgery:

'I would try one if I knew it would help me with all my cravings. I was going to buy two packets [of tobacco] and put them in the cupboard, because no one will buy for me. I don't know what to do. It's always been my best friend.' (P.23)

There were patients who were uninterested in e-cigarettes. All longer-term ex-smokers professed to having neither the knowledge nor the interest in e-cigarettes as they had quit tobacco smoking and did not want to create another habit or nicotine dependence:

'I wouldn't try e-cigarettes again. I wouldn't go back to using any cigarettes because I don't want the nicotine addiction again.' (P.27)

Other reasons for their lack of interest in e-cigarettes included: e-cigarettes were an ineffective method of quitting, based on personal experiences (2 recent ex-smokers and 2 current smokers); the patients were more confident in their ability to remain off tobacco without any cessation aid due to the support of family (2 recent ex-smokers); the patients were not interested in quitting smoking before or after surgery (4 current smokers). These patients had CAD and either had family members who had continued smoking after cardiac surgery in previous years, concurrent illicit drug use, or comorbidities such as HIV and depression.

Perceived benefits to using e-cigarettes in the perioperative period

Current smokers and recent ex-smokers perceived significantly more benefits in the use of e-cigarettes around the time of surgery compared to longer-

term ex-smokers (Figure 1). There was a general uncertainty about the contents of e-cigarettes, yet a higher proportion of current smokers (50%) and recent ex-smokers (48%) considered e-cigarettes to be better for their health compared to tobacco smoking in the perioperative period, which they knew would cause 'problems' during or after surgery. Again, recent ex-smokers considered the benefits of e-cigarettes were a means of tobacco harm reduction and relapse prevention:

'I don't know if it will help me do better after surgery, but I would try one as I must try to stay off cigarettes. I don't know how long I can stay off smoking.' (P.42)

However, current smokers' views were more pragmatic, with e-cigarettes deemed a healthier form of nicotine delivery compared to smoking:

'I have been tempted to try one. You're not getting rid of the nicotine but you're getting rid of all the other crap which is doing you more damage than the nicotine.' (P.25)

Patients who were neutral to or disagreed with the survey questions on e-cigarette benefits (Appendix A) had diverse reasons. Among the 32 current smokers, 6 (19%) reported that they enjoyed tobacco smoking, knew 'their enemy' in tobacco and preferred it to any alternative, whereas among the 18 recent ex-smokers, 6 (33%) were wary about e-cigarettes and their ability to create a personal temptation to relapse, particularly among those missing the taste or act of smoking:

'It might lead me back to smoking. It's the same trigger isn't it? It's the same – you're inhaling, you're holding something.' (P.9)

Negative views of the benefits of e-cigarettes were expressed by 4 of the 15 patients with prior use of e-cigarettes due to either personal adverse symptoms of nausea or coughing at first use, or negativity from family or the media:

'It made me very healthy for a year. But when they said to me that it [continuing vaping] was very dangerous, I gave it up straight away. We heard it on the news. That's why I stop it and went back to smoking.' (P.32)

Perceived barriers to using e-cigarettes in the perioperative period

Longer-term and recent ex-smokers perceived more barriers to the use of e-cigarettes than current smokers (Figure 1), with safety and the unknown risks of e-cigarettes and their constituents commonly cited as a barrier. This view was more prominent among those patients with prior negative experiences of e-cigarettes, recent ex-smokers who viewed e-cigarettes as a temptation back to smoking (55%), and among 83% of the 12 longer-term ex-smokers who had reported little knowledge or interest in e-cigarettes:

'I don't know about them what I can say, it's smoking whether it's electronic or not, it is dangerous. If you're smoking that's not good for your health.' (P.30)

Other longer-term ex-smokers (7%) regarded e-cigarettes a backwards step, implying that the person did not really want to quit:

'I think they're disgusting, they're smoking cigarettes anyway. What's the point? Users have no willpower [to quit].' (P.60)

The barrier of learning how to use an e-cigarette was expressed mostly by older patients (age 65–84 years) who had been smoking for over 20 years, were either current smokers (21%) or had recently quit (15%) and had no e-cigarette experience. However, among most other current smokers, fewer barriers to e-cigarette use around the time of surgery were perceived, with 25 (79%) strongly stating that e-cigarettes had to be safer than tobacco smoking:

'What aren't you getting? 90% of the chemicals that a cigarette has.' (P.11)

DISCUSSION

This is the first Australian study to report on the perceptions of e-cigarettes of patients with lung cancer and CAD awaiting cardiothoracic surgery. Patients' smoking status likely predicts their perceptions of benefits, barriers and interest in e-cigarettes as a smoking cessation tool in the perioperative period. Patients who were current smokers or had recently quit showed particular interest in e-cigarettes to improve their surgical outcomes and to reduce tobacco harm compared to longer-term ex-smokers. E-cigarettes were perceived negatively by ex-smokers who either firmly identified themselves as a 'non-smoker' or were more uncertain of the efficacy of e-cigarettes in helping people remain abstinent from smoking. For current smokers and recent ex-smokers who feel incapable

of negotiating the constant challenge of perioperative tobacco abstinence and have previously failed a quit attempt or have relapsed in the perioperative period, completely switching to e-cigarettes, coupled with proactive cessation support and counselling, may be a novel method to achieve and maintain tobacco abstinence.

Findings from studies in the US[8,9] have also indicated that current smokers, irrespective of their prior e-cigarette use, were more likely to be interested in e-cigarettes to reduce tobacco use prior to surgery. However, these studies did not include self-reported ex-smokers, or patients at different stages of preoperative quit attempts. This study has identified recent ex-smokers who quit 2–8 weeks prior to preoperative research interview as a *distinct group* that should be specifically considered by clinicians and policy-makers as candidates for e-cigarette assisted smoking cessation. Whilst these patients demonstrated motivation to quit smoking prior to surgery, they also displayed characteristics associated with a propensity for relapse, such as higher nicotine dependency, a long history of smoking, multiple failed quit attempts and low self-efficacy compared to longer-term ex-smokers. These recent ex-smokers had higher expectations that e-cigarettes would maintain their quit attempt by providing behavioural cues or offering a sufficient tobacco substitute. However, whilst some of these patients had used NRT patches in prior quit attempts, it had not been in conjunction with oral NRT, or with any means of formal cessation support. Therefore, in a post-quit period of approximately one month, patients who are demonstrating high nicotine dependence and who are at high risk of relapse[41,42] could be offered either NRT or e-cigarettes, together with smoking cessation advice and support as a short-term aid to sustain their quit attempt, maintain tobacco abstinence and reduce surgical risk.

The positive attitudes of current smokers to e-cigarettes as a means to quit smoking in this study mirror recent surveys of representative samples of Australian national[43] and State[25] populations and studies amongst lower socioeconomic groups, including people with substance use disorders and mental illness in Australia[44]. There was uncertainty about the safety and risks of e-cigarettes amongst most patients in this study, which is partly attributed to the stringent regulations on the sale of nicotine-containing e-cigarettes in Australia[45]. However, amongst current smokers or recent ex-smokers, e-cigarettes were considered a means of tobacco harm reduction and a tool to reduce or quit smoking, particularly when other methods of cessation had not led to personal tobacco cessation. Prior unsuccessful quit attempts were also suggested as a reason for high levels of interest in e-cigarettes for future quit attempts among hospitalised smokers[27]. However, as e-cigarettes are not included in Australian clinical guidelines for smoking cessation[46], e-cigarettes were not offered as a cessation method[47], thus the effectiveness of e-cigarettes as a novel method for smoking reduction or cessation amongst the patient population has not been examined in Australia. Given that the incidence of tobacco-related diseases such as lung cancer and CAD are higher amongst older and disadvantaged populations in Australia, the positive perceptions of e-cigarettes found in this study and other studies[27,44] indicate that switching to e-cigarettes, coupled with extended cessation support, may be a feasible, novel method[48] to quit tobacco by people with comorbidities for one to three months after hospitalisation[24].

No significant differences were found between a patient's disease and their perceptions of e-cigarettes in this study. However, the characteristics and perceptions of patients awaiting cardiothoracic surgery are comparable to those of international studies of patients recently diagnosed with cardiothoracic diseases or in the perioperative period of non-cardiothoracic surgery. For example, in the US e-cigarette use was reported among post-acute coronary syndrome patients who had reported more lifetime quit attempts and lower confidence in their ability to quit[14], and amongst patients with lung cancer and high nicotine dependence[13]. Also in the US surgical field, patients were interested in e-cigarettes to reduce tobacco consumption in the perioperative period, particularly if they had never used e-cigarettes[8]. Less interest was reported among patients who had unmet expectations of the devices to help them quit tobacco smoking[8,9], or were not interested in quitting tobacco smoking.

While research into the awareness and use of e-cigarettes by the general population is increasing in Australia, this study adds to the limited literature

investigating the use and perceptions of patients with tobacco-related comorbidities. Diagnoses of lung cancer or CAD, hospitalisation and surgery all serve as powerful 'teachable moments' for behavioural change[21], but some patients continue to smoke or relapse for a variety of reasons. The findings of this study and our previous work[23] illustrate that despite a patient's motivation to quit prior to surgery, the delivery and use of evidence-based methods do not necessarily lead to cessation success. Therefore, e-cigarettes coupled with consistent, proactive cessation support both before and after surgery may engage more patients in a quit attempt, be a bridge to evidence-based cessation methods and lead to longer-term, permanent postoperative cessation.

Limitations

The size of our sample, the sampling method and the complex regulatory environment in Australia limits the generalisability of the findings beyond Australia. Similarly, although the sample included patients from diverse backgrounds and demographics from the most populous city and State in Australia, it does represent a very small percentage of the cardiothoracic surgeries by the Australian population. However, using a mixed-methods approach allowed better understanding both of patients' opinions about e-cigarettes and patients' influences on achieving or maintaining tobacco abstinence in the preoperative environment. Fewer patients were recruited with lung cancer and from private hospitals. This was due to smaller number of patients self-reporting smoking in the private PACs, and fewer lung cancer patients attending cardiothoracic surgical PACs at five of the six hospitals. Nonetheless, a strength of this study is the realistic representation of patients who smoke in Australia, their honesty about their smoking and psychosocial histories, and the time given by patients in each interview, allowing a deep insight into their views on tobacco and e-cigarette use. Since the interviews were conducted however, there has been an Australian parliamentary inquiry[49] into e-cigarettes, which resulted in more media discussion about their safety and efficacy as smoking cessation aids. Whilst no changes were made to current regulations on e-cigarette sale and use in Australia, the intense media discussions may have increased patients' awareness of the existence and/or altered some of the patients' views about the risks and benefits of e-cigarettes.

CONCLUSIONS

This study has found that patients with lung cancer and coronary artery disease, who either currently smoke or have recently quit, have positive perceptions of e-cigarettes for reducing tobacco harm in the perioperative period. Patients identified specific roles for e-cigarettes, predominantly as an alternative method when other cessation methods had failed, or as a tool to prevent relapse for those struggling to maintain preoperative tobacco abstinence. The study provides insights for clinicians involved in the care of cardiothoracic surgical patients on why patients may enquire about or use e-cigarettes. It will help clinicians enhance the teachable moment of surgery by offering proactive, long-term evidence-based perioperative cessation support to patients awaiting cardiothoracic surgery, irrespective of their current or recent smoking status.

REFERENCES

1. Glasser AM, Collins L, Pearson JL, et al. Overview of Electronic Nicotine Delivery Systems: A Systematic Review. Am J Prev Med. 2017;52(2):e33-e66. doi:10.1016/j.amepre.2016.10.036
2. National Academies of Sciences E, and Medicine. Public health consequences of e-cigarettes. https://www.nap.edu/resource/24952/012318ecigaretteConclusionsbyEvidence.pdf. Published January, 2018. Accessed August, 2018.
3. Rahman MA, Hann N, Wilson A, Mnatzaganian G, Worrall-Carter L. E-cigarettes and smoking cessation: evidence from a systematic review and meta-analysis. PloS One. 2015;10(3). doi:10.1371/journal.pone.0122544
4. Hartmann-Boyce J, Begh R, Aveyard P. Electronic cigarettes for smoking cessation. BMJ. 2018;360:j5543. doi:10.1136/bmj.j5543
5. van Domburg RT, Meeter K, van Berkel DF, Veldkamp RF, van Herwerden LA, Bogers AJ. Smoking cessation reduces mortality after coronary artery bypass surgery: a 20-year follow-up study. J Am Coll Cardiol. 2000;36(3):878-883. doi:10.1016/s0735-1097(00)00810-x
6. Warner DO. Helping surgical patients quit smoking: why, when, and how. Anesth Analg. 2005;101(2):481-487. doi:10.1213/01.ane.0000159152.31129.84
7. Warren GW, Kasza KA, Reid ME, Cummings KM, Marshall JR. Smoking at diagnosis and survival in cancer patients. Int J Cancer. 2013;132(2):401-410. doi:10.1002/ijc.27617

8. Kadimpati S, Nolan M, Warner DO. Attitudes, beliefs, and practices regarding electronic nicotine delivery systems in patients scheduled for elective surgery. Mayo Clin Proc. 2015;90(1):71-76. doi:10.1016/j.mayocp.2014.11.005
9. Nolan M, Leischow S, Croghan I, et al. Feasibility of Electronic Nicotine Delivery Systems in Surgical Patients. Nicotine Tob Res. 2016;18(8):1757-1762. doi:10.1093/ntr/ntw003
10. Parliament of Australia. Inquiry into the Use and Marketing of Electronic Cigarettes and Personal Vaporisers in Australia. http://parlinfo.aph.gov.au/parlInfo/download/committees/reportrep/024115/toc_pdf/ ReportontheInquiryintotheUseandMarketingofElectronicCigarettesandPersonalVaporisersinAustralia.pdf;fileType=application%2Fpdf. Published March, 2018. Accessed August 6, 2018.
11. Rigotti NA, Chang Y, Tindle HA, et al. Association of e-cigarette use with smoking cessation among smokers who plan to quit after a hospitalization. Ann Intern Med. 2018;168(9):613-620. doi:10.7326/M17-2048
12. Notley C, Ward E, Dawkins L, Holland R. The unique contribution of e-cigarettes for tobacco harm reduction in supporting smoking relapse prevention. Harm Reduct J. 2018;15(1):31.doi:10.1186/s12954-018-0237-7
13. Borderud SP, Li Y, Burkhalter JE, Sheffer CE, Ostroff JS. Electronic cigarette use among patients with cancer: characteristics of electronic cigarette users and their smoking cessation outcomes. Cancer. 2014;120(22):3527-3535. doi:10.1002/cncr.28811
14. Busch AM, Leavens EL, Wagener TL, Buckley ML, Tooley EM. Prevalence, reasons for use, and risk perception of electronic cigarettes among post-acute coronary syndrome smokers. J Cardiopulm Rehabil Prev. 2016;36(5):352-357. doi:10.1097/HCR.0000000000000179
15. Kalkhoran S, Kruse GR, Rigotti NA, Rabin J, Ostroff JS, Park ER. Electronic cigarette use patterns and reasons for use among smokers recently diagnosed with cancer. Cancer Med. 2018;7. doi:10.1002/cam4.1585
16. Kruse GR, Kalkhoran S, Rigotti NA. Use of Electronic Cigarettes Among U.S. Adults With Medical Comorbidities. Am J Prev Med. 2017;52(6):798-804. doi:10.1016/j.amepre.2016.12.004
17. Correa JB, Brandon KO, Meltzer LR, et al. Electronic cigarette use among patients with cancer: Reasons for use, beliefs, and patient-provider communication. Psychooncology. 2018;27(7):1757-1764. doi:10.1002/pon.4721
18. Australian Institute of Health and Welfare. Australia's health 2018. Cat. no. AUS 221. Canberra: AIHW. https://www.aihw.gov.au/getmedia/96909f12-5e9d-4531-a32a-34e414c6b862/aihw-aus-221-chapter-3-2.pdf.aspx. Published June, 2018. Accessed August 26, 2018.
19. Australian Institute of Health and Welfare. Cancer in Australia 2017. Cat. no. CAN 100. Canberra: AIHW. https://www.aihw.gov.au/reports/cancer/cancer-in-australia-2017/contents/table-of-contents. Published February, 2017. Accessed August 26, 2018.
20. Australian Institute of Health and Welfare. Cardiovascular disease snapshot. Cat. no. CVD 83. Canberra: AIHW. https://www.aihw.gov.au/reports/heart-stroke-vascular-disease/cardiovascular-health-compendium/contents/how-many-australians-have-cardiovascular-disease. Published July, 2018. Accessed August 26, 2018.
21. McBride CM, Emmons KM, Lipkus IM. Understanding the potential of teachable moments: the case of smoking cessation. Health Educ Res. 2003;18(2):156-170. doi:10.1093/her/18.2.156
22. Shi Y, Warner DO. Surgery as a teachable moment for smoking cessation. Anesthesiology. 2010;112(1):102-107. doi:10.1097/ALN.0b013e3181c61cf9
23. Luxton NA, MacKenzie R, Shih P. Smoking cessation care in cardiothoracic surgery: A qualitative study exploring the views of Australian clinicians. Heart Lung Circ. 2018. doi:10.1016/j.hlc.2018.04.293
24. Rojewski AM, Baldassarri S, Cooperman NA, et al. Exploring Issues of Comorbid Conditions in People Who Smoke. Nicotine Tob Res. 2016;18(8):1684-1696. doi:10.1093/ntr/ntw016
25. Cancer Institute NSW. NSW Smoking & Health Survey 2015. https://www.cancer.nsw.gov.au/how-we-help/reports-and-publications/nsw-smoking-and-health-survey-2015. Published February, 2018. Accessed August 26, 2018.
26. Australian Institute of Health and Welfare. National Drug Strategy Household Survey 2016: detailed findings. Drug Statistics Series no. 31. Cat. No. PHE 214. Canberra: AIHW. https://www.aihw.gov.au/reports/illicit-use-of-drugs/2016-ndshs-detailed/contents/summary. Published January, 2018. Accessed August 26, 2018.
27. Thomas D, Abramson MJ, Bonevski B, et al. Quitting experiences and preferences for a future quit attempt: a study among inpatient smokers. BMJ Open. 2015;5(4). doi:10.1136/bmjopen-2014-006959
28. Curry L, Nunez-Smith M. Mixed methods in health sciences research: A practical primer. Vol 1. Sage Publications; 2014.
29. Bureau of Health Information. Healthcare Quarterly. Performance Profiles. Elective Surgery. January to March 2018. www.bhi.nsw.gov.au/__data/assets/pdf_file/0011/425567/HQ_32_Profile_SAS_NSW_ES_AllNSW.pdf. Published May, 2018. Accessed August 6, 2018.
30. Morales NA, Romano MA, Cummings KM, et al. Accuracy of self-reported tobacco use in newly diagnosed cancer patients. Cancer Causes Control. 2013;24(6):1223-1230. doi:10.1007/s10552-013-0202-4
31. Attebring MF, Herlitz J, Berndt AK, Karlsson T, Hjalmarson A. Are patients truthful about their smoking

habits? A validation of self-report about smoking cessation with biochemical markers of smoking activity amongst patients with ischaemic heart disease. J Intern Med. 2001;249(2):145-151. doi:10.1046/j.1365-2796.2001.00770.x
32. Glantz L. Should smokers be refused surgery? BMJ. 2007;334(7583):21. doi:10.1136/bmj.39059.532095.68
33. Australian Institute of Health and Welfare. Elective surgery waiting times 2016-17: Australian hospital statistics. AIHW cat. no. HSE 197. https://www.aihw.gov.au/reports/hospitals/ahs-2016-17-elective-surgery-waiting-times/contents/table-of-contents. Published December, 2018. Accessed August 26, 2018.
34. NSW Health. Managing Nicotine Dependence: A Guide for NSW Health Staff. http://www.health.nsw.gov.au/tobacco/Pages/managing-nicotine-dependence.aspx. Published January, 2015. Accessed August 26, 2018.
35. Heatherton TF, Kozlowski LT, Frecker RC, Fagerström K. The Fagerström Test for Nicotine Dependence: a revision of the Fagerström Tolerance Questionnaire. Br J Addict. 1991;86(9):1119-1127. doi:10.1111/j.1360-0443.1991.tb01879.x
36. Yu C, Shi Y, Kadimpati S, et al. Perioperative smoking behavior of Chinese surgical patients. Anesth Analg. 2013;116(6):1238-1246. doi:10.1213/ANE.0b013e31828e5cf0
37. Hsieh HF, Shannon SE. Three approaches to qualitative content analysis. Qual Health Res. 2005;15(9):1277-1288. doi:10.1177/1049732305276687
38. Creswell J, Plano Clark V. Designing and conducting mixed methods research. California: SAGE Publications Inc.; 2011.
39. NVivo qualitative data analysis [computer program]. Version 11, 2017.
40. Mays N, Pope C. Assessing quality in qualitative research. BMJ. 2000;320(7226):50-52.
41. Baker BT, Collins LM, Robin M, et al. Enhancing the effectiveness of smoking treatment research: conceptual bases and progress. Addiction. 2016;111(1):107-116. doi:10.1111/add.13154
42. Borland R, Partos TR, Yong HH, Cummings KM, Hyland A. How much unsuccessful quitting activity is going on among adult smokers? Data from the International Tobacco Control Four Country cohort survey. Addiction. 2012;107(3):673-682. doi:10.1111/j.1360-0443.2011.03685.x
43. Twyman L, Bonevski B, Paul C, Bryant J, Gartner C, Guillaumier A. Electronic Cigarettes: Awareness, Recent Use, and Attitudes Within a Sample of Socioeconomically Disadvantaged Australian Smokers. Nicotine Tob Res. 2016;18(5):670-677. doi:10.1093/ntr/ntv183
44. Department of Health. Therapeutic Goods Administration. https://www.tga.gov.au/node/736223. Published January, 2018. Accessed August 6, 2018.
45. The Royal Australian College of General Practitioners. Supporting smoking cessation: a guide for health professionals. https://www.racgp.org.au/guidelines/smokingcessation. Published December, 2011. Updated July, 2014. Accessed August 26, 2018.
46. Thomas D, Abramson MJ, Bonevski B, et al. Integrating smoking cessation into routine care in hospitals-a randomized controlled trial. Addiction. 2016;111(4):714-723. doi:10.1111/add.13239
47. Heckman CJ, Egleston BL, Hofmann MT. Efficacy of motivational interviewing for smoking cessation: a systematic review and meta-analysis. Tob Control. 2010;19(5):410-416. doi:10.1136/tc.2009.033175
48. Nolan MB, Warner DO. Perioperative tobacco use treatments: putting them into practice. BMJ. 2017;358:j3340. doi:10.1136/bmj.j3340
49. Parliament of Australia. Report on the Inquiry into the Use and Marketing of Electronic Cigarettes and Personal Vaporisers in Australia. https://www.aph.gov.au/Parliamentary_Business/Committees/House/Health_Aged_Care_and_Sport/ElectronicCigarettes/Report. Published, 2018. Accessed October 11, 2018.

ACKNOWLEDGEMENTS
The authors thank the patients who participated in the study and the hospital staff who facilitated the study.

CONFLICTS OF INTEREST
R. MacKenzie reports a grant from the National Cancer Institute, US National Institutes of Health, Grant R01-CA091021. The rest of the authors have also completed and submitted an ICMJE form for disclosure of potential conflicts of interest. The authors declare that they have no competing interests, financial or otherwise, related to the current work.

FUNDING
This work was supported by a Macquarie University Research Excellence Scholarship (to N. A. Luxton), and National Cancer Institute, US National Institutes of Health, Grant R01-CA091021 (to R. MacKenzie). The funding organisations had no role in the design and conduct of the study, collection, management, analysis and interpretation of the data, or preparation, review or approval of the paper.

PROVENANCE AND PEER REVIEW
Not commissioned; externally peer reviewed.

Appendix A: Survey of patients (Qualtrics, iPad)

Q1 Where do you live?
- ❍ Metropolitan Sydney
- ❍ Central Coast and surrounds
- ❍ Rural NSW
- ❍ Remote NSW
- ❍ Other _____

Q2 What is your age?
- ❍ 18-24
- ❍ 25-44
- ❍ 40-54
- ❍ 55-64
- ❍ 65-84
- ❍ 85+

Q3 What is your gender?
- ❍ Male
- ❍ Female

Q4 What is the highest educational qualification you have obtained?
- ❍ Less than Year 12
- ❍ Year 12
- ❍ Certificate
- ❍ Diploma
- ❍ Bachelor's degree
- ❍ Postgraduate qualification
- ❍ Doctorate

Q5 What is your ethnicity?
- ❍ Aboriginal or Torres Strait Islander
- ❍ European
- ❍ Asian
- ❍ Middle East
- ❍ African
- ❍ Other _____

Q6 At what age did you start smoking?
- ❍ < 18 years
- ❍ 18-35 years
- ❍ 35 years and over

Q7 Do you currently smoke?
- ❍ Every day
- ❍ Some days
- ❍ Not at all

Q8 When did you smoke your last cigarette?
- ❍ Today
- ❍ Yesterday
- ❍ Less than 2 weeks ago
- ❍ Less than 4 weeks ago
- ❍ More than 4 weeks but less than 8 weeks ago
- ❍ Within the last year

Q9 The following 6 questions (questions 9-14) will ask about your current smoking habits:
How soon after waking do you smoke your first cigarette?
- ❍ Within 5 minutes
- ❍ 5-30 minutes
- ❍ 31-60 minutes

Q10 Do you find it difficult to refrain from smoking in places where it is forbidden? E.g. Church, Library, Hospital
- ❍ Yes
- ❍ No

Q11 Which cigarette would you hate to give up?
- ❍ The first in the morning
- ❍ Any other

Q12 How many cigarettes a day do you smoke?
- ❍ 10 or less
- ❍ 11-20
- ❍ 21-30
- ❍ 31 or more

Q13 Do you smoke most frequently in the morning?
- ❍ Yes
- ❍ No

Q14 Do you smoke even if you are sick in bed most of the day?
- ❍ Yes
- ❍ No

Q15 Have you tried to quit smoking in the last year?
- ❍ Yes
- ❍ No

Q16 If you have made a quit attempt, what is the longest time you have quit for?
- ☐ Never
- ☐ < 1 month
- ☐ 1-6 months
- ☐ >6 months
- ☐ Don't know

Q17 If you have made a quit attempt how did you do it? Tick all that apply.

- ❑ 'Cold Turkey'
- ❑ Spoke to GP / health professional for advice
- ❑ Nicotine replacement therapy
- ❑ Individual counselling/therapy
- ❑ Quitline
- ❑ Other _____

Q18 Are you planning to stay off smoking after surgery?

- ❍ Yes
- ❍ No

Q19 What is the likelihood of staying off tobacco cigarettes after hospital?

- ❍ Very likely
- ❍ Likely
- ❍ Undecided
- ❍ Unlikely
- ❍ Very Unlikely

Q20 Do you agree with following statements

	Disagree	Neither Agree nor Disagree	Agree
Smoking causes problems with healing after surgery in smokers	❍	❍	❍
Smoking causes lung problems after surgery in smokers	❍	❍	❍
Smoking causes heart problems after surgery in smokers	❍	❍	❍
Quitting smoking will reduce chances of having problems after surgery	❍	❍	❍

Q21 Electronic cigarettes (e-cigarettes) are electronic devices that deliver nicotine in a vapour and look like cigarettes but contain no tobacco. Have you ever heard of or seen an e-cigarette?

- ❍ Yes
- ❍ No

Q22 If you have heard about them or seen them, where did this occur? Tick all that apply?

- ❑ In-person conversation
- ❑ Internet
- ❑ When travelling overseas
- ❑ TV or radio
- ❑ Newspapers or magazines
- ❑ Information shared on social media
- ❑ Other _____

Q23 Have you ever tried an e-cigarette?

- ❍ Yes
- ❍ No

Q24 If you have tried an e-cigarette, why?

- ❑ Curiosity
- ❑ To try to quit tobacco cigarettes
- ❑ Easy to use when I can't smoke
- ❑ Safer than tobacco cigarettes
- ❑ Cheaper than cigarettes
- ❑ Other _____

Q25 How likely are you to try e-cigarettes in the future?

- ❍ Strongly Disagree
- ❍ Disagree
- ❍ Neither Agree nor Disagree
- ❍ Agree
- ❍ Strongly Agree

Q26 I would be willing to try e-cigarettes to help me stay off or cut down regular tobacco cigarettes around the time of surgery

- ❍ Strongly Disagree
- ❍ Disagree
- ❍ Neither Agree nor Disagree
- ❍ Agree
- ❍ Strongly Agree

Q27 I think that e-cigarettes could help me stay off or cut down regular tobacco cigarette use around the time of surgery

- ❍ Strongly Agree
- ❍ Agree
- ❍ Neither Agree nor Disagree
- ❍ Disagree
- ❍ Strongly Disagree

Q28 If they were available free of charge, I would try to use them to help stay off or cut down regular tobacco cigarette use around the time of surgery

- ❍ Strongly Agree
- ❍ Agree
- ❍ Neither Agree nor Disagree
- ❍ Disagree
- ❍ Strongly Disagree

Q29 Even if I needed to buy them myself, it would be worth to try e-cigarettes to stay off or cut down regular tobacco cigarettes around the time of surgery

- ❍ Strongly Disagree
- ❍ Disagree
- ❍ Neither Agree nor Disagree
- ❍ Agree
- ❍ Strongly Agree

Q30 Using e-cigarettes instead of smoking regular tobacco cigarettes could help me do better after my surgery

- ❍ Strongly Agree
- ❍ Agree
- ❍ Neither Agree nor Disagree
- ❍ Disagree
- ❍ Strongly Disagree

Q31 E-cigarettes could help me cope with not being able to smoke regular tobacco cigarettes whilst in hospital for my surgery

- ❍ Strongly agree
- ❍ Agree
- ❍ Neither Agree nor Disagree
- ❍ Disagree
- ❍ Strongly Disagree

Q32 It would be better for my health if I could use e-cigarettes around the time of surgery rather than smoking regular tobacco cigarettes

- ❍ Strongly agree
- ❍ Agree
- ❍ Neither Agree nor Disagree
- ❍ Disagree
- ❍ Strongly Disagree

Q33 Using e-cigarettes could help me improve my health around the time of surgery

- ❍ Strongly agree
- ❍ Agree
- ❍ Neither Agree nor Disagree
- ❍ Disagree
- ❍ Strongly Disagree

Q34 It would be hard for me to learn how to use e-cigarettes around the time of my surgery

- ❍ Strongly Agree
- ❍ Agree
- ❍ Neither Agree nor Disagree
- ❍ Disagree
- ❍ Strongly Disagree

Q35 I have too many other things to worry about other than to try e-cigarettes around the time of surgery

- ❍ Strongly Agree
- ❍ Agree
- ❍ Neither Agree nor Disagree
- ❍ Disagree
- ❍ Strongly Disagree

Q36 E-cigarettes would be too expensive for me to use

- ❍ Strongly agree
- ❍ Agree
- ❍ Neither Agree nor Disagree
- ❍ Disagree
- ❍ Strongly Disagree

Q37 I am concerned that e-cigarettes are not safe

- ❍ Strongly agree
- ❍ Agree
- ❍ Neither Agree nor Disagree
- ❍ Disagree
- ❍ Strongly Disagree

Q38 Do you think e-cigarettes or any electronic nicotine delivery systems are allowed to be sold in Australia?

- ❍ Yes
- ❍ No

Q39 Would you try e-cigarettes if they were recommended to you by a health professional, such as your GP or cardiothoracic surgeon, in order to reduce your tobacco smoking now or in the future?

- ❍ Yes
- ❍ No

Appendix B: Interest in, perceived benefits of, and barriers to e-cigarette use (N=62)

	SA	A	NAND	D	SD
Interest					
I would be willing to try e-cigarettes to help me stay off or cut down regular tobacco cigarettes around the time of surgery	1 (1%)	21 (34%)	7 (11%)	18 (29%)	15 (24%)
If e-cigarettes were available free of charge, I would try to use them to help stay off or cut down regular tobacco cigarette use around the time of surgery	6 (10%)	18 (29%)	5 (8%)	28 (45%)	5 (8%)
Even if I needed to buy them myself, it would be worth to try e-cigarettes to stay off or cut down regular tobacco cigarettes around the time of surgery	0 (0%)	17 (27%)	7 (11%)	28 (45%)	10 (16%)
I think that e-cigarettes could help me stay off or cut down regular tobacco cigarette use around the time of surgery	4 (6%)	16 (26%)	13 (21%)	21 (34%)	8 (13%)
Perceived benefits					
E-cigarettes could help me cope with not being able to smoke regular tobacco cigarettes whilst in hospital for my surgery	3 (5%)	16 (26%)	8 (13%)	29 (47%)	5 (8%)
Using e-cigarettes instead of smoking regular tobacco cigarettes could help me do better after my surgery	4 (6%)	16 (26%)	13 (21%)	21 (34%)	8 (13%)
It would be better for my health if I could use e-cigarettes around the time of surgery rather than smoking regular tobacco cigarettes	3 (5%)	19 (31%)	11 (18%)	22 (35%)	5 (8%)
Using e-cigarettes could help me improve my health around the time of surgery	3 (5%)	14 (23%)	12 (19%)	27 (44%)	6 (10%)
Perceived barriers					
It would be hard for me to learn how to use e-cigarettes around the time of my surgery	0 (0%)	10 (16%)	15 (24%)	32 (52%)	5 (8%)
I have too many other things to worry about other than to try e-cigarettes around the time of surgery	3 (5%)	36 (58%)	11 (18%)	10 (16%)	2 (3%)
E-cigarettes would be too expensive for me to use	2 (3%)	14 (23%)	29 (47%)	17 (27%)	0 (0%)
I am concerned that e-cigarettes are not safe	8 (13%)	26 (42%)	13 (21%)	15 (24%)	0 (0%)

Values given as n (%) for the 62 participants. SA: strongly agree; A: agree; NAND: neither agree nor disagree; D: disagree; SD: strongly disagree.

Chapter 5: Discussion and conclusion

5.1 Overview and summary

The literature on electronic cigarettes among patients with tobacco-induced diseases such as coronary artery disease and lung cancer is growing but limited on patients awaiting curative surgical treatment. Since electronic cigarettes entered the global marketplace in 2006, they have increased in popularity, particularly among people who smoke. While the constituents of electronic cigarettes are considered less harmful than those in combustible tobacco cigarettes, significant questions remain about the long-term health effects of electronic cigarettes, as well as the potential harm to non-smokers and young people attracted to the novel devices. These uncertainties have led to an ongoing debate among public health and medical communities on the potential benefits of electronic cigarettes as a tool for smoking cessation or harm reduction.

Regardless of this debate and the uncertainties surrounding electronic cigarettes, their prevalence in the general population is increasing in many countries, including Australia. Internationally, among people with comorbidities, such as CAD and lung cancer, and patients in healthcare settings, the interest and use of electronic cigarettes as a means to reduce or quit smoking is also increasing. Correspondingly, clinicians are reporting an increase in the frequency of conversations with patients about electronic cigarettes, and little clinical guidance exists on this issue. What guidance there is for clinicians varies, with current recommendations ranging from counselling patients to avoid tobacco completely to supporting patients in continuing their quit attempt with an electronic cigarette coupled with information about the uncertainties of their use. Australia has adopted the precautionary approach to electronic cigarettes, and there is limited clinical guidance.

As CAD and lung cancer continue to be among the leading causes of morbidity and mortality in Australia, cardiothoracic surgery has a pivotal role in the management of these diseases. Smoking cessation mitigates surgical risks and deaths in the perioperative period, however not all patients undergoing surgery are able or willing to quit. This thesis examined the awareness and opinions of cardiothoracic clinicians about electronic cigarettes and their potential role in reducing postoperative

complications caused by tobacco smoking and creating a sustained quit attempt. It also examined the awareness, use of and beliefs about electronic cigarettes and their potential role as a smoking cessation aid in the perioperative period in patients diagnosed with CAD or lung cancer awaiting cardiothoracic surgery. A multi-methods research approach, consisting of 52 interviews with cardiothoracic surgical clinicians, and surveys and interviews with 62 patients, was used to develop a multifaceted and in-depth view of the perceived role of electronic cigarettes around the time of cardiothoracic surgery.

The three studies in this thesis reported a variety of views about the challenges and needs of smoking cessation support at a critical clinical period, but all consistently point to the difficulties that patients experience when trying to quit smoking in the perioperative period of cardiothoracic surgery. The findings can be used to inform public health authorities, health administrators, clinicians and patients about the current knowledge of smoking cessation guidelines. Furthermore, the novel, but pragmatic perceptions towards electronic cigarettes and their potential role to reduce smoking in the perioperative period add to the growing body of evidence within Australia that identifies a need for open communication and clear guidance for clinicians and patients about electronic cigarettes, regardless of the regulatory environment and precautionary positions taken by the health organisations and professional societies related to perioperative care, CAD and lung cancer.

This discussion chapter firstly summarises the key findings of the three studies, then discusses the significance and implications of these findings for smoking cessation. It also makes recommendations for future research, smoking cessation practice, and policies on electronic cigarette regulation.

5.2 Summary of findings

Study I: Smoking cessation care in cardiothoracic surgery: A qualitative study exploring the views of Australian clinicians

Study I explored the perceived factors affecting smoking cessation throughout the cardiothoracic perioperative period. It examined Australian cardiothoracic clinicians' perspectives on smoking cessation care given to surgery patients who continue to smoke in the perioperative period and identified the barriers and facilitators to the provision of smoking cessation care. The findings

identified similar barriers to the implementation of smoking cessation guidelines as those reported elsewhere. However the perspectives are unique as the clinicians are from a range of disciplines that care for patients in the field of cardiothoracic surgery in Australia. Factors that contributed to inconsistent smoking cessation were: differing perceptions on whose responsibility and role it is to provide smoking cessation support and advice; different views on patients' need for cessation support; and inadequate workplace training and resources to implement clinical guidelines on smoking cessation. The study revealed the positive influences of individual clinicians' optimism and empathy, and exemplars of coherent teamwork that promote perioperative smoking cessation. The barriers and facilitators identified highlight the need for different approaches and interventions to improve the use of evidence-based guidelines in routine cardiothoracic perioperative practice.

Study II: Electronic cigarettes and smoking cessation in the perioperative period of cardiothoracic surgery: Views of Australian clinicians

Study II explored the knowledge and practices of cardiothoracic clinicians on electronic cigarettes. It examined the opinions of the clinicians about the potential use of electronic cigarettes by patients to reduce or quit tobacco smoking to reduce perioperative complications. The semi-structured interviews with 52 multidisciplinary cardiothoracic clinicians revealed limited knowledge about electronic cigarettes and the Australian regulatory environment surrounding electronic cigarettes. None of the clinicians had been asked by a patient about electronic cigarettes as a method to quit smoking at the time of the study, and there is a diversity in their views about electronic cigarettes which was influenced by their professional role. Clinicians considered that while electronic cigarettes are unlikely to be safe, they are most likely safer than tobacco cigarettes. Due to the lack of scientific evidence and the potential for electronic cigarettes to continue an addiction to either nicotine or smoking behaviours, clinicians do not view electronic cigarettes as a viable smoking cessation method for the general population. Yet in the extraordinary circumstances of surgery, electronic cigarettes are regarded as a potential smoking cessation tool for those patients who are unable to quit or maintain cessation before their cardiothoracic surgery to help reduce their surgical risks.

Study III: Use of electronic cigarettes in the perioperative period: A mixed method study exploring perceptions of cardiothoracic patients in Australia

Study III explored the knowledge and views of 62 patients who were smoking or had recently quit tobacco smoking and were scheduled for cardiothoracic surgery. More specifically the study examined their interest in and perceived benefits and barriers to the use of electronic cigarettes around the time of surgery. All patients except one had heard of or seen an electronic cigarette, and a quarter of the patients had used or were using an electronic cigarette during the study. Sources of information were predominantly family or friends, or the media. There were diverse views about the safety of electronic cigarettes, ranging from strongly negative to strongly positive, with the comparison being the known harm of tobacco use. Compared to ex-smokers who perceived abrupt abstinence as an effective method to quit, current smokers perceived more health benefits and had more interest in electronic cigarette use around the time of surgery. Similarly current smokers considered electronic cigarettes to be either a safer alternative to tobacco or a novel method for quitting. Furthermore, compared to longer-term ex-smokers (eight to 52 weeks of non-smoking), recent ex-smokers, defined as those who quit two to eight weeks ago at the time of the study interview, were more interested in electronic cigarettes, and considered them a useful aid to prevent relapse in the lead up to surgery and manage their nicotine cravings. The key finding of this study was that, in analysis of the data, recent ex-smokers appeared as a distinct group with high nicotine dependency, a long history of smoking, and multiple failed quit attempts. For some patients awaiting cardiothoracic surgery for coronary artery disease or lung cancer who were currently smoking or have recently quit and are experiencing difficulties maintaining smoking abstinence, electronic cigarettes might be considered a short-term novel aid and a bridge to evidence-based methods to reduce harm from continued tobacco use.

5.3 Implications of the findings

Gaining an insight into current views and practices of smoking cessation and electronic cigarettes from both the patient and clinician perspective is paramount in making recommendations for change. The findings from this thesis provided an insight into the views and practices of both patients awaiting cardiothoracic surgery and the multidisciplinary clinicians involved in patients' surgical journey in

private and public hospitals in Sydney, NSW. The thesis findings revealed problematic issues, such as the failure of clinicians to take advantage of the unique opportunity created by the diagnosis and surgery for tobacco-related diseases, and offer all patients tangible cessation support. The thesis also provided a unique insight into the diversity of beliefs about electronic cigarettes among patients and clinicians. The findings also raised questions about how best to inform clinicians about electronic cigarettes, so that they may openly address patients' questions in the perioperative period. Recommendations and suggestions for future research and practice are discussed in greater detail below.

Address research deficits in smoking cessation practice in cardiothoracic surgery

The findings of this thesis uncovered a need to initiate further research to help guide and support future smoking cessation practice in the cardiothoracic perioperative setting. Research needs to address the barriers that prevent the routine provision of evidence-based support to patients (Luxton et al., 2018a). For example, it was revealed that the surgeons, anaesthetists, nurses and physiotherapists affirmed the value of smoking cessation and were motivated to help patients, yet due to the competing demands they faced in the perioperative period, clinicians made judgements about whether providing smoking cessation advice and support was both a feasible and worthwhile component of their role. While understandable, their judgements meant that the teachable moments of diagnosis, hospitalisation and surgery were not used to the benefit of the patient (McBride et al., 2003; Shi & Warner, 2010).

There have been many high-quality studies exploring the provision of smoking cessation advice and support in preadmission clinics and hospitals in Australia (Freund et al., 2009; McCarter et al., 2016; McCrabb et al., 2017; Slattery et al., 2016; Thomas et al., 2015; Webb & Wilson, 2017; Wolfenden et al., 2005, 2009). Yet in the field of CAD, there have been fewer studies that explore the provision of smoking cessation interventions among patients after an acute coronary event (Day et al., 2008; May et al., 2010). Furthermore, to the best of the researcher's knowledge, no studies have explored the provision of cessation support by four different professions in the perioperative cardiothoracic

surgical period in Australia. As highlighted in the thesis introduction, to increase the likelihood of cardiothoracic patients achieving smoking cessation before and after surgery, consistent advice and support should be routinely offered and provided on several occasions for an extended period of time (preoperatively, on ward and post-discharge) by multiple clinical disciplines. Further investigation is required, however, to examine the barriers and facilitators to the provision of advice and offered by other clinical disciplines involved in the surgical journey of cardiothoracic patients, such as pharmacists, ward nurses, and cardiac and pulmonary rehabilitation clinicians, who all play an important role in the care of patients both in the short and longer-term perioperative period.

For hospitals in Australia, there are major challenges to providing evidence-based care and sustaining smoking cessation after discharge. Specific to patients with CAD and lung cancer, research advocates for either novel approaches to assist with long-term cessation or extended cessation support, as noted in the introduction of this thesis. The evidence on sustaining smoking cessation after hospital discharge points to a number of successful methods that hospitals in Sydney, and Australia, could adopt. Methods include the provision of 30-day free cessation pharmacotherapy coupled with automated phone calls using interactive voice response technology (Rigotti et al., 2017), or interactive texting services that deliver motivational messages and education about smoking and cessation in the perioperative period (Nolan et al., 2018). In Australia, there have been positive results in the CAD population, that included patients after CABG, using text-messaging to improve their cardiovascular disease risk factors such as smoking cessation (Chow et al., 2015). Therefore, future studies could explore the effectiveness of pro-actively linking patients to a smoking cessation text-messaging program during their cardiothoracic preadmission clinic visit, and whether such messages provide patients with consistent long-term support, and encourage them to seek help to maintain cessation after hospital discharge.

Address knowledge deficits and negative perceptions among cardiothoracic clinicians

As noted in the introduction to the thesis, international surgical clinicians frequently perceived patients to be uninterested or unwilling to quit smoking.

The novel findings of this thesis are:

- Australian clinicians involved in cardiothoracic patient care perceive similar barriers.
- Patients are aware of the risks of continued smoking to their health and to their surgery.
- Most patients are interested in quitting but have been unsuccessful with prior quit attempts.

Cardiothoracic clinicians would benefit from specific education and training that incorporates these thesis findings to reduce their negative perceptions of patients' attitude to quitting and enhance clinician engagement of smoking cessation. Engagement of clinicians to promote smoking cessation consistently to all patients throughout the perioperative period would require 'top down' changes. For example, health authorities and hospitals should provide exclusive funding to enable the implementation of smoking cessation support for patients, such as specialist preoperative printed resources, on hand access to pharmacotherapy, and in-hospital cessation counsellors available in all areas of the perioperative pathway. Likewise, regular customised in-service training should be encouraged and financially supported for the different disciplines caring for cardiothoracic patients, training which is appropriate to the discipline's working environment and schedule.

In the interim, Australian local health authorities should support and monitor the use and completion of existing training services currently available for their clinicians, including e-learning modules such as the "Smoking cessation: a guide for all staff" from the Health and Education Training Institute (HETI) for NSW Health staff (NSW Government, 2018) or the "Brief Tobacco Intervention Training Program" for WA Health staff (National Drug and Research Institute, 2018), and private hospitals should promote the use of online training programs, such as Quit Learning Hub (Quit Victoria, 2018). With their improved knowledge, clinicians could promote the most suitable cessation support and specifically link patients' awareness and concerns of the risks of smoking to patients' surgical outcomes to increase the likelihood of a quit attempt prior to surgery (Flocke et al., 2014; Webb et al., 2013).

Address the disconnect between smoking cessation guidelines and real-world practice

The beliefs and attitudes of both clinicians and patients towards the effectiveness of abrupt cessation as a smoking cessation method meant that pharmacotherapy or referrals for behavioural support were neither routinely offered, received or considered during the journey from preadmission clinic to hospital discharge. Abrupt cessation is a common method used in both patient and general populations in Australia (Smith et al., 2017; Thomas et al., 2016), yet for patients with smoking-related diseases such as CAD and lung cancer, especially awaiting surgery, quitting is particularly difficult. Sustaining a quit attempt through abrupt cessation may be impossible for some patients due to stress, high nicotine dependence and their environment (Luxton et al., 2018c; Rojewski et al., 2016; Tofler et al., 2013). Evidence suggests that if a patient fails at a cessation attempt, an alternative method should be used in a subsequent attempt (Heckman et al., 2017). Yet some patients will continue to try, and fail, with unaided quit attempts unless clinicians have adequate knowledge of their clinical smoking cessation guidelines and the services available for patient behavioural support (NSW Health, 2015; RACGP, 2014). The findings of this thesis revealed a disconnect between the knowledge and practice of clinicians and the recommendations of the "5A's" approach to smoking cessation guidelines in the newly explored area of Australian cardiothoracic surgery, where continued smoking has a dramatic effect on patients' long-term survivorship.

Developing, providing and promoting access to relevant training on smoking cessation clinical guidelines needs to be addressed to enable cardiothoracic clinicians in both the public and private hospital sectors to be more informed. Possible strategies have been outlined in the smoking cessation framework from the Cancer Institute NSW (2018). However, the framework includes the use of the "5A's" approach to smoking cessation. The review of the extant literature, the view of international experts and the findings of this thesis suggest that adopting the simpler AAR (Ask, Advise, Refer) approach may improve cessation guideline knowledge and improve the provision of cessation support (Nolan & Warner, 2017).

The AAR approach addresses the barriers of limited clinician time, confidence and guideline knowledge found in this thesis and elsewhere, as it does not expect clinicians to have in-depth

knowledge of cessation pharmacotherapies and behavioural support, but rather to have the motivation and knowledge to provide consistent advice to quit and refer patients to those expert in providing smoking cessation. The AAR approach is currently recommended by the professional societies of Australian surgeons and anaesthetists (ANZCA, 2014; RACS, 2015). Furthermore, it was recalled and reported to be used by the majority of the surgeons and anaesthetists in Study I of this thesis. Therefore, it is anticipated that the change in approach would be feasible and acceptable to Australian cardiothoracic clinicians, if provided with the necessary referral resources, onsite patient services to provide cessation counselling, and clinician education and training that includes the evidence base and reasoning behind the change in smoking cessation approach.

Adopt an open, non-judgemental approach to electronic cigarette conversation

The implementation of the smoking cessation framework suggested by Cancer Institute NSW (2018), with or without the adoption of the AAR approach, will take time. In the meantime, patients undergoing surgery for CAD or lung cancer who are either nicotine dependent, have low self-confidence in their ability to quit or view smoking as a stress-reliever may seek other methods, such as electronic cigarettes to either aid their quit attempt before surgery or sustain smoking cessation after hospital (Busch et al., 2016; Correa et al., 2018; Luxton et al., 2018c; Rigotti et al., 2018). In a similar manner to the guidelines promoted in the UK (NICE, 2018) and New Zealand (New Zealand Ministry of Health, 2014, 2018), it is suggested that clinicians and cessation counsellors adopt a more open approach to the conversation about electronic cigarettes, in order to examine and address the underlying environmental, societal and psychological motives for patients' interest in or use of the devices.

The findings of this thesis offer new and important information about such motives. For some patients, the interest in the perceived benefits and use of electronic cigarettes was as a "healthier" alternative to smoking. For others, electronic cigarettes offered a novel method to prevent relapse as they had little confidence in maintaining their quit attempt. These motives should be interpreted by clinicians as a positive step by patients towards cessation (Luxton et al., 2018b, 2018c; Stepney,

Aveyard & Begh, 2018), and a need for nicotine dependence treatment. The new information reported in this thesis will help remove some of the barriers — perceptions of a lack of desire, willpower or ability to quit — to a productive smoking cessation conversation, and help clinicians and patients co-create a cessation plan that involves more evidence-based methods given the complex regulations around electronic cigarettes in Australia.

Consider electronic cigarettes as an aid for prevention of relapse

Cessation pharmacotherapies for nicotine dependence, such as NRT or varenicline, substitute the nicotine from cigarettes with nicotine from gum, patches and/or inhalers, or simulation of nicotinic effects in the brain via medications (varenicline) (Keane, 2013). Patients are often unwilling to use pharmacotherapy, regarding it as unnatural and dependence-forming with serious adverse side effects (Horne & Weinman, 1999; Horne et al., 1999). Despite the efficacy of these treatments, other patients who use pharmacotherapy struggle to maintain their quit attempt and ultimately relapse to smoking in the perioperative period (Kotz, Brown & West, 2014; Luxton et al., 2018a; Thomsen et al., 2014). The novelty of electronic cigarettes, particularly as a consumer product, has been suggested as a reason for their popularity in the general population (Keane et al., 2017). Therefore the interest and use of electronic cigarette use in the patient population in Australia, and elsewhere, is likely to be due to a combination of such factors and more, as discussed in the thesis introduction (Kalkhoran et al., 2018; Luxton et al., 2018c; Rigotti et al., 2018; Thomas et al., 2015). Experts in the area of perioperative smoking cessation propose that this novelty should be harnessed in the perioperative field to encourage more patients to engage in a quit attempt and reduce their tobacco-related surgical risk (Lee et al., 2018; Nolan & Warner, 2017).

While some clinicians and patients considered electronic cigarettes negatively, either as another form of nicotine addiction or a threat to a quit attempt, others perceived the similarities with tobacco smoking as a benefit. There is evidence that electronic cigarettes address the ritualistic aspects of smoking which, for some people who smoke, are considered more desirable than nicotine delivery (Baldassarri et al., 2018b; Dawkins & McRobbie, 2017; Palmer & Brandon, 2018; Pepper & Brewer,

2014; Romijnders et al., 2018). In the perioperative period, patients experience increased stress and anxiety for various reasons, such as fear of postoperative pain, intraoperative awareness, nicotine withdrawal, or their inability to quit or maintain smoking abstinence (Warner et al., 2004; Wetsch et al., 2009). Furthermore, it is well known that smoking is used to cope with stressful situations (Shiffman, 1982; Shiffman et al., 1985). A significant finding of this thesis is that electronic cigarettes were considered largely beneficial to reduce the stress of a life-threatening diagnosis and surgery, and replace the sensorimotor aspect of smoking, in a previously unexplored cohort of patients and clinicians. While it adds to previous research in electronic cigarettes, it poses the question that needs further exploration in Australia: should electronic cigarettes be condoned or recommended for certain patients to sustain their quit attempt before and/or after cardiothoracic surgery?

As previously mentioned, patients face much uncertainty and anxiety due to the fear of pain, surgery, and disease recurrence which makes sustained smoking cessation particularly challenging. Internationally, studies have explored patient interest in and use of electronic cigarettes to quit or reduce tobacco use (Borderund et al., 2014; Busch et al., 2016; Buzcek et al., 2018; Kadimpati et al., 2015; Kalkhoran et al., 2018; Kruse et al., 2017; Sherratt et al., 2016), yet few have explored their interest and use in electronic cigarettes to reduce nicotine cravings (Correa et al., 2018). This thesis presents the first study to explore patients' interest in and views about electronic cigarettes in Australia in the context of cardiothoracic surgery, and adds to, and is consistent with, the views of the general population and vaping communities overseas and in Australia (AIHW, 2017; Glasser et al., 2017; Hajek et al., 2018; Palmer & Brandon, 2018; Romijnders et al., 2018; Twyman et al., 2018).

The implications of the patient findings reported in this thesis are important to current Australian clinical practice. Among patients who had recently quit, irrespective of their underlying disease or sociodemographic characteristics, electronic cigarettes were perceived as a potential aid to manage their urge to smoke and reduce nicotine withdrawal symptoms, two well-known triggers that often lead to smoking lapses during quit attempts (Ferguson, Shiffman & Blizzard, 2009). Relapse to smoking during a quit attempt is greatest in the first few weeks and decreases rapidly over time as the

duration of abstinence extends (Ferguson, Gitchell, Shiffman & Sembower, 2009; Hughes, Keely & Naud, 2004). As noted in the Australian cessation clinical guidelines from the RACGP (2014) and a Cochrane systematic review (Hajek et al., 2013), there is no current intervention that is proven to prevent relapse. Therefore, there remains a need to educate Australian cardiothoracic clinicians and patients about the time periods where risk of relapse is higher, in order to improve their awareness and vigilance of nicotine withdrawal symptoms and increase the provision and acceptance of evidence-based NRT and behavioural support to sustain patients' cessation attempts.

Consider non-nicotine electronic cigarettes in the perioperative period

The presumption that all electronic cigarettes contained nicotine was considered undesirable by some clinicians and patients, and perceived as a barrier to their use as a smoking cessation aid (Luxton et al., 2018b, 2018c). This was a novel finding in the area of electronic cigarette research in Australia. Yet the perception of nicotine causing adverse effects on wound healing after surgery and on the cardiovascular system of patients with established CAD has consistently created a barrier to the routine provision of NRT by clinicians in the perioperative period, despite its proven safety and effectiveness to aid a quit attempt (Benowitz et al., 2018; Lee et al., 2013; Nolan et al., 2016; Thomsen et al., 2014).

Therefore, there are two possible outcomes from this thesis in the cardiothoracic perioperative context in Australia if patients are only interested in using electronic cigarettes to quit smoking. Firstly, in light of the concern about nicotine around the time of cardiothoracic surgery, the option of non-nicotine electronic cigarettes could be discussed with patients as they are legal in Australia, and have been found to be effective in the acute management of cravings to smoke (Palmer and Brandon, 2018; Przulij, McRobbie & Hajek, 2016). Secondly, if a nicotine-containing electronic cigarette is being used, clinicians could suggest patients taper down their nicotine dose to a zero dose (a non-nicotine electronic cigarette) in the lead up to surgery, as trialled in a US study by Lee et al. (2018), preferably coupled with behavioural support. There is uncertainty about the physiological effects of non-nicotine e-liquid constituents and flavourings (Muthumalage et al., 2018), however, short-term use of non-

nicotine electronic cigarettes in maintaining preoperative smoking cessation may be acceptable to Australian patients and clinicians alike.

Respond to current and future use of electronic cigarettes in the patient population

Compared to the US, the use of electronic cigarettes in hospitalised patients in Australia is lower (Harrington et al., 2014; Kapdimpati et al., 2015; Luxton et al., 2018c; Rigotti et al., 2018; Thomas et al., 2015). This is to be expected as electronic cigarettes arrived later to the consumer market in Australia, and their use is influenced by factors such as the views of respected health organisations, the media and the regulatory environment (Yong et al., 2015, 2017). In Australia, as identified throughout this thesis, the regulations are complex and restrictive, and electronic cigarettes are publicly dis-endorsed. Therefore, the high levels of awareness and use of electronic cigarettes among patients, their families and friends was a surprising finding of this thesis, and contrasted with the awareness and views of clinicians, who thought electronic cigarette use in Australia was minimal.

What will determine future use of electronic cigarettes in the patient population in Australia is unclear. Future use may continue to be heavily influenced by the use of electronic cigarettes among friends and family (Lee et al., 2018a; Luxton et al., 2018c), and the regulatory environment (Yong et al., 2017). Yet, future use in patients with smoking-related diseases, such as CAD or lung cancer, may be influenced by the provision, or lack thereof, of cessation support during the short-term perioperative period and longer term during adjuvant cancer or rehabilitation period (Day et al., 2018; Pipe & Reid, 2018). Some patients may either continue or return to smoking, or use self-help alternatives, such as electronic cigarettes, to achieve or sustain their quit attempt. How Australian hospital and healthcare settings enforce the current bans on electronic cigarettes is yet to be revealed. Yet, it is doubtful that such policies will impact patients' use of electronic cigarettes as evidence has shown that the current smoke-free policies are poorly enforced and complied with by inpatients and visitors (Luxton et al., 2018a; Martin et al., 2017; McCrabb et al., 2017).

Address the uncertainties surrounding electronic cigarettes

The uncertainty about the long-term safety of electronic cigarettes was a focus of dialogue throughout this thesis, which requires further rigorous research. This uncertainty is consistent with the reports from recent expert reviews: while electronic cigarettes are likely to be less harmful than combustible tobacco smoking, there is insufficient evidence to allow reliable conclusions on the longer-term health risks and benefits for smoking cessation (McNeill et al., 2018; NASEM, 2018). Clinical judgement on the appropriateness of cessation pharmacotherapies is important to ensure patient safety (RACGP, 2014). However, the likely implications of a clinician's uncertain or negative views towards electronic cigarettes will be to advise patients against their use in the perioperative period. To address the diversity of clinicians' views identified and highlighted throughout this thesis, clear guidance should be created for all clinicians to use to ensure patients are receiving a consistent message about the risks, benefits and uncertainties of electronic cigarettes.

In Australia, the need for customised, accessible education and information to guide conversations about electronic cigarettes has been identified in the perioperative hospital setting (Luxton et al., 2018b, 2018c), but also in other healthcare settings and among other professionals such as those involved with people with the human immunodeficiency virus (HIV) (Bell et al., 2017a); those involved with people with mental illness (Sharma-Kumar et al., 2018a, 2018b); and community pharmacists (Erku et al., 2018). At present in Australia, information for clinicians, health professionals, patients and clients about electronic cigarettes is both challenging to find and to decipher, and clinician guidance is limited (Australian Government Department of Health, 2018; Australian Government National Health and Medical Research Council, 2017; NSW Health, 2018). Creating simple, accessible documents for clinicians and health professionals to use in their patient-clinician discussion, similar to that created by the UK National Institute for Health and Care Excellence (2018), and the New Zealand Ministry of Health (2014, 2018) would address their desire for information and guidance, and ensure patients and clients receive up-to-date, unbiased information.

5.4 Strengths and limitations of the thesis

The research undertaken for this thesis has provided a significant contribution to health research in perioperative smoking cessation care. However, it is important to acknowledge the strengths and limitations of the research.

A pivotal strength of the mixed methods study (Luxton et al., 2018c) was the ability to explore the interest, beliefs and barriers of patients about electronic cigarettes using both quantitative and qualitative methods. A smaller number of patients were recruited compared to the US survey which served as a stimulus for this study (Kadimpati et al., 2015). However, the mixed methods approach allowed for a deeper exploration of patient responses about electronic cigarettes in a cohort of patients previously unexplored in Australia, and the factors that sustained their smoking habits despite imminent life-threatening surgery. While face-to-face interviews are considered costly, time consuming and a source of response bias (Doyle, 2014), they also provide rich sources of data. For example, there was a disconnect between what a patient revealed on their hospital documentation for clinicians, and in their research interview. This supports the notion that smoking status is often under-reported to avoid judgement, stigma or cancellation of surgery, and provides evidence that smoking cessation support may not be offered to patients most in need due to the misleading information they provide on their hospital documentation.

Another limitation was that most patients had CAD rather than lung cancer, and were from public rather than private hospitals. Therefore, their views about electronic cigarettes were not generalisable to all patients awaiting cardiothoracic surgery in NSW and Australia. This was due firstly to the difference in the preadmission pathway between the six hospitals for lung cancer patients, and the nature of lung cancer. Early detection and treatment has been found to increase the chances of survival, thus patients in NSW tend to be admitted for surgery promptly after their positive test results, without routinely attending a preadmission clinic.

Secondly, more patients met the inclusion criteria of recent or current smoking status in the public hospitals compared to the private hospitals. While this limited generalisability of the findings, it was also a strength of the study as it reflects the current smoking rates in Australia, which remain

disproportionately high among people from low socioeconomic status backgrounds compared to higher status backgrounds (AIHW, 2017). State, national and international surveys suggest that current smoking status is associated with higher rates of ever use of electronic cigarettes (AIHW, 2017; Harrold et al., 2015; Hartwell et al., 2017; McMillen et al., 2015; Pepper et al., 2014; Tywman et al., 2015). Therefore, public hospital patients with tobacco-related diseases, of low socioeconomic status and higher nicotine dependence may be more likely to try electronic cigarettes to quit smoking even though they have limited knowledge of where to buy them and what they contain (Boland et al., 2017; Twyman et al., 2018). The findings of this thesis may generate future conversations between clinicians and patients about electronic cigarettes, and encourage open, non-judgemental and supportive discussions to assist patients to quit smoking both before surgery and permanently.

5.5 Future research directions

Findings from this thesis reflect the complex relationship between smoking and the mutual desire of clinicians and patients for cessation before and after surgery for tobacco-induced diseases. Due to the limited clinical research on the perceptions or use of electronic cigarettes in the patient population, there are many avenues for future research.

Although electronic cigarette use among those who smoke in Australia remains lower than in other high income countries, the prevalence is increasing. Survey research is needed to determine the prevalence and reasons for use of electronic cigarettes among people with tobacco-related comorbidities such as cancer, cardiovascular disease and chronic obstructive pulmonary disease, based on surveys conducted in the US (Kalkhoran et al., 2018; Rigotti et al., 2018) among people with comorbidities, and among hospitalised patients. It is likely that the legislative, socio-demographic and cultural differences on electronic cigarettes between the US and Australia will result in more differences than similarities between the survey findings. Yet, as this thesis revealed, the results may be surprising.

Likewise, future quantitative and/or qualitative research of other Australian multidisciplinary professions in cardiothoracic surgery — general practitioners, cardiologists, clinical pharmacists,

social workers and Aboriginal liaison officers — and in other surgical fields, is needed to assess their awareness of clinical cessation guidelines, their current practices of smoking cessation and their opinions of electronic cigarettes. The views from an Australian perspective would add to the body of international studies described in the thesis introduction, enable comparisons between the views of clinicians and health professionals from other high income countries, and assess the influence of the different regulatory environments.

Leading experts on smoking cessation in the perioperative period indicate that electronic cigarettes are both feasible and acceptable as a harm reduction or smoking cessation method and are viewed by patients equally or more favourably than other types of cessation pharmacotherapy (Lee et al., 2018; Nolan et al., 2016; Nolan & Warner, 2017). Therefore, it would be of interest to replicate the US studies of Nolan et al. (2017) and Lee et al. (2018) and explore whether electronic cigarettes are feasible and acceptable in the Australian patient population. However, due to the current precautionary approach of the Australian government, future research to investigate the efficacy of electronic cigarettes as a smoking cessation or harm reduction tool in the perioperative period of other smoking-related diseases, such as peripheral vascular disease, will most likely continue in other high income countries where the sale of nicotine-containing electronic cigarettes is legal.

Nevertheless, the results of these international studies will help determine whether electronic cigarettes are effective in assisting patients to quit smoking in the perioperative period, or hinder cessation and negate the motivation to quit that occurs from the teachable moment of diagnosis and surgery. If proven to be efficacious, funding may be available for Australian trials that include electronic cigarettes in the perioperative period of various surgical specialties where patient smoking rates are known to be high. Currently, national and state-based health organisations provide funding and support for trials that examine the efficacy of electronic cigarettes for smoking cessation and relapse prevention in specific populations such as HIV and drug and alcohol populations (Bell et al., 2017b; Guillaumier et al., 2018). Findings from these trials may lead to changes in the legislation around electronic cigarettes as a form of NRT for certain sub-groups of the Australian population, and enable trials with patients with tobacco-related diseases such as CAD and lung cancer.

References

Abrams, D. B., Glasser, A. M., Pearson, J. L., Villanti, A. C., Collins, L. K. & Niaura, R. S. (2018). Harm minimization and tobacco control: reframing societal views of nicotine use to rapidly save lives. *Annual Review of Public Health*, 39,193-213. doi: 10.1146/annurev-publhealth-040617-013849

Adkison, S. E., O'Connor, R. J., Bansal-Travers, M., Hyland, A., Borland, R., Yong, H. H., ... & Fong, G. T. (2013). Electronic nicotine delivery systems: international tobacco control four-country survey. *American Journal of Preventive Medicine*, *44*(3), 207-215, doi:10.1016/j.amepre.2012.10.018.

Agency for Clinical Innovation, NSW Government (2016). The Perioperative Toolkit. Retrieved from: https://www.aci.health.nsw.gov.au/resources/anaesthesia-perioperative-care/the-perioperative-toolkit/the-perioperative-toolkit-webpage. Accessed 22 October 2018.

Altheide, D. L. & Johnson, J. M. (2011). Reflections on interpretive adequacy in qualitative research. In N. K. Denzin, & Y. S. Lincoln (Eds.), *The SAGE handbook of qualitative research* (pp. 581-594). Thousand Oaks, California. Sage Publications.

Ambrose, J. A. & Barua, R. S. (2004). The pathophysiology of cigarette smoking and cardiovascular disease: an update. *Journal of the American College of Cardiology*, *43*(10), 1731-1737. doi: 10.1016/j.jacc.2003.12.047

American Cancer Society (2018). American Cancer Society Position Statement on Electronic Cigarettes. Retrieved from: https://www.cancer.org/healthy/stay-away-from-tobacco/e-cigarette-position-statement.html. Accessed 22 October 2018.

American Society of Anesthesiologists (2013). Help Your Patients Stop Smoking for Surgery. Retrieved from: https://www.asahq.org/whensecondscount/wp-content/uploads/2017/10/asa_stop_smoking_doctors_final.pdf. Accessed 22 October 2018.

An, L. C., Foldes, S. S., Alesci, N. L., Bluhm, J. H., Bland, P. C., Davern, M. E., ... & Manley, M. W. (2008). The impact of smoking-cessation intervention by multiple health professionals. *American Journal of Preventive Medicine*, *34*(1), 54-60. doi:10.1016/j.amepre.2007.09.019

Australian and New Zealand College of Anaesthetists (2014). Guidelines on Smoking as Related to the Perioperative Period. PSB 12. Retrieved from: http://www.anzca.edu.au/getattachment/resources/professional-documents/ps12bp-2014-guidelines-on-smoking-as-related-to-the-perioperative-period-background-paper.pdf. Accessed 22 October 2018.

Australian Bureau of Statistics (2015). National Health Survey: First Results, 2014-15, cat. no. 4364.0.55.00. Retrieved from: http://www.abs.gov.au/ausstats/abs@.nsf/Lookup/by%20Subject/4364.0.55.001~2014-15~Main%20Features~Heart,%20stroke%20and%20vascular%20disease~13. Accessed 22 October 2018.

Australian Government Department of Health (2018). E-cigarettes. Updated 21 September 2018. Retrieved from: http://www.health.gov.au/internet/main/publishing.nsf/Content/mc16-031907-reduce-the-harm-from-tobacco. Accessed 22 October 2018.

Australian Government National Health and Medical Research Council (HMRC) (2017). NHMRC CEO Statement: Electronic Cigarettes (E-Cigarettes). Retrieved from: https://nhmrc.gov.au/about-

us/publications/ceo-statement-electronic-cigarettes#block-views-block-file-attachments-content-block-1. Accessed 22 October 2018.

Australian Institute of Health and Welfare (2017). National Drug Strategy Household Survey 2016: detailed findings. Drug Statistics series no. 31. Cat. no. PHE 214. Canberra: AIHW. Retrieved from: https://www.aihw.gov.au/reports/illicit-use-of-drugs/ndshs-2016-detailed/contents/table-of-contents. Accessed 22 October 2018.

Australian Institute of Health and Welfare (2018). Australia's health 2018. Australia's health series no. 16. AUS 221. Canberra: AIHW. Retrieved from: https://www.aihw.gov.au/reports/australias-health/australias-health-2018/contents/table-of-contents. Accessed 22 October 2018.

Baldassarri, S. R., Chupp, G. L., Leone, F. T., Warren, G. W. & Toll, B. A. (2018a). Practise patterns and perceptions of chest health care providers on electronic cigarette use: an in-depth discussion and report of survey results. *Journal of Smoking Cessation, 13*(2), 72-77. doi:10.1017/jsc.2017.6

Baldassarri, S. R., Bernstein, S. L., Chupp, G. L., Slade, M. D., Fucito, L. M. & Toll, B. A. (2018b). Electronic cigarettes for adults with tobacco dependence enrolled in a tobacco treatment program: A pilot study. *Addictive Behaviors*, *80*, 1-5. doi:10.1016/j.addbeh.2017.11.033

Barnes, S. B. & Lewin, C. (2011). An introduction to inferential statistics: Testing for differences and relationships. In B. Somekh & C. Lewin (Eds.), *Theory and Methods in Social Research* (2nd ed., pp. 231-240). London: Sage Publications.

Barrera, R., Shi, W., Amar, D., Thaler, H. T., Gabovich, N. & Bains, M. S. (2005). Smoking and timing of cessation: impact on pulmonary complications after thoracotomy. *Chest, 127*(6), 1977-1983. doi:10.1378/chest.127.6.1977

Barrington-Trimis, J. L., Samet, J. M. & McConnell, R. J. J. (2014). Flavourings in electronic cigarettes: an unrecognized respiratory health hazard? *JAMA*, *312*(23), 2493-2494. doi:10.1001/jama.2014.14830

Baumeister, R. F. (2017). Addiction, cigarette smoking, and voluntary control of action: Do cigarette smokers lose their free will? *Addictive Behaviors Reports*, *5*, 67-84. doi:10.1016/j.abrep.2017.01.003

Bayly, M., Scollo, M. M. & Wakefield, M. A. (2018). Who uses rollies? Trends in product offerings, price and use of roll-your-own tobacco in Australia. *Tobacco Control*. Advance online publication. doi: 10.1136/tobaccocontrol-2018-054334.

Beard, E., Brown, J., McNeill, A., Michie, S. & West, R. (2015). Has growth in electronic cigarette use by smokers been responsible for the decline in use of licensed nicotine products? Findings from repeated cross-sectional surveys. *Thorax, 70*(10), 974-8. doi:10.1136/thoraxjnl-2015-206801

Bell, S. K., Mena, G., Dean, J., Boyd, M., Gilks, C. & Gartner, C. (2017a). Vaporised nicotine and tobacco harm reduction for addressing smoking among people living with HIV: a cross-sectional survey of Australian HIV health practitioners' attitudes. *Drug and Alcohol Dependence, 177*, 67-70. doi: 10.1016/j.drugalcdep.2017.03.023

Bell, S., Dean, J., Gilks, C., Boyd, M., Fitzgerald, L., Mutch, A., Baker, P., Neilsen, G. & Gartner, C. (2017b). Tobacco harm reduction with vaporised nicotine (THRiVe): The study protocol of an uncontrolled feasibility study of novel nicotine replacement products among people living with HIV who smoke. *International Journal of Environmental Research and Public Health, 14*(7), 799. doi: 10.3390/ijerph14070799

Benowitz, N. L. (2003). Cigarette smoking and cardiovascular disease: Pathophysiology and implications for treatment. *Progress in Cardiovascular Diseases*, *46*(1), 91-111. doi:10.1016/S0033-0620(03)00087-2

Benowitz, N. L. (2009). Pharmacology of nicotine: addiction, smoking-induced disease, and therapeutics. *Annual Review of Pharmacology Toxicology*, 49, 57-71. doi:10.1146/annurev.pharmtox.48.113006.094742

Benowitz, N. L. & Burbank, A. D. (2016). Cardiovascular toxicity of nicotine: Implications for electronic cigarette use. *Trends in Cardiovascular Medicine*, *26*(6), 515-23. doi:10.1016/j.tcm.2016.03.001

Benowitz, N. L. & Fraiman, J. B. (2017). Cardiovascular effects of electronic cigarettes. *Nature Reviews Cardiology, 14*(8), 447-456. doi: 10.1038/nrcardio.2017.36

Benowitz, N. L. & Prochaska, J. J. (2013). Smoking cessation after acute myocardial infarction. *Journal of the American College of Cardiology*, *61*(5), 533-555. doi:10.1016/j.jacc.2012.11.017

Bhatnagar, A. (2016). Cardiovascular perspective of the promises and perils of e-cigarettes. *Circulation Research*, *118*(12), 1872-1875. doi:10.1161/CIRCRESAHA.116.308723

Bhatnagar, A., Whitsel, L. P., Ribisl, K. M., Bullen, C., Chaloupka, F., Piano, M. R., ... & Benowitz, N. (2014). Electronic cigarettes: a policy statement from the American Heart Association. *Circulation*, *130*(16), 1418-1436. doi: 10.1161/CIR.0000000000000107

Blumenthal, J. A., Lett, H. S., Babyak, M. A., White, W., Smith, P. K., Mark, D. B., ... & NORG Investigators. (2003). Depression as a risk factor for mortality after coronary artery bypass surgery. *The Lancet*, *362*(9384), 604-609. doi:10.1016/S0140-6736(03)14190-6

Bodner, M. E., Miller, W. C., Rhodes, R. E. & Dean, E. 2011. Smoking cessation and counseling: knowledge and views of Canadian physical therapists. *Physical Therapy*, *91*(7), 1051-1062. doi:10.2522/ptj.20100245

Bodner, M. E., Rhodes, R. E., Miller, W. C. & Dean, E. (2012). Smoking cessation and counseling: practices of Canadian physical therapists. *American Journal of Preventive Medicine*, *43*(1), 67-71. doi:10.1016/j.amepre.2012.03.009

Boland, V. C., Mattick, R. P., McRobbie, H., Siahpush, M. & Courtney, R. J. (2017). "I'm not strong enough; I'm not good enough. I can't do this, I'm failing": a qualitative study of low-socioeconomic status smokers' experiences with accessing cessation support and the role for alternative technology-based support. *International Journal for Equity in Health*, *16*(1), 196. doi:10.1186/s12939-017-0689-5

Borderud, S. P., Li, Y., Burkhalter, J. E., Sheffer, C. E. & Ostroff, J. S. (2014). Electronic cigarette use among patients with cancer: characteristics of electronic cigarette users and their smoking cessation outcomes. *Cancer*, *120*(22), 3527-3535. doi:10.1002/cncr.28811

Bottorff, J. L., Seaton, C. L. & Lamont, S. (2015). Patients' awareness of the surgical risks of smoking: Implications for supporting smoking cessation. *Canadian Family Physician*, *61*(12), e562-e569.

Boyatzis, R. E. (1998). *Transforming qualitative information: Thematic analysis and code development.* Thousand Oaks, CA, US: Sage Publications.

Brandon, T. H., Goniewicz, M. L., Hanna, N. H., Hatsukami, D. K., Herbst, R. S., Hobin, J. A., ... & Viswanath, K. (2015). Electronic nicotine delivery systems: a policy statement from the American Association for Cancer Research and the American Society of Clinical Oncology. *Journal of Clinical Oncology: Official Journal of the American Society of Clinical Oncology*, *33*(8), 952. doi:10.1158/1078-0432.CCR-14-2544

Braun, V. & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology, 3*(2), 77-101.

British Thoracic Society (2012). BTS Recommendations for smoking cessation services in secondary care. Retrieved from: https://www.brit-thoracic.org.uk/standards-of-care/guidelines/bts-recommendations-for-smoking-cessation-services-in-secondary-care. Accessed 22 October 2018.

Buczek, E. J., Harrington, K. F., Hendricks, P. S. & Schmalbach, C. E. (2018). Electronic cigarette awareness, use, and perceptions among cancer patients. *Otolaryngology–Head and Neck Surgery (OTO) Open*. Advance online publication. https://doi.org/10.1177/2473974X18774543.

Busch, A. M., Leavens, E. L., Wagener, T. L., Buckley, M. L. & Tooley, E. M. (2016). Prevalence, reasons for use, and risk perception of electronic cigarettes among post-acute coronary syndrome smokers. *Journal of Cardiopulmonary Rehabilitation and Prevention*, *36*(5), 352-357. doi: 10.1097/HCR.0000000000000179

CAN-ADAPTT (2012a). Canadian smoking cessation clinical practice guidelines. Retrieved from; https://www.nicotinedependenceclinic.com/English/CANADAPTT/Guideline/Introduction.aspx. Accessed 22 October 2018.

CAN-ADAPTT (2012b). Surgical outcomes and smoking. Key messages for health care providers and policy makers. Retrieved from: https://www.nicotinedependenceclinic.com/english/teach/siteassets/pages/smoking-fact-sheets2/surgical%20outcomes%20and%20smoking%20fact%20sheet%20for%20healthcare%20providers%20(2014).pdf. Accessed 22 October 2018.

Canadian Nicotine Dependence Service at the Centre for Addiction and Mental Health (2014). Tobacco dependence treatment Frequently asked questions. Retrieved from: https://www.nicotinedependenceclinic.com/english/teach/siteassets/pages/faq/tobaccocessationfaq.pdf Accessed 22 October 2018.

Cancer Council Australia (2018). Statement on e-cigarettes in Australia. Retrieved from: https://canceraustralia.gov.au/sites/default/files/statement_on_e-cigarettes_february_2018_0.pdf. Accessed 22 October 2018.

Cancer Institute NSW (2017). New South Wales Smoking & Health Survey 2015. Retrieved from: https://www.cancer.nsw.gov.au/how-we-help/reports-and-publications/nsw-smoking-and-health-survey-2015. Accessed 22 October 2018.

Cancer Institute NSW (2018). Smoking Cessation Framework for NSW Health Services. Retrieved from: https://www.cancerinstitute.org.au/how-we-help/cancer-prevention/stopping-smoking/nsw-smoking-cessation-framework. Accessed 22 October 2018.

Cancer Research UK (2017). Our policy on e-cigarettes. Retrieved from: https://www.cancerresearchuk.org/about-us/we-develop-policy/our-policy-on-preventing-cancer/our-policy-on-tobacco-control-and-cancer/our-policy-on-e-cigarettes. Accessed 22 October 2018.

Cancer Society of New Zealand (2018). Position Statement: Personal vapourisers (e-cigarettes). Retrieved from: https://cancernz.org.nz/assets/Positions-Statements/Position-statement-E-CIGARETTES-2018-ID-15984-230718-ID-20120.pdf. Accessed 22 October 2018.

Chapman, S. (2014). E-cigarettes: does the new emperor of tobacco harm reduction have any clothes? *The European Journal of Public Health*, *24*(4), 535-536. doi:10.1093/eurpub/cku054

Chapman, S., Bareham, D. & Maziak, W. (2018). The gateway effect of e-cigarettes; Reflections on main criticisms. *Nicotine & Tobacco Research*. Advance online publication. doi: 10.1093/ntr/nty067.

Chow, C. K., Redfern, J., Hillis, G. S., Thakkar, J., Santo, K., Hackett, M. L., Jan, S., Graves, N., de Keizer, L., Barry, T. & Bompoint, S. (2015). Effect of lifestyle-focused text messaging on risk factor modification in patients with coronary heart disease: a randomized clinical trial. *Journal of the American Medical Association, 314*(12), 1255-1263.

Clare, P., Slade, T., Courtney, R. J., Martire, K. A. & Mattick, R. P. (2014). Use of smoking cessation and quit support services by socioeconomic status over 10 years of the national drug strategy household survey. N*icotine & Tobacco Research*, *16*(12), 1647-1655. doi:10.1093/ntr/ntu119

Cobb, N. K. & Abrams, D. B. (2011). E-cigarette or drug-delivery device? Regulating novel nicotine products. *The New England Journal of Medicine*, *365*(3), 193-195. doi: 10.1056/NEJMp1105249.

Cobb, C. O., Hendricks, P. S. & Eissenberg, T. (2015). Electronic cigarettes and nicotine dependence: evolving products, evolving problems. *BMC Medicine*, *13*(1), 119. doi:10.1186/s12916-015-0355-y

Colivicchi, F., Mocini, D., Tubaro, M., Aiello, A., Clavario, P. & Santini, M. (2011). Effect of smoking relapse on outcome after acute coronary syndromes. *The American Journal of Cardiology*, *108*(6), 804-808. doi:10.1016/j.amjcard.2011.04.033

Connerney, I., Shapiro, P. A., McLaughlin, J. S., Bagiella, E. & Sloan, R. P. (2001). Relation between depression after coronary artery bypass surgery and 12-month outcome: a prospective study. *The Lancet*, *358*(9295), 1766-1771. doi:10.1016/S0140-6736(01)06803-9

Cooley, M. E., Sarna, L., Kotlerman, J., Lukanich, J. M., Jaklitsch, M., Green, S. B. & Bueno, R. (2009). Smoking cessation is challenging even for patients recovering from lung cancer surgery with curative intent. *Lung Cancer*, *66*(2), 218-225. doi:10.1016/j.lungcan.2009.01.021

Correa, J. B., Brandon, K. O., Meltzer, L. R., Hoehn, H. J., Piñeiro, B., Brandon, T. H. & Simmons, V. N. (2018). Electronic cigarette use among patients with cancer: Reasons for use, beliefs, and patient-provider communication. *Psycho-Oncology*. *27*(7):1757-1764. doi:10.1002/pon.4721

Crabtree, B. F. & Miller, W. L. (Eds.). (1999). *Doing qualitative research*. (2nd ed). Thousand Oaks, California: Sage Publications.

Creswell, J. W. & Clark, V. L. P. (2017). *Designing and conducting mixed methods research*. Thousand Oaks, California. Sage publications.

Critchley, J. A. & Capewell, S. (2003). Mortality risk reduction associated with smoking cessation in patients with coronary heart disease: a systematic review. *JAMA*, *290*(1), 86-97. doi:10.1001/jama.290.1.86

Dawkins, L. E. & McRobbie, H. (2017). Changing Behaviour: Electronic Cigarettes. British Psychological Society. Retrieved from: http://researchopen.lsbu.ac.uk/1379/. Accessed 22 October 2018.

Day, F. L., Sherwood, E., Chen, T. Y., Barbouttis, M., Varlow, M., Martin, J., Weber, M., Sitas, F. & Paul, C. (2018). Oncologist provision of smoking cessation support: A national survey of Australian medical and radiation oncologists. *Asia-Pacific Journal of Clinical Oncology 14*(6), 431-438. doi: 10.1111/ajco.12876.

De Andrade, M., Hastings, G. & Angus, K. (2013). Promotion of electronic cigarettes: tobacco marketing reinvented? *British Medical Journal*, *347*. doi:10.1136/bmj.f7473

De Bobadilla, J. F., Dalmau, R. & Saltó, E. (2015). Cardiologists and electronic cigarettes. *Revista Española de Cardiología*, *68*(04), 286-289. doi:10.1016/j.rec.2014.08.014

De Genna, N. M., Ylioja, T., Schulze, A. E., Manta, C., Douaihy, A. B. & Davis, E. M. (2017). Electronic cigarette use among counseled tobacco users hospitalized in 2015. *Journal of Addiction Medicine*, *11*(6), 449-453. doi:10.1097/ADM.0000000000000344

Delgado-Rodríguez, M., Medina-Cuadros, M., Martínez-Gallego, G., Gómez-Ortega, A., Mariscal-Ortiz, M., Palma-Pérez, S. & Sillero-Arenas, M. (2003). A prospective study of tobacco smoking as a predictor of complications in general surgery. *Infection Control & Hospital Epidemiology*, *24*(1), 37-43. doi:10.1086/502113

Dockrell, M., Morrison, R., Bauld, L. & McNeill, A. (2013). E-cigarettes: prevalence and attitudes in Great Britain. *Nicotine & Tobacco Research*, *15*(10), 1737-1744. doi:10.1093/ntr/ntt057

Doll, R. & Hill, A. B. (1950). Smoking and carcinoma of the lung; preliminary report. *British Medical Journal, 2*(4682), 739-48.

Douglas, H., Hall, W. & Gartner, C. (2015). E-cigarettes and the law in Australia. *Australian Family Physician*, *44*(6), 415-418.

Doyle, J. K. (2014). Face-to-Face Surveys. In *Wiley StatsRef: Statistics Reference Online*. doi:10.1002/9781118445112.stat06686.

Drummond, M. B. & Upson, D. (2014). Electronic cigarettes. Potential harms and benefits. *Annals of the American Thoracic Society*, *11*(2), 236-242. doi:10.1513/AnnalsATS.201311-391FR

Duffy, S. A., Reeves, P., Hermann, C., Karvonen, C. & Smith, P. (2008). In-hospital smoking cessation programs: what do VA patients and staff want and need? *Applied Nursing Research*, *21*(4), 199-206. doi:10.1016/j.apnr.2006.11.002

Egnot, E., Jordan, K. & Elliott, J. O. (2017). Associations with resident physicians' early adoption of electronic cigarettes for smoking cessation. *Postgraduate Medical Journal*, *93*(1100), 319-325. doi:10.1136/postgradmedj-2016-134058

El-Shahawy, O., Brown, R. & Elston Lafata, J. (2016). Primary care physicians' beliefs and practices regarding e-cigarette use by patients who smoke: a qualitative assessment. *International Journal of Environmental Research and Public Health*, *13*(5), 445. doi:10.3390/ijerph13050445

El Dib, R., Suzumura, E. A., Akl, E. A., Gomaa, H., Agarwal, A., Chang, Y., Prasad, M., Ashoorion, V., Heels-Ansdell, D. & Maziak, W. (2017). Electronic nicotine delivery systems and/or electronic non-nicotine delivery systems for tobacco smoking cessation or reduction: a systematic review and meta-analysis. *British Medical Journal Open, 7*(2). doi:10.1136/bmjopen-2016-012680

Fairchild, A. L., Bayer, R. & Colgrove, J. (2014). The renormalization of smoking? E-cigarettes and the tobacco "endgame". *New England Journal of Medicine*, *370(*4), 293-295. doi: 10.1056/NEJMp1313940

Fairchild, A. L., Lee, J. S., Bayer, R. & Curran, J. (2018). E-cigarettes and the harm-reduction continuum. *New England Journal of Medicine*, *378*(3), 216-219. doi: 10.1056/NEJMp1711991

Farsalinos, K. (2018). Electronic cigarettes: an aid in smoking cessation, or a new health hazard?. *Therapeutic Advances in Respiratory Disease*, 12. doi:10.1177/1753465817744960

Farsalinos, K. E. & Polosa, R. (2014). Safety evaluation and risk assessment of electronic cigarettes as tobacco cigarette substitutes: a systematic review. *Therapeutic Advances in Drug Safety*, *5*(2), 67-86. doi:10.1177/2042098614524430

Farsalinos, K. E., Poulas, K., Voudris, V. & Le Houezec, J. (2016). Electronic cigarette use in the European Union: analysis of a representative sample of 27 460 Europeans from 28 countries. *Addiction*, *111*(11), 2032-2040. doi:10.1111/add.13506

Fereday, J. & Muir-Cochrane, E. (2006). Demonstrating rigor using thematic analysis: A hybrid approach of inductive and deductive coding and theme development. *International Journal of* Q*ualitative Methods, 5*(1), 80-92.

Ferguson, S. G., Shiffman, S., Gitchell, J. G., Sembower, M. A. & West, R. (2009). Unplanned quit attempts—Results from a US sample of smokers and ex-smokers. *Nicotine & Tobacco Research*, *11*(7), 827-832. doi:10.1093/ntr/ntp072

Ferguson, S. G., Shiffman, S. & Blizzard, L. (2017). Triggers of smoking lapses over the course of a quit attempt. *Journal of Smoking Cessation*, *12*(4), 205-212. doi:10.1017/jsc.2016.21

Fiore, M. C., Bailey, W. C., Cohen, S. J., Dorfman, S. F., Goldstein, M. G., Gritz, E. R., Heyman, R. B. et al. (2008). Treating tobacco use and dependence. *Clinical practice guideline.* Editor. Rockville, MD: US Department of Health and Human Services, Public Health Service. Retrieved from: https://www.ncbi.nlm.nih.gov/books/NBK63952/. Accessed 22 October 2018.

Flocke, S. A., Step, M. M., Antognoli, E., Lawson, P. J., Smith, S., Jackson, B., ... & Marsh, S. (2014). A randomized trial to evaluate primary care clinician training to use the Teachable Moment Communication Process for smoking cessation counseling. *Preventive Medicine*, *69*, 267-273. doi:10.1016/j.ypmed.2014.10.020

Fracol, M., Dorfman, R., Janes, L., Kulkarni, S., Bethke, K., Hansen, N. & Kim, J. (2017). The surgical impact of e-cigarettes: a case report and review of the current literature. *Archives of Plastic Surgery*, *44*(6), 477. doi:10.5999/aps.2017.00087

Fraser, D., Weier, M., Keane, H. & Gartner, C. (2015). Vapers' perspectives on electronic cigarette regulation in Australia. *International Journal of Drug Policy*, *26*(6), 589-594. doi:10.1016/j.drugpo.2015.01.019

Freund, M., Campbell, E., Paul, C., Sakrouge, R., Lecathelinais, C., Knight, J., ... & Nagle, A. (2009). Increasing hospital-wide delivery of smoking cessation care for nicotine-dependent in-patients: a multi-strategic intervention trial. *Addiction*, *104*(5), 839-849. doi:10.1111/j.1360-0443.2009.02520.x

Fu, S. S., Partin, M. R., Snyder, A., An, L. C., Nelson, D. B., Clothier, B., ... & Joseph, A. M. (2006). Promoting repeat tobacco dependence treatment: are relapsed smokers interested?. *American Journal of Managed Care*, *12*(4), 235-243.

Gaalema, D. E., Leventhal, A. M., Priest, J. S. & Higgins, S. T. (2018). Understanding individual differences in vulnerability to cigarette smoking is enhanced by attention to the intersection of common risk factors. *Preventive Medicine*, *117*, 38-42. doi:10.1016/j.ypmed.2018.09.006

Gajdos, C., Hawn, M. T., Campagna, E. J., Henderson, W. G., Singh, J. A. & Houston, T. (2012). Adverse effects of smoking on postoperative outcomes in cancer patients. *Annals of Surgical Oncology*, *19*(5), 1430-1438. doi:10.1245/s10434-011-2128-y

Gale, N. K., Heath, G., Cameron, E., Rashid, S. & Redwood, S. (2013). Using the framework method for the analysis of qualitative data in multi-disciplinary health research. *BMC Medical Research Methodology, 13*(1), 117-125. doi:10.1186/1471-2288-13-117

Gartner, C. & Hall, W. (2010). Harm reduction policies for tobacco users. *International Journal of Drug Policy, 21*(2), 129-130. doi:10.1016/j.drugpo.2009.10.008

Glantz, S. A. & Bareham, D. W. (2018). E-cigarettes: use, effects on smoking, risks, and policy implications. *Annual Review of Public Health*, 39, 215-235. doi:10.1146/annurev-publhealth-040617-013757

Glasgow, R. E., Stevens, V. J., Vogt, T. M., Mullooly, J. P. & Lichtenstein, E. (1991). Changes in smoking associated with hospitalization: quit rates, predictive variables, and intervention implications. *American Journal of Health Promotion*, *6*(1), 24-29. doi:10.4278/0890-1171-6.1.24

Glasser, A. M., Collins, L., Pearson, J. L., Abudayyeh, H., Niaura, R. S., Abrams, D. B. & Villanti, A. C. (2017). Overview of electronic nicotine delivery systems: a systematic review. *American Journal of Preventive Medicine*, *52*(2), e33-e66. doi:10.1016/j.amepre.2016.10.036

Goniewicz, M. L., Knysak, J., Gawron, M., Kosmider, L., Sobczak, A., Kurek, J., ... & Jacob, P. (2014). Levels of selected carcinogens and toxicants in vapour from electronic cigarettes. *Tobacco Control*, *23*(2), 133-139. doi:10.1136/tobaccocontrol-2012-050859

Goniewicz, M. L., Gawron, M., Smith, D. M., Peng, M., Jacob, I. I. I. P. & Benowitz, N. L. (2017). Exposure to nicotine and selected toxicants in cigarette smokers who switched to electronic cigarettes: A longitudinal within-subjects observational study. *Nicotine & Tobacco Research*, *19*(2), 160-167. doi:10.1093/ntr/ntw160

Grana, R. A. (2013). Electronic cigarettes: a new nicotine gateway?. *Journal of Adolescent Health*, *52*(2), 135-136. doi:10.1016/j.jadohealth.2012.11.007

Gravely, S., Fong, G. T., Cummings, K. M., Yan, M., Quah, A. C., Borland, R., ... & Thrasher, J. F. (2014). Awareness, trial, and current use of electronic cigarettes in 10 countries: Findings from the ITC project. *International Journal of Environmental Research and Public Health*, *11*(11), 11691-11704. doi:10.3390/ijerph111111691

Gritz, E. R., Nisenbaum, R., Elashoff, R. E. & Holmes, E. C. (1991). Smoking behavior following diagnosis in patients with stage I non-small cell lung cancer. *Cancer Causes & Control*, *2*(2), 105-112.

Gritz, E. R., Carr, C. R., Rapkin, D., Abemayor, E., Chang, L. J., Wong, W. K., ... & Chonkich, G. (1993). Predictors of long-term smoking cessation in head and neck cancer patients. *Cancer Epidemiology and Prevention Biomarkers*, *2*(3), 261-270.

Guba, E. G. & Lincoln, Y. S (1981). *Effective Evaluation* (1st ed). Jossey-Bass Publishers, San Francisco.

Guillaumier, A., Manning, V., Wynne, O., Gartner, C., Borland, R., Baker, A.L., Segan, C.J., Skelton, E., Moore, L., Bathish, R. & Lubman, D.I. (2018). Electronic nicotine devices to aid smoking cessation by alcohol-and drug-dependent clients: protocol for a pilot randomised controlled trial. *Trials*, 19(1), 415. doi:10.1186/s13063-018-2786-1

Guimond, A. J., Croteau, V. A., Savard, M. H., Bernard, P., Ivers, H. & Savard, J. (2016). Predictors of smoking cessation and relapse in cancer patients and effect on psychological variables: An 18-month observational study. *Annals of Behavioral Medicine*, *51*(1), 117-127. doi:10.1007/s12160-016-9834-4

Hackshaw, A., Morris, J. K., Boniface, S., Tang, J. L. & Milenković, D. (2018). Low cigarette consumption and risk of coronary heart disease and stroke: meta-analysis of 141 cohort studies in 55 study reports. *British Medical Journal*, *360*, j5855. doi:10.1136/bmj.j5855

Hajek, P., Stead, L. F., West, R., Jarvis, M., Hartmann-Boyce, J. & Lancaster, T. (2013). Relapse prevention interventions for smoking cessation. *Cochrane Database of Systematic Reviews*, *2013*(8), CD003999. doi: 10.1002/14651858.CD003999.pub4.

Hajek, P., Przulj, D., Phillips-Waller, A., Anderson, R. & McRobbie, H. (2018). Initial ratings of different types of e-cigarettes and relationships between product appeal and nicotine delivery. *Psychopharmacology*, *235*(4), 1083-1092. doi:10.1007/s00213-017-4826-z

Hajek, P., Phillips-Waller, A., Przulj, D., Pesola, F., Myers Smith, K., Bisal, N., Li, J., Parrott, S., Sasieni, P., Ross, L., Goniewicz, M., Wu, Q. & McRobbie, H. (2019). A randomized trial of e-cigarettes versus nicotine-replacement therapy. *New England Journal of Medicine, 380*(7),629-637. doi: 10.1056/NEJMoa1808779

Harrington, K. F., Hull, N. C., Akindoju, O., Kim, Y. I., Hendricks, P. S., Kohler, C. & Bailey, W. C. (2014). Electronic cigarette awareness, use history, and expected future use among hospitalized cigarette smokers. *Nicotine & Tobacco Research*, *16*(11), 1512-1517. doi:10.1093/ntr/ntu054

Harrold, T. C., Maag, A. K., Thackway, S., Mitchell, J. & Taylor, L. K. (2015). Prevalence of e-cigarette users in New South Wales. *The Medical Journal of Australia*, *203*(8), 326. doi: 10.5694/mja15.00652

Hartmann-Boyce, J., McRobbie. H., Bullen, C., Begh, R., Stead, L.F. & Hajek, P. (2016). Electronic cigarettes for smoking cessation. *Cochrane Database of Systematic Reviews*, 2016(9), CD010216. doi: 10.1002/14651858.CD010216.pub3

Hartmann-Boyce, J., Begh, R. & Aveyard, P. (2018). Electronic cigarettes for smoking cessation. *British Medical Journal*, 360, doi:10.1136/bmj.j5543.

Hartwell, G., Thomas, S., Egan, M., Gilmore, A. & Petticrew, M. (2017). E-cigarettes and equity: a systematic review of differences in awareness and use between sociodemographic groups. *Tobacco Control, 26*(e2), e85-e91. doi:10.1136/tobaccocontrol-2016-053222

Heart and Stroke Foundation (2018). E-cigarettes in Canada. Retrieved from: https://www.heartandstroke.ca/-/media/pdf-files/position-statements/ecigarettesincanada.ashx?la=en&hash=20392382432A4072BECEB05343467154F6ED929E. Accessed 22 October 2018.

Hecht, S. S., Carmella, S. G., Kotandeniya, D., Pillsbury, M. E., Chen, M., Ransom, B. W. S., Vogel, R. I., Thompson, E., Murphy, S. E. & Hatsukami, D. K. (2015). Evaluation of toxicant and carcinogen metabolites in the urine of e-cigarette users versus cigarette smokers. *Nicotine & Tobacco Research*, *17*(6), 704-709. doi:10.1093/ntr/ntu218

Heckman, B. W., Cummings, K. M., Kasza, K. A., Borland, R., Burris, J. L., Fong, G. T., McNeill, A. & Carpenter, M. J. (2017). Effectiveness of switching smoking-cessation medications following relapse. *American Journal of Preventive Medicine*, *53*(2), e63-e70. doi:10.1016/j.amepre.2017.01.038

Heeschen, C., Jang, J. J., Weis, M., Pathak, A., Kaji, S., Hu, R. S., ... & Cooke, J. P. (2001). Nicotine stimulates angiogenesis and promotes tumor growth and atherosclerosis. *Nature Medicine*, *7*(7), 833-839.

Hendricks, P. S., Cases, M. G., Thorne, C. B., Cheong, J., Harrington, K. F., Kohler, C. L. & Bailey, W. C. (2015). Hospitalized smokers' expectancies for electronic cigarettes versus tobacco cigarettes. *Addictive Behaviors*, *41*, 106-111. doi:10.1016/j.addbeh.2014.09.031

Herbec, A. A., Chang, Y., Tindle, H. A. & Rigotti, N. A. (2018). Smokers' use of electronic cigarettes before, during, and in the month after hospitalization. Findings from the helping HAND 2 study. *Addictive Behaviors*. Advance online publication. doi:10.1016/j.addbeh.2018.10.039

Horne, R. & Weinman, J. (1999). Patients' beliefs about prescribed medicines and their role in adherence to treatment in chronic physical illness. *Journal of Psychosomatic Research*, *47*(6), 555-567. doi:10.1016/S0022-3999(99)00057-4

Horne, R., Weinman, J. & Hankins, M. (1999). The beliefs about medicines questionnaire: the development and evaluation of a new method for assessing the cognitive representation of medication. *Psychology and Health*, *14*(1), 1-24. doi:10.1080/08870449908407311

House of Commons Education Science and Technology Committee (2018). E-cigarettes. HC 505. London: TSO. Retrieved from: https://publications.parliament.uk/pa/cm201719/cmselect/cmsctech/505/50502.htm. Accessed 22 October 2018.

Hughes, J. R., Keely, J. & Naud, S. (2004). Shape of the relapse curve and long-term abstinence among untreated smokers. *Addiction*, *99*(1), 29-38. doi:10.1111/j.1360-0443.2004.00540.x

Ikonomidis, I., Vlastos, D., Kourea, K., Kostelli, G., Varoudi, M., Pavlidis, G., ... & Iliodromitis, E. (2018). Electronic cigarette smoking increases arterial stiffness and oxidative stress to a lesser extent than a single conventional cigarette: An acute and chronic study. *Circulation*, *137*(3), 303-306. doi: 10.1161/CIRCULATIONAHA.117.029153.

Institute for Global Tobacco Control (2018). Country Laws Regulating E-cigarettes: A Policy Scan. Baltimore, MD: Johns Hopkins Bloomberg School of Public Health. Retrieved from: http://globaltobaccocontrol.org/e-cigarette/country-laws-regulating-e-cigarettes.

Jones, R., Nyawo, B., Jamieson, S. & Clark, S. (2011). Current smoking predicts increased operative mortality and morbidity after cardiac surgery in the elderly. *Interactive Cardiovascular and Thoracic Surgery, 12*(3), 449-453. doi:10.1510/icvts.2010.239863

Kadimpati, S., Nolan, M. & Warner, D. O. (2015). Attitudes, beliefs, and practices regarding electronic nicotine delivery systems in patients scheduled for elective surgery. *Mayo Clinic Proceedings*, *90*(1), 71-76. doi:10.1016/j.mayocp.2014.11.005

Kai, T., Maki, T., Takahashi, S. & Warner, D. O. (2008). Perioperative tobacco use interventions in Japan: a survey of thoracic surgeons and anaesthesiologists. *British Journal of Anaesthesia*, *100*(3), 404-410. doi:10.1093/bja/aem400

Kalkhoran, S., Benowitz, N. L. & Rigotti, N. A. (2018). Prevention and treatment of tobacco use: JACC Health Promotion Series. *Journal of the American College of Cardiology*, *72*(9), 1030-1045. doi:10.1016/j.jacc.2018.06.036

Kalkhoran, S., Kruse, G. R., Rigotti, N. A., Rabin, J., Ostroff, J. S. & Park, E. R. (2018). Electronic cigarette use patterns and reasons for use among smokers recently diagnosed with cancer. *Cancer Medicine*. Advance online publication. doi: 10.1002/cam4.1585.

Kanchustambham, V., Saladi, S., Rodrigues, J., Fernandes, H., Patolia, S. & Santosh, S. (2017). The knowledge, concerns and healthcare practices among physicians regarding electronic cigarettes. *Journal of Community Hospital Internal Medicine Perspectives*, *7*(3), 144-150. doi:10.1080/20009666.2017.1343076

Kandra, K. L., Ranney, L. M., Lee, J. G. L. & Goldstein, A. O. (2014). Physicians' attitudes and use of e-cigarettes as cessation devices. *PLoS One*. doi:10.1371/journal.pone.0103462

Keane, H. (2013). Making smokers different with nicotine: NRT and quitting. *International Journal of Drug Policy*, *24*(3), 189-195. doi:10.1016/j.drugpo.2013.01.011

Keane, H., Weier, M., Fraser, D. & Gartner, C. (2017). 'Anytime, anywhere': vaping as social practice. *Critical Public Health*, *27*(4), 465-476. doi:10.1080/09581596.2016.1250867

Khullar, D. & Maa, J. (2012). The impact of smoking on surgical outcomes. *Journal of the American College of Surgeons, 215(*3), 418-426. doi:10.1016/j.jamcollsurg.2012.05.023

Khullar, D. & Schroeder, S. A. (2013). Helping smokers quit around the time of surgery. *The Journal of the American Medical Association, 309*(10), 993-994. doi:10.1001/jama.2013.1702

Kosmider, L., Sobczak, A., Fik, M., Knysak, J., Zaciera, M., Kurek, J. & Goniewicz, M. L. (2014). Carbonyl compounds in electronic cigarette vapors: effects of nicotine solvent and battery output voltage. *Nicotine & Tobacco Research*, *16*(10), 1319-1326. doi:10.1093/ntr/ntu078

Kotz, D., Brown, J. & West, R. (2014). 'Real-world' effectiveness of smoking cessation treatments: a population study. *Addiction*, *109*(3), 491-499. doi:10.1111/add.12429

Krupski, W. C., Nguyen, H. T., Jones, D. N., Wallace, H., Whitehill, T. A. & Nehler, M. R. (2002). Smoking cessation counseling: a missed opportunity for general surgery trainees. *Journal of Vascular Surgery, 36*(2), 257-262. doi:10.1067/mva.2002.125030

Kruse, G. R., Kalkhoran, S. & Rigotti, N. A. (2017). Use of electronic cigarettes among US adults with medical comorbidities. *American Journal of Preventive Medicine, 52*(6), 798-804. doi:10.1016/j.amepre.2016.12.004

Kyu, H. H., Abate, D., Abate, K. H., Abay, S. M., Abbafati, C., Abbasi, N., ... & Abdollahpour, I. (2018). Global, regional, and national disability-adjusted life-years (DALYs) for 359 diseases and injuries and healthy life expectancy (HALE) for 195 countries and territories, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017. *The Lancet, 392*(10159), 1859-1922. doi.org/10.1016/S0140-6736(18)32335-3

Laverty, A. A., Filippidis, F. T. & Vardavas, C. I. 2018. Patterns, trends and determinants of e-cigarette use in 28 European Union Member States 2014–2017. *Preventive Medicine, 116*, 13-18. doi.org/10.1016/j.ypmed.2018.08.028

Lawson, P. J. & Flocke, S. A. (2009). Teachable moments for health behavior change: a concept analysis. *Patient Education and Counseling*, 76(1), 25-30. doi.org/10.1016/j.pec.2008.11.002

Lee, S. M., Landry, J., Jones, P. M., Buhrmann, O. & Morley-Forster, P. (2013). The effectiveness of a perioperative smoking cessation program: a randomized clinical trial. *Anesthesia & Analgesia*, *117*(3), 605-613. doi: 10.1213/ANE.0b013e318298a6b0

Lee, S. M., Tenney, R., Wallace, A. W. & Arjomandi, M. (2018). E-cigarettes versus nicotine patches for perioperative smoking cessation: a pilot randomized trial. *PeerJ,* 6:e5609 2018, doi:10.7717/peerj.5609.

Lee, C., Yong, H.-H., Borland, R., McNeill, A. & Hitchman, S. C. (2018a). Acceptance and patterns of personal vaporizer use in Australia and the United Kingdom: Results from the International Tobacco Control survey. *Drug and Alcohol Dependence*, *185*, 142-148. doi.org/10.1016/j.drugalcdep.2017.12.018

Leone, F. T., Evers-Casey, S., Toll, B. A. & Vachani, A. (2013). Treatment of tobacco use in lung cancer: diagnosis and management of lung cancer: American College of Chest Physicians evidence-based clinical practice guidelines. *Chest*, *143*(5), e61S-e77S. doi: 10.1378/chest.12-2349.

Long, T. & Johnson, M. (2000) Rigour, reliability and validity in qualitative research. *Clinical Effectiveness in Nursing, 4*(1):30-37. doi: 10.1054/cein.2000.0106

Lugg, S. T., Agostini, P. J., Tikka, T., Kerr, A., Adams, K., Bishay, E., Kalkat, M. S., Steyn, R. S., Rajesh, P. B., Thickett, D. R. & Naidu, B. (2016). Long-term impact of developing a postoperative pulmonary complication after lung surgery. *Thorax*, *71*(2), 171-176.

Lung Foundation Australia (2018). *Making lung cancer a fair fight. A blueprint for reform.* Retrieved from: https://lungfoundation.com.au/resources/?condition=14&search=Making%20lung%20cancer%20a%20fair%20fight. Accessed 22 October 2018.

Luxton, N. A., MacKenzie, R. & Shih, P. (2018a). Smoking cessation care in cardiothoracic surgery: A qualitative study exploring the views of Australian clinicians. *Heart, Lung and Circulation,* May. doi: 10.1016/j.hlc.2018.04.293.

Luxton, N. A., Shih, P. & Rahman, M. A. (2018b). Electronic cigarettes and smoking cessation in the perioperative period of cardiothoracic surgery: Views of Australian clinicians. *International Journal of Environmental Research and Public Health*, *15*(11), 2481. doi:10.3390/ijerph15112481

Luxton, N. A., Shih, P., Rahman, M. A., Adams, R. & MacKenzie, R. (2018c). Use of electronic cigarettes in the perioperative period: A mixed-method study exploring perceptions of cardiothoracic patients in Australia. *Tobacco Induced Diseases*, *16*, 53. doi.org/10.18332/tid/98957

Malas, M., Van Der Tempel, J., Schwartz, R., Minichiello, A., Lightfoot, C., Noormohamed, A., Andrews, J., Zawertailo, L. & Ferrence, R. (2016). Electronic cigarettes for smoking cessation: a systematic review. *Nicotine & Tobacco Research*, 18, 1926-1936. doi:10.1093/ntr/ntw119

Martin, K., Dono, J., Sharplin, G., Bowden, J. & Miller, C. (2017). Staff and patient perspectives of a smoke-free health services policy in South Australia: A state-wide implementation. *Health Policy, 121(*8), 895-902. doi:10.1016/j.healthpol.2017.06.003

Mason, D. P., Subramanian, S., Nowicki, E. R., Grab, J. D., Murthy, S. C., Rice, T. W. & Blackstone, E. H. (2009). Impact of smoking cessation before resection of lung cancer: A society of thoracic surgeons general thoracic surgery database study. *The Annals of Thoracic Surgery*, 2(88), 362-371. doi: 10.1016/j.athoracsur.2009.04.035

Mauthner, N. S. & Doucet, A. (2003). Reflexive accounts and accounts of reflexivity in qualitative data analysis. *Sociology, 37*(3), 413-431. doi: 10.1177/00380385030373002

McBride, C. M., Emmons, K. M. & Lipkus, I. M. (2003). Understanding the potential of teachable moments: The case of smoking cessation. *Health Education Research, 18*, 156-170. doi:10.1093/her/18.2.156

McBride, C. M. & Ostroff, J. S. (2003). Teachable moments for promoting smoking cessation: the context of cancer care and survivorship. *Cancer Control*, *10*, 325-333.

McCarty, M. C., Hennrikus, D. J., Lando, H. A. & Vessey, J. T. (2001). Nurses' attitudes concerning the delivery of brief cessation advice to hospitalized smokers. *Preventive Medicine, 33*(6), 674-681. doi:10.1006/pmed.2001.0944

McCarty, M. C., Zander, K. M., Hennrikus, D. J. & Lando, H. A. (2001a). Barriers among nurses to providing smoking cessation advice to hospitalized smokers. *American Journal of Health Promotion*, *16*(2), 85-87. doi:10.4278/0890-1171-16.2.85

McCrabb, S., Baker, A. L., Attia, J., Balogh, Z. J., Lott, N., Palazzi, K., ... & Wolfenden, L. (2017). Hospital smoke-free policy: compliance, enforcement, and practices. A staff survey in two large public hospitals in Australia. *International Journal of Environmental Research and Public Health, 14*(11), 1358. doi: 10.3390/ijerph14111358

McMillen, R. C., Gottlieb, M. A., Shaefer, R. M. W., Winickoff, J. P. & Klein, J. D. (2014). Trends in electronic cigarette use among US adults: use is increasing in both smokers and nonsmokers. *Nicotine & Tobacco Research*, *17*(10), 1195-1202. doi:10.1093/ntr/ntu213

McNeill, A., Brose, L. S., Calder, R., Bauld, L. & Robson, D. (2018). Evidence review of e-cigarettes and heated tobacco products 2018: a report commissioned by Public Health England. London: Public Health England. Retrieved from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/684963/Evidence_review_of_e-cigarettes_and_heated_tobacco_products_2018.pdf.

Michie, S., Atkins, L. & West, R. (2014). *The behaviour change wheel. A guide to designing interventions.* 1st ed. Great Britain: Silverback Publishing, 1003-1010.

Mills, E. J., Thorlund, K., Eapen, S., Wu, P. & Prochaska, J. J. (2014). Cardiovascular events associated with smoking cessation pharmacotherapies. Clinical perspective: A network meta-analysis. *Circulation*, *129*(1), 28-41. doi: 10.1161/CIRCULATIONAHA.113.003961

Moheimani, R. S., Bhetraratana, M., Peters, K. M., Yang, B. K., Yin, F., Gornbein, J., ... & Middlekauff, H. R. (2017). Sympathomimetic effects of acute e-cigarette use: Role of nicotine and non-nicotine constituents. *Journal of the American Heart Association*, *6*(9), e006579. doi: 10.1161/JAHA.117.006579

Moheimani, R. S., Bhetraratana, M., Yin, F., Peters, K. M., Gornbein, J., Araujo, J. A. & Middlekauff, H. R. (2017a). Increased cardiac sympathetic activity and oxidative stress in habitual electronic cigarette users: implications for cardiovascular risk. *JAMA Cardiology*, *2*(3), 278-284. doi:10.1001/jamacardio.2016.5303

Moysidou, A., Farsalinos, K. E., Voudris, V., Merakou, K., Kourea, K. & Barbouni, A. (2016). Knowledge and perceptions about nicotine, nicotine replacement therapies and electronic cigarettes among healthcare professionals in Greece. *International Journal of Environmental Research and Public Health,* 13(5), 514. doi.org/10.3390/ijerph13050514

Myers, K., Hajek, P., Hinds, C. & McRobbie, H. (2011). Stopping smoking shortly before surgery and postoperative complications: A systematic review and meta-analysis. *Archives of Internal Medicine*, *171*(11), 983-989. doi:10.1001/archinternmed.2011.97

National Academies of Sciences, Engineering, and Medicine; Health and Medicine Division; Board on Population Health and Public Health Practice; Committee on the Review of the Health Effects of Electronic Nicotine Delivery Systems. Public Health Consequences of E-Cigarettes. (2018). D.L. Eaton, L.Y. Kwan and K. Stratton (Eds). Washington DC. Retrieved from: https://www.ncbi.nlm.nih.gov/books/NBK507171/. Accessed 22 October 2018.

National Drug and Research Institute (2018). The Brief Tobacco Intervention Training Program. Retrieved from: http://ndri.curtin.edu.au/btitp/. Accessed 22 October 2018.

National Institute for Health and Care Excellence (UK) (2013). Smoking: acute, maternity and mental health services (PH48). Retrieved from: https://www.nice.org.uk/guidance/ph48. Accessed 22 October 2018.

National Institute for Health and Care Excellence (UK) (2018). Stop smoking interventions and services. NICE guideline 92. Retrieved from: https://www.nice.org.uk/guidance/ng92. Accessed 22 October 2018.

New Nicotine Alliance (Australia) (2016). Application for amendment of Schedule 7 entry for nicotine - 29 June 2016. Retrieved from: https://www.nnalliance.org.au/our-application-to-the-tga-the-complete-document/. Accessed 22 October 2018.

New Zealand Ministry of Health (2014). New Zealand Smoking Cessation Guidelines, Wellington: Ministry of Health. Retrieved from: http://www.health.govt.nz/publication/new-zealand-guidelines-helping-people-stop-smoking. Accessed 22 October 2018.

New Zealand Ministry of Health (2018). Vaping and smokeless tobacco. Retrieved from: https://www.health.govt.nz/our-work/preventative-health-wellness/tobacco-control/vaping-and-smokeless-tobacco. Accessed 22 October 2018.

Newhall, K., Burnette, M., Brooke, B. S., Schanzer, A., Tan, T., Flocke, S., Farber, A. & Goodney, P. (2016). Smoking cessation counseling in vascular surgical practice using the results of interviews and focus groups in the Vascular Surgeon offer and report smoking cessation pilot trial. *Journal of Vascular Surgery*, *63*(4), 1011-1017. doi:10.1016/j.jvs.2015.10.086

Nickels, A. S., Warner, D. O., Jenkins, S. M., Tilburt, J. & Hays, J. T. (2017). Beliefs, practices, and self-efficacy of US physicians regarding smoking cessation and electronic cigarettes: A national survey. *Nicotine & Tobacco Research, 19*(2), 197-207. doi:10.1093/ntr/ntw194.

Nickels, A. S., Warner, D. O., Jenkins, S. M., Tilburt, J. & Hays, J. T. (2017a). Pulmonologists' and primary care physicians' responses to an adult patient with asthma who inquires about using electronic cigarettes as a smoking cessation tool. *Annals of the American Thoracic Society*, *14*(3), 466-468. doi:10.1513/AnnalsATS.201610-828LE

Nolan, M., Leischow, S., Croghan, I., Kadimpati, S., Hanson, A., Schroeder, D. & Warner, D. O. (2016). Feasibility of Electronic Nicotine Delivery Systems in surgical patients. *Nicotine & Tobacco Research*, *18*(8), 1757-1762. doi: org/10.1093/ntr/ntw003

Nolan, M. B. & Warner, D. O. (2017). Perioperative tobacco use treatments: putting them into practice. *British Medical Journal*, 358, doi:10.1136/bmj.j3340.

NSW Government (2018). Health Education and Training. Smoking Cessation: A Guide for All Staff. Retrieved from: https://www.heti.nsw.gov.au/education-and-training/courses-and-programs/smoking-cessation-a-guide-for-all-staff. Accessed 22 October 2018.

NSW Health (2015). Managing Nicotine Dependence: A Guide for NSW Health Staff. Retrieved from: http://www.health.nsw.gov.au/tobacco/Pages/managing-nicotine-dependence.aspx. Accessed 22 October 2018.

NSW Health (2018). Electronic cigarettes. Retrieved from: https://www.health.nsw.gov.au/tobacco/Pages/e-cigarettes.aspx. Accessed 22 October 2018.

Ockene, I. S. & Miller, N. H. (1997). Cigarette smoking, cardiovascular disease, and stroke: a statement for healthcare professionals from the American Heart Association. American Heart Association Task Force on Risk Reduction. *Circulation*, *96*(9), 3243-7.

Palmer, A. M. & Brandon, T. H. (2018). How do electronic cigarettes affect cravings to smoke or vape? Parsing the influences of nicotine and expectancies using the balanced-placebo design. *Journal of Consulting and Clinical Psychology, 86*(5), 486-491. doi:10.1037/ccp0000303

Parliament of Australia (2017a). Royal Australian College of General Practitioners. Inquiry into the Use and Marketing of Electronic Cigarettes and Personal Vaporisers in Australia Submission 183. Retrieved from: https://www.aph.gov.au/Parliamentary_Business/Committees/House/Health_Aged_Care_and_Sport/ElectronicCigarettes/Submissions. Accessed 22 October 2018.

Parliament of Australia (2017b). Royal Australasian College of Surgeons. Inquiry into the Use and Marketing of Electronic Cigarettes and Personal Vaporisers in Australia Submission 329. Retrieved from: https://www.aph.gov.au/Parliamentary_Business/Committees/House/Health_Aged_Care_and_Sport/ElectronicCigarettes/Submissions. Accessed 22 October 2018.

Parliament of Australia (2018). Report on the Inquiry into the Use and Marketing of Electronic Cigarettes and Personal Vaporisers in Australia. Retrieved from: https://www.aph.gov.au/Parliamentary_Business/Committees/House/Health_Aged_Care_and_Sport/ElectronicCigarettes/Report. Accessed 22 October 2018.

Parsons, A., Daley, A., Begh, R. & Aveyard, P. (2010). Influence of smoking cessation after diagnosis of early stage lung cancer on prognosis: systematic review of observational studies with meta-analysis. *British Medical Journal*, 340. doi:10.1136/bmj.b5569

Pearson, J. L., Richardson, A., Niaura, R. S., Vallone, D. M. & Abrams, D. B. (2012). e-Cigarette awareness, use, and harm perceptions in US adults. *American Journal of Public Health*, *102*(9), 1758-1766. doi: 10.2105/AJPH.2011.300526

Pepper, J. K. & Brewer, N. T. (2014). Electronic nicotine delivery system (electronic cigarette) awareness, use, reactions and beliefs: a systematic review. *Tobacco Control*, *23*(5), 375-384. doi: 10.1136/tobaccocontrol-2013-051122

Pepper, J. K., Mcree, A.-L. & Gilkey, M. B. (2014). Healthcare providers' beliefs and attitudes about electronic cigarettes and preventive counseling for adolescent patients. *Journal of Adolescent Health, 54*(6), 678-683. doi:10.1016/j.jadohealth.2013.10.001

Peto, J. (2011). That lung cancer incidence falls in ex-smokers: misconceptions 2. *British Journal of Cancer, 104*(3), 389. doi:10.1038/sj.bjc.6606080

Peto, R., Lopez, A. D., Boreham, J. & Thun, M. (2015). Mortality from smoking in developed countries 1950–2020. Retrieved from: http://gas.ctsu.ox.ac.uk/tobacco/contents.htm. Accessed 22 October 2018.

Pierre, S., Rivera, C., Le Maître, B., Ruppert, A. M., Bouaziz, H., Wirth, N., ... & Martinet, Y. (2017). Guidelines on smoking management during the perioperative period. *Anaesthesia Critical Care & Pain Medicine, 36*(3), 195-200. doi: 10.1016/j.accpm.2017.02.002

Pipe, A. L. & Reid, R. D. (2018). Smoking cessation and cardiac rehabilitation: A Priority!. *The Canadian Journal of Cardiology*, *34*(10) S247. doi:10.1016/j.cjca.2018.07.416

Pisinger, C. (2014). Why public health people are more worried than excited over e-cigarettes. *BMC Medicine*, *12*(1), 226. doi:10.1186/s12916-014-0226-y

Pisinger, C. & Døssing, M. (2014). A systematic review of health effects of electronic cigarettes. *Preventive Medicine*, 69, 248-260. doi:10.1016/j.ypmed.2014.10.009

Przulj, D., McRobbie, H. & Hajek, P. (2016). Effects of nicotine-free e-cigarettes on urges to smoke and cigarette withdrawal symptoms: a randomised cross-over study. *Addiction Research and Therapy, 7*(2). doi:10.4172/2155-6105.1000259.

Quit Victoria (2018). Quit Learning Hub. Retrieved from: http://learninghub.quit.org.au/learning-hub/. Accessed 22 October 2018.

Rahman, M. A., Hann, N., Wilson, A., Mnatzaganian, G. & Worrall-Carter, L. (2015). E-cigarettes and smoking cessation: evidence from a systematic review and meta-analysis. *PloS One*, *10*. doi:10.1371/journal.pone.0122544

Rapport, F., Hogden, A., Faris, M., Bierbaum, M., Clay-Williams R., Long, J., Shih, P., Seah, R. & Braithwaite, J. (2018). *Qualitative Research in Healthcare – Modern Methods, Clear Translation: A White Paper.* Australian Institute of Health Innovation, Macquarie University. Sydney, Australia.

Raupach, T., Merker, J., Hasenfuß, G., Andreas, S. & Pipe, A. (2011). Knowledge gaps about smoking cessation in hospitalized patients and their doctors. *European Journal of Cardiovascular Prevention & Rehabilitation, 18*(2), 334-341. doi:10.1177/1741826710389370

Raw, M., Anderson, P., Batra, A., Dubois, G., Harrington, P., Hirsch, A., ... & Zatonski, W. (2002). WHO Europe evidence-based recommendations on the treatment of tobacco dependence. *Tobacco Control*, *11*(1), 44-46. doi:10.1136/tc.11.1.44

Raw, M., McNeill, A. & West, R. (1999). Smoking cessation: evidence-based recommendations for the healthcare system. *British Medical Journal*, *318*(7177), 182-185. doi.org/10.1136/bmj.318.7177.182

Rigotti, N. A., Clair, C., Munafo, M. R. & Stead, L. F. (2012). Interventions for smoking cessation in hospitalised patients. *Cochrane Database Systematic Reviews, 2012* (5), CD001837. doi: 10.1002/14651858.CD001837.pub3

Rigotti, N. A., Harrington, K. F., Richter, K., Fellows, J. L., Sherman, S. E., Grossman, E., ... & Consortium of Hospitals Advancing Research on Tobacco (CHART). (2014). Increasing prevalence of electronic cigarette use among smokers hospitalized in 5 US cities, 2010–2013. *Nicotine & Tobacco Research, 17*(2), 236-244. doi:10.1093/ntr/ntu138

Rigotti, N. A., Chang, Y., Tindle, H. A., Kalkhoran, S. M., Levy, D. E., Regan, S., Kelley, J. H., Davis, E. M. & Singer, D. E. (2018). Association of e-cigarette use with smoking cessation among smokers who plan to quit after a hospitalization. *Annals of Internal Medicine*, *168*(9), 613-620. doi: 10.7326/M17-2048

Ritchie, J., Lewis, J., Nicholls, C. M. & Ormston, R. (Eds.). (2013). *Qualitative research practice: A guide for social science students and researchers*. London. Sage Publications.

Rojewski, A. M., Baldassarri, S., Cooperman, N. A., Gritz, E. R., Leone, F. T., Piper, M. E., Toll, B. A. & Warren, G. W. (2016). Exploring issues of comorbid conditions in people who smoke. *Nicotine & Tobacco Research*, *18*(8), 1684-1696. doi:10.1093/ntr/ntw016

Romijnders, K., Van Osch, L., De Vries, H. & Talhout, R. (2018). Perceptions and reasons regarding e-cigarette use among users and non-users: A narrative literature review. *International Journal of Environmental Research and Public Health*, *15*(6), 1190. doi:10.3390/ijerph15061190

Roth, G. A., Abate, D., Abate, K. H., Abay, S. M., Abbafati, C., Abbasi, N., ... & Abdollahpour, I. (2018). Global, regional, and national age-sex-specific mortality for 282 causes of death in 195 countries and territories, 1980–2017: a systematic analysis for the Global Burden of Disease Study 2017. *The Lancet, 392*(10159), 1736-1788. doi:10.1016/S0140-6736(18)32203-7

Royal Australasian College of Physicians (2018). Policy on Electronic Cigarettes. Retrieved from: https://www.racp.edu.au/docs/default-source/advocacy-library/policy-on-electronic-cigarettes.pdf. Accessed 22 October 2018.

Royal Australasian College of Surgeons (2015). Cessation of Smoking. Available from: https://www.surgeons.org/media/21553848/2015-10-27_pos_rel-gov-031_cessation_of_smoking.pdf. Accessed 22 October 2018.

Royal College of Anaesthetists, Royal College of Surgeons of Edinburgh, & Action on Smoking and Health (2016). Joint briefing: Smoking and surgery. Retrieved from: https://www.rcoa.ac.uk/search/all/e-cigs. Accessed 22 October 2018.

Royal College of General Practitioners (2014). Supporting smoking cessation: a guide for health professionals. Retrieved from: https://www.racgp.org.au/clinical-resources/clinical-guidelines/key-

racgp-guidelines/view-all-racgp-guidelines/supporting-smoking-cessation. Accessed 22 October 2018.

Royal College of Physicians (2016). Nicotine without smoke: Tobacco harm reduction. Available online: https://www.rcplondon.ac.uk/projects/outputs/nicotine-without-smoke-tobacco-harm-reduction-0. Accessed 22 October 2018.

Rutten, L. J. F., Blake, K. D., Agunwamba, A. A., Grana, R. A., Wilson, P. M., Ebbert, J. O., ... & Leischow, S. J. (2015). Use of e-cigarettes among current smokers: associations among reasons for use, quit intentions, and current tobacco use. *Nicotine & Tobacco Research*, *17*(10), 1228-1234. doi:10.1093/ntr/ntv003

Samet, J. M. (1991). Health benefits of smoking cessation. *Clinics in Chest Medicine*, *12*(4), 669-679.

Sandelowski, M. (1986). The problem of rigor in qualitative research. *Advances in Nursing Science, 8*(3), 27-37.

Sarna, L., Wewers, M. E., Brown, J. K., Lillington, L. & Brecht, M. L. (2001). Barriers to tobacco cessation in clinical practice: report from a national survey of oncology nurses. *Nursing Outlook*, *49*(4), 166-172. doi:10.1067/mno.2001.115448

Sarna, L., Bialous, S. A., Wells, M., Kotlerman, J., Wewers, M. E. & Froelicher, E. S. (2009). Frequency of nurses' smoking cessation interventions: report from a national survey. *Journal of Clinical Nursing, 18*(14), 2066-2077. doi: 10.1111/j.1365-2702.2009.02796.x.

Saxena, A., Shan, L., Reid, C., Dinh, D. T., Smith, J. A., Shardey, G. C. & Newcomb, A. E. (2013). Impact of smoking status on early and late outcomes after isolated coronary artery bypass graft surgery. *Journal of Cardiology*, *61*(5), 336-341. doi:10.1016/j.jjcc.2013.01.002

Schmid, M., Sood, A., Campbell, L., Kapoor, V., Dalela, D., Klett, D.E., Chun, F.K.H., Kibel, A.S., Sammon, J.D., Menon, M. & Fisch, M. (2015). Impact of smoking on perioperative outcomes after major surgery. *The American Journal of Surgery*, *210*(2) 221-229. doi:10.1016/j.amjsurg.2014.12.045

Schnoll, R. A., Calvin, J., Malstrom, M., Rothman, R. L., Wang, H., Babb, J., ... & Unger, M. (2003). Longitudinal predictors of continued tobacco use among patients diagnosed with cancer. *Annals of Behavioral Medicine, 25*(3), 214-222.

Schnoll, R. A., Martinez, E., Tatum, K. L., Glass, M., Bernath, A., Ferris, D. & Reynolds, P. (2010). Nicotine patch vs. nicotine lozenge for smoking cessation: an effectiveness trial coordinated by the Community Clinical Oncology Program. *Drug and Alcohol Dependence*, *107*(2-3), 237-243. doi:10.1016/j.drugalcdep.2009.11.001

Schraufnagel, D. E., Blasi, F., Drummond, M. B., Lam, D. C., Latif, E., Rosen, M. J., ... & Van Zyl-Smit, R. (2014). Electronic cigarettes. A position statement of the forum of international respiratory societies. *American Journal of Respiratory and Critical Care Medicine*, *190*(6), 611-618. doi:10.1164/rccm.201407-1198PP

Schultz, A. S., Johnson, J. L. & Bottorff, J. L. (2006). Registered nurses' perspectives on tobacco reduction: Views from western Canada. *Canadian Journal of Nursing Research, 38*(4), 192-211.

Sharma, R., Meurk, C., Bell, S., Ford, P. & Gartner, C. (2018a). Australian mental health care practitioners' practices and attitudes for encouraging smoking cessation and tobacco harm reduction

in smokers with severe mental illness. *International Journal of Mental Health Nursing, 27*(1), 247-257.

Sharma-Kumar, R., Meurk, C., Ford, P., Beere, D. & Gartner, C. (2018b). Are Australian smokers with mental illness receiving adequate smoking cessation and harm reduction information?. *International Journal of Mental Health Nursing, 27*(6), 1673-1688.

Sherratt, F. C., Newson, L. & Field, J. K. (2016). Electronic cigarettes: a survey of perceived patient use and attitudes among members of the British thoracic oncology group. *Respiratory Research*, *17*(1), 55. doi:10.1186/s12931-016-0367-y

Shi, Y. & Warner, D. O. (2010). Surgery as a teachable moment for smoking cessation. *Anesthesiology*, *112*(1):102-7. doi: 10.1097/ALN.0b013e3181c61cf9.

Shi, Y., Yu, C., Luo, A., Huang, Y. & Warner, D. O. (2010). Perioperative tobacco interventions by Chinese anesthesiologists: practices and attitudes. *Anesthesiology*, *112*(2), 338-46. doi: 10.1097/ALN.0b013e3181c91ee7.

Shields, P. G., Herbst, R. S., Arenberg, D., Benowitz, N. L., Bierut, L., Luckart, J. B., ... & Hitsman, B. (2016). Smoking cessation. NCCN clinical practice guidelines in oncology. *Journal of the National Comprehensive Cancer Network, 14*(11), 1430-1468. doi: 10.6004/jnccn.2016.0152

Shiffman, S. (1982). Relapse following smoking cessation: a situational analysis. *Journal of Consulting and Clinical Psychology*, *50*(1), 71-86.

Shiffman, S. (1984). Coping with temptations to smoke. *Journal of Consulting and Clinical Psychology*, *52*(2), 261-7.

Shiffman, S., Gitchell, J., Pinney, J. M., Burton, S. L., Kemper, K. E. & Lara, E. A. (1997). Public health benefit of over-the-counter nicotine medications. *Tobacco Control*. *6*(4), 306-310.

Shin, D. W., Kim, Y. I., Kim, S. J., Kim, J. S., Chong, S., Park, Y. S., Song, S.-Y., Lee, J. H., Ahn, H. K., Kim, E. Y., Yang, S. H., Lee, M. K., Cho, D. G., Jang, T. W., Son, J. W., Ryu, J.-S. & Cho, M.-J. (2017). Lung cancer specialist physicians' attitudes towards e-cigarettes: A nationwide survey. *PLoS One*, *12*(2). doi:10.1371/journal.pone.0172568

Simmons, V. N., Litvin, E. B., Jacobsen, P. B., Patel, R. D., McCaffrey, J. C., Oliver, J. A., ... & Brandon, T. H. (2013). Predictors of smoking relapse in patients with thoracic cancer or head and neck cancer. *Cancer*, *119*(7), 1420-1427. doi:10.1002/cncr.27880

Singh, B., Hrywna, M., Wackowski, O. A., Delnevo, C. D., Jane Lewis, M. & Steinberg, M. B. (2017). Knowledge, recommendation, and beliefs of e-cigarettes among physicians involved in tobacco cessation: A qualitative study. *Preventive Medicine Reports*, *8*, 25-29. doi:10.1016/j.pmedr.2017.07.012

Slattery, C., Freund, M., Gillham, K., Knight, J., Wolfenden, L., Bisquera, A. & Wiggers, J. (2016). Increasing smoking cessation care across a network of hospitals: an implementation study. *Implementation Science*, *11*(1), 28. doi:10.1186/s13012-016-0390-x

Smith, A. L., Chapman, S. & Dunlop, S. M. (2015). What do we know about unassisted smoking cessation in Australia? A systematic review, 2005-2012. *Tobacco Control*, *24*(1), 18-27. doi: 10.1136/tobaccocontrol-2013-051019

Sørensen, L. T., Toft, B. G., Rygaard, J., Ladelund, S., Paddon, M., James, T., ... & Gottrup, F. (2010). Effect of smoking, smoking cessation, and nicotine patch on wound dimension, vitamin C, and systemic markers of collagen metabolism. *Surgery*, *148*(5), 982-990. doi:10.1016/j.surg.2010.02.005

Speziale, H. S., Streubert, H. J. & Carpenter, D. R. (2011). *Qualitative Research in Nursing*: *Advancing the Humanistic Imperative*. Lippincott Williams & Wilkins.

Stead, L. F., Buitrago, D., Preciado, N., Sanchez, G., Hartmann-Boyce, J. & Lancaster, T. (2013). Physician advice for smoking cessation. *Cochrane Database of Systematic Reviews, 2013*(5), CD000165. doi: 10.1002/14651858.CD000165.pub4.

Steinberg, M. B., Giovenco, D. P. & Delnevo, C. D. (2015). Patient–physician communication regarding electronic cigarettes. *Preventive Medicine Reports*, 2, 96-98. doi:10.1016/j.pmedr.2015.01.006

Talih, S., Balhas, Z., Eissenberg, T., Salman, R., Karaoghlanian, N., El Hellani, A., ... & Shihadeh, A. (2014). Effects of user puff topography, device voltage, and liquid nicotine concentration on electronic cigarette nicotine yield: measurements and model predictions. *Nicotine & Tobacco Research, 17*(2), 150-157. doi:10.1093/ntr/ntu174

Theadom, A. & Cropley, M. (2006). Effects of preoperative smoking cessation on the incidence and risk of intraoperative and postoperative complications in adult smokers: a systematic review. *Tobacco Control*, *15*(5), 352-358. doi:10.1136/tc.2005.015263

Therapeutic Goods Administration (Australia) (2015). Electronic cigarettes. Retrieved from: https://www.tga.gov.au/community-qa/electronic-cigarettes. Accessed 22 October 2018.

Therapeutic Goods Administration (Australia) (2018). Special Access Scheme. Retrieved from: https://www.tga.gov.au/form/special-access-scheme. Accessed 22 October 2018.

Thomas, D., Abramson, M. J., Bonevski, B., Taylor, S., Poole, S. G., Weeks, G. R., Dooley, M. J. & George, J. (2015). Quitting experiences and preferences for a future quit attempt: a study among inpatient smokers. *British Medical Journal Open*, *5*(4). doi:10.1136/bmjopen-2014-006959

Thomas, D., Abramson, M. J., Bonevski, B., Taylor, S., Poole, S. G., Paul, E., Weeks, G. R., Dooley, M. J. & George, J. (2016). Integrating smoking cessation into routine care in hospitals—a randomized controlled trial. *Addiction*, *111*(4), 714-723. doi:10.1111/add.13239

Thomsen, T., Villebro, N. & Møller, A. M. (2014). Interventions for preoperative smoking cessation. *Cochrane Database of Systematic Reviews*, *2014*(3), CD002294. doi: 10.1002/14651858.CD002294.pub4.

Tofler, G. H., May, R., Bartrop, R., Kirkness, A., Glinatsis, H. & de Burgh, S. (2013). Acute coronary syndrome as a teachable moment for smoking cessation. *Journal of Smoking Cessation*, *10*(1), 5-11. doi:10.1017/jsc.2013.35

Tonstad, S. & Johnston, J. A. (2006). Cardiovascular risks associated with smoking: a review for clinicians. *European Journal of Cardiovascular Prevention Rehabilitation Counseling Bulletin*, *13*(4), 507-514. doi: 10.1097/01.hjr.0000214609.06738.62

Troiano, C., Jaleel, Z. & Spiegel, J. H. (2018). Association of electronic cigarette vaping and cigarette smoking with decreased random flap viability in rats. *JAMA Facial Plastic Surgery*. Advance online publication. doi: 10.1001/jamafacial.2018.1179.

Tully, P. J., Baker, R. A., Turnbull, D. & Winefield, H. (2008). The role of depression and anxiety symptoms in hospital readmissions after cardiac surgery. *Journal of Behavioral Medicine*, *31*(4), 281-290. doi:10.1007/s10865-008-9153-8

Turan, A., Mascha, E. J., Roberman, D., Turner, P. L., You, J. & Kurz, A. (2011). Smoking and perioperative outcomes. *Anesthesiology*, *114*(4), 837-846. doi:10.1097/ALN.0b013e318210f560.

Twyman, L., Bonevski, B., Paul, C., Bryant, J., Gartner, C. & Guillaumier, A. (2015). Electronic cigarettes: awareness, recent use, and attitudes within a sample of socioeconomically disadvantaged Australian smokers. *Nicotine & Tobacco Research*, *18*(5), 670-677. doi:10.1093/ntr/ntv183

Twyman, L., Watts, C., Chapman, K. & Walsberger, S. C. (2018). Electronic cigarette use in New South Wales, Australia: reasons for use, place of purchase and use in enclosed and outdoor places. *Australian and New Zealand Journal of Public Health*, *42*(5), 491-496. doi:10.1111/1753-6405.12822

US Department of Health and Human Services (2010). How Tobacco Smoke Causes Disease: The Biology and Behavioral Basis for Smoking-Attributable Disease: A Report of the Surgeon General. Atlanta, GA: US Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health. Retrieved from: https://www.ncbi.nlm.nih.gov/books/NBK53017/. Accessed 22 October 2018.

US Preventive Services Task Force (USPSF) (2015). Tobacco Smoking Cessation in Adults, Including Pregnant Women: Behavioral and Pharmacotherapy Interventions. Retrieved from: https://www.uspreventiveservicestaskforce.org/Page/Document/UpdateSummaryFinal/tobacco-use-in-adults-and-pregnant-women-counseling-and-interventions1?ds=1&s=smoking. Accessed 22 October 2018.

Van Domburg, R. T., Meeter, K., Van Berkel, D. F. M., Veldkamp, R. F., Van Herwerden, L. A. & Bogers, A. J. (2000). Smoking cessation reduces mortality after coronary artery bypass surgery: a 20-year follow-up study. *Journal of the American College of Cardiology*, *36*(3), 878-883.

Van Gucht, D. & Baeyens, F. (2016). Health professionals in Flanders perceive the potential health risks of vaping as lower than those of smoking but do not recommend using e-cigarettes to their smoking patients. *Harm Reduction Journal,* 13, 22. doi:10.1186/s12954-016-0111-4

Vardavas, C. I., Anagnostopoulos, N., Kougias, M., Evangelopoulou, V., Connolly, G. N. & Behrakis, P. K. (2012). Short-term pulmonary effects of using an electronic cigarette: impact on respiratory flow resistance, impedance, and exhaled nitric oxide. *Chest*, *141*(2),1400-1406. doi:10.1378/chest.11-2443

Villanti, A. C., Feirman, S. P., Niaura, R. S., Pearson, J. L., Glasser, A. M., Collins, L. K. & Abrams, D. B. (2018). How do we determine the impact of e-cigarettes on cigarette smoking cessation or reduction? Review and recommendations for answering the research question with scientific rigor. *Addiction*, *113*(3), 391-404. doi:10.1111/add.14020

Voors, A. A., van Brussel, B. L., Thijs Plokker, H. W., Ernst, S. M., Ernst, N. M., Koomen, E. M., ... & Vermeulen, F. E. (1996). Smoking and cardiac events after venous coronary bypass surgery: a 15-year follow-up study. *Circulation*, *93*(1), 42-47.

Walker, M. S., Vidrine, D. J., Gritz, E. R., Larsen, R. J., Yan, Y., Govindan, R. & Fisher, E. B. (2006). Smoking relapse during the first year after treatment for early-stage non–small-cell lung cancer. *Cancer Epidemiology and Prevention Biomarkers*, *15*(12), 2370-2377. doi:10.1158/1055-9965.EPI-06-0509

Warner, D. O. (2006). Perioperative abstinence from cigarettes – Physiologic and clinical consequences. *Anesthesiology*, *104*(2), 356-367. doi:10.1097/00000542-200602000-00023

Warner, M. A., Offord, K. P., Warner, M. E., Lennon, R. L., Conover, A. & Janson-Schumacher, U. (1989). Role of preoperative cessation of smoking and other factors in postoperative pulmonary complications: A blinded study of coronary artery bypass patients. *Mayo Clinic Proceedings*, *64*(6), 609-616. doi:10.1016/S0025-6196(12)65337-3

Warner, D. O., Sarr, M. G., Offord, K. P. & Dale, L. C. (2004). Anesthesiologists, general surgeons, and tobacco interventions in the perioperative period. *Anesthesia & Analgesia*, *99*(6), 1766-1773. doi: 10.1213/01.ANE.0000136773.40216.87

Warren, G. W., Marshall, J. R., Cummings, K. M., Toll, B., Gritz, E. R., Hutson, A., ... & Smoking Cessation Committee (2013). Practice patterns and perceptions of thoracic oncology providers on tobacco use and cessation in cancer patients. *Journal of Thoracic Oncology*, *8*(5), 543-548. doi:10.1097/JTO.0b013e318288dc96

Webb, A. R., Robertson, N. & Sparrow, M. (2013). Smokers know little of their increased surgical risks and may quit on surgical advice. *ANZ Journal of Surgery*, *83*(10), 753-757. doi:10.1111/ans.12096

Webb, A. R. & Wilson, A. C. (2017). The addition of tick-boxes related to tobacco cessation improves smoking-related documentation in the anaesthesia chart. *Anaesthesia and Intensive Care*, *45*(1), 52-57.

Wells, M., Aitchison, P., Harris, F., Ozakinci, G., Radley, A., Bauld, L., ... & Williams, B. (2017). Barriers and facilitators to smoking cessation in a cancer context: A qualitative study of patient, family and professional views. *BMC Cancer, 17*(1), 348. doi:10.1186/s12885-017-3344-z

Westmaas, J. L., Newton, C. C., Stevens, V. L., Flanders, W. D., Gapstur, S. M. & Jacobs, E. J. (2015). Does a recent cancer diagnosis predict smoking cessation? An analysis from a large prospective US cohort. *Journal of Clinical Oncology*, *33*(15), 1647-1652. Doi:10.1200/JCO.2014.58.3088

Wetsch, W. A., Pircher, I., Lederer, W., Kinzl, J. F., Traweger, C., Heinz-Erian, P. & Benzer, A. (2009). Preoperative stress and anxiety in day-care patients and inpatients undergoing fast-track surgery. *British Journal of Anaesthesia*, *103*(2), 199-205. doi:10.1093/bja/aep136

Wilson, K., Gibson, N., Willan, A. & Cook, D. 2000. Effect of smoking cessation on mortality after myocardial infarction: Meta-analysis of cohort studies. *Archives of Internal Medicine*, *160*(7), 939-944. doi:10.1001/archinte.160.7.939

Wolfenden, L., Wiggers, J., Knight, J., Campbell, E., Rissel, C., Kerridge, R., ... & Moore, K. (2005). A programme for reducing smoking in pre-operative surgical patients: randomised controlled trial. *Anaesthesia*, *60*(2), 172-179. doi:10.1111/j.1365-2044.2004.04070.x

Wolfenden, L., Wiggers, J., Campbell, E., Knight, J., Kerridge, R. & Spigelman, A. (2009). Providing comprehensive smoking cessation care to surgical patients: The case for computers. *Drug and Alcohol Review,* 28, 60-65.

World Health Organization (2017). Electronic nicotine delivery systems and electronic non-nicotine delivery systems (ENDS/ENNDS). Retrieved from: http://www.who.int/tobacco/communications/statements/eletronic-cigarettes-january-2017/en/. Accessed 22 October 2018.

Wright, C. D., Gaissert, H. A., Grab, J. D., O'Brien, S. M., Peterson, E. D. & Allen, M. S. (2008). Predictors of prolonged length of stay after lobectomy for lung cancer: A society of thoracic surgeons general thoracic surgery database risk-adjustment model. *The Annals of Thoracic Surgery*, *6*(85), 1857-1865. doi:10.1016/j.athoracsur.2008.03.024

Yong, H. H., Borland, R., Balmford, J., McNeill, A., Hitchman, S., Driezen, P., ... & Cummings, K. M. (2014). Trends in e-cigarette awareness, trial, and use under the different regulatory environments of Australia and the United Kingdom. *Nicotine & Tobacco Research*, *17*(10), 1203-1211. https://doi.org/10.1093/ntr/ntu231

Yong, H. H., Borland, R., Balmford, J., Hitchman, S. C., Cummings, K. M., Driezen, P. & Thompson, M. E. (2017). Prevalence and correlates of the belief that electronic cigarettes are a lot less harmful than conventional cigarettes under the different regulatory environments of Australia and the United Kingdom. *Nicotine & Tobacco Research*, *19*(2), 258-263. doi:10.1093/ntr/ntw137

Zaballos, M., Canal, M. I., Martínez, R., Membrillo, M. J., Gonzalez, F. J., Orozco, H. D., Sanz, F. J. & Lopez-Gil, M. (2015). Preoperative smoking cessation counseling activities of anesthesiologists: a cross-sectional study. *BMC Anesthesiology*, 15, 60-67. doi:10.1186/s12871-015-0036-6

Appendices

Appendix A: Ethics approval

Appendix B: Patient information sheet

Appendix C: Methodology

Appendix A: Ethics approval

Office of the Deputy Vice-Chancellor
(Research)

Research Office
Research Hub, Building C5C East
Macquarie University
NSW 2109 Australia
T: +61 (2) 9850 4459
http://www.research.mq.edu.au/
ABN 90 952 801 237

MACQUARIE University
SYDNEY·AUSTRALIA

27 April 2016

Dear Dr MacKenzie

Reference No: 5201500797

Title: *Electronic cigarettes in Australia: Knowledge, attitudes and potential applications in perioperative care*

Thank you for submitting the above application for ethical and scientific review. Your application was considered by the Macquarie University Human Research Ethics Committee (HREC (Medical Sciences)).

I am pleased to advise that ethical and scientific approval has been granted for this project to be conducted at:

- Macquarie University

This research meets the requirements set out in the *National Statement on Ethical Conduct in Human Research* (2007 – Updated May 2015) (the *National Statement*).

Standard Conditions of Approval:

1. Continuing compliance with the requirements of the *National Statement,* which is available at the following website:

http://www.nhmrc.gov.au/book/national-statement-ethical-conduct-human-research

2. This approval is valid for five (5) years, subject to the submission of annual reports. Please submit your reports on the anniversary of the approval for this protocol.

3. All adverse events, including events which might affect the continued ethical and scientific acceptability of the project, must be reported to the HREC within 72 hours.

4. Proposed changes to the protocol and associated documents must be submitted to the Committee for approval before implementation.

It is the responsibility of the Chief investigator to retain a copy of all documentation related to this project and to forward a copy of this approval letter to all personnel listed on the project.

Should you have any queries regarding your project, please contact the Ethics Secretariat on 9850 4194 or by email ethics.secretariat@mq.edu.au

The HREC (Medical Sciences) Terms of Reference and Standard Operating Procedures are available from the Research Office website at:

http://www.research.mq.edu.au/for/researchers/how_to_obtain_ethics_approval/human_research_ethics

The HREC (Medical Sciences) wishes you every success in your research.

Yours sincerely

Professor Tony Eyers
Chair, Macquarie University Human Research Ethics Committee (Medical Sciences)

This HREC is constituted and operates in accordance with the National Health and Medical Research Council's (NHMRC) *National Statement on Ethical Conduct in Human Research* (2007) and the *CPMP/ICH Note for Guidance on Good Clinical Practice*.

Details of this approval are as follows:

Approval Date: 15 April 2016

The following documentation has been reviewed and approved by the HREC (Medical Sciences):

Documents reviewed	Version no.	Date
Macquarie University Prior Review Ethics Application Form		Received 31/3/2016
MQ Protocol	3	8/3/2016
Correspondence responding to the issues raised by the HREC (Medical Sciences)		Received 12/4/2016
MQ Participant Information and Consent Form (PICF)	2*	12/4/2016
Participant Qualtrics Questionnaire	1*	31/3/2016

Documents Noted	Version no.	Date
Northern Sydney Local Health District (HSLHD) HREC Approval letters		11/3/2016, 3/12/2015 & 16/9/2015
Site Specific Assessment (SSA) Form		7/9/2015

***If the document has no version date listed one will be created for you. Please ensure the footer of these documents are updated to include this version date to ensure ongoing version control.**

ADDRESS FOR ALL CORRESPONDENCE
RESEARCH ETHICS AND GOVERNANCE OFFICE
ROYAL PRINCE ALFRED HOSPITAL
CAMPERDOWN NSW 2050

TELEPHONE: (02) 9515 7899
FACSIMILE: (02) 9515 7176
EMAIL: maree.larkin@sswahs.nsw.gov.au
REFERENCE: X16-0037

Health
Sydney
Local Health District

18 February 2016

Ms Nia Luxton
Psychology Department
Macquarie University
Building C3A, Balaclava Road
NORTH RYDE NSW 2109

Dear Ms Luxton,

Re: Protocol No X16-0037 - "Electronic cigarettes in Australia: Knowledge, attitudes and potential applications in perioperative care"

LNR/15/HAWKE/356 **LNRSSA/16/RPAH/42**

Thank you for submitting a Site Specific Assessment Form (AU/7/53B324) for this low and negligible risk study. I am pleased to inform you that authorisation has been granted for it to be undertaken at the ***Royal Prince Alfred Hospital.***

The approved information and consent documents for use at this site are:

- ***Participant Information Sheet and Consent Form including Form for Withdrawal of Participation (RPAH Version 1, 17 February 2016) based on Master Version 1, 4 February 2016***

The following conditions apply to this research study. These are additional to those conditions imposed by the human research ethics committee (HREC) that granted ethical approval:

1. A copy of the annual report and any other reports to the approving HREC, accompanied by a copy of the HREC's acknowledgement letter, should be provided to me for review.
3. When required, the appropriate documentation must be submitted to me for authorisation before any new external researcher is authorised to be on-site for the project.
4. Proposed amendments to the research protocol or conduct of the research, which may affect the ethical acceptability of the study and which are submitted to the lead HREC for review, must be copied to me.
5. Proposed amendments to the research protocol or conduct of the research, which may affect the ongoing site acceptability of the study, must be submitted to me.

I wish you every success in your research.

Yours sincerely,

Maree Larkin
Research Governance Officer
SLHD (RPAH Zone)

RGO - Maree\CORRES\X16-0037 LNR

Research Office
Kolling Building, Level 13
Royal North Shore Hospital
St Leonards NSW 2065
Tel (02) 9926 4590 Fax (02) 9926 6179

Health
Northern Sydney
Local Health District

3 December 2015

Ms Nia Luxton
Psychology Department
Macquarie University
Balaclava Road North Ryde NSW 2109

Dear Nia

NSLHD reference: RESP/15/256
Study Title: Electronic cigarettes in Australia: knowledge, attitudes and potential applications in perioperative care
HREC reference: LNR/15/HAWKE/356

Thank you for your letter dated **1 December 2015** submitting a request to extend HREC approval for the above project to additional study sites. This HREC has been accredited by NSW Ministry of Health as a Lead HREC under the model for single ethical and scientific review and Certified by the NHMRC under the National model for Harmonisation of Multicentre Ethical Review (HoMER).This lead HREC is constituted and operates in accordance with the National Health and Medical Research Council's *National Statement on Ethical Conduct in Human Research* and the *CPMP/ICH Note for Guidance on Good Clinical Practice*. No HREC members with a conflict of interest were present for review of this project.

I am pleased to advise that the HREC Executive at a meeting on **2 December 2015** approved this request. HREC approval has been extended to the following additional **sites:**

- Westmead Public Hospital – Principal Investigator: Nia Luxton
- Royal Prince Alfred Hospital – Principal Investigator: Nia Luxton

You are reminded that this letter constitutes *ETHICAL* and *SCIENTIFIC* approval only. You must not commence this research project at a site until a completed Site Specific Assessment Form/Access Request and associated documentation have been submitted to the site Research Governance Officer and Authorised. A copy of this letter must be forwarded to all site investigators for submission to the relevant Research Governance Officer.

Should you have any queries about your project please contact the Research Office, Tel: 9926 4590, email NSLHD-Research@health.nsw.gov.au . The HREC Terms of Reference, Standard Operating Procedures, *National Statement on Ethical Conduct in Human Research* (2007) and the *CPMP/ICH Note for Guidance on Good Clinical Practice* and standard forms are available on the Research Office website: http://www.nslhd.health.nsw.gov.au/AboutUs/Research/Office

Yours sincerely

Ellie Pratt
Research Ethics Manager
NORTHERN SYDNEY LOCAL HEALTH DISTRICT

RESD/15/8483

Research Office
Kolling Building, Level 13
Royal North Shore Hospital
St Leonards NSW 2065
Tel (02) 9926 4590 Fax (02) 9926 6179

NSW GOVERNMENT Health
Northern Sydney
Local Health District

28 September 2015

Ms Nia Luxton
Psychology Department
Macquarie University
Balaclava Road North Ryde NSW 2109

Dear Nia

NSLHD reference: RESP/15/256
Study Title: Electronic cigarettes in Australia: knowledge, attitudes and potential applications in perioperative care
HREC reference: LNR/15/HAWKE/356 SSA reference: LNRSSA/15/HAWKE/371

Thank you for submitting an application for authorisation for a Low and Negligible Risk Research Site Specific Assessment (LNR SSA) project. I am pleased to advise that the delegate of the Chief Executive for Northern Sydney Local Health District has granted authorisation on **28 September 2015** for the above project to commence at **Royal North Shore Hospital.**

The version of the LNR SSA reviewed by NSLHD RGO was **AU/7/6731214.**

Ethical approval for this study was granted by the **Northern Sydney Local Health District HREC** at a meeting of the Executive Committee **held** on **11 September 2015.**

The documents authorised for use at this site are:

Document	Version	Date
Protocol	1	1 September 2015
Participant Information Sheet and Consent Form	1	7 September 2015
Participant Survey	1	7 September 2015

Site authorisation will cease on the date of HREC expiry **11 September 2020.**

The following external research personnel have been authorised to conduct study activity as detailed in the external researcher letter and the protocol at this site:

Name:	Nia Angharad Luxton
Supervised onsite by:	Dr David Marshman, Dept of Cardiothoracic Surgery

You are reminded that, in order to comply with the Guidelines for Good Clinical Research Practice (GCRP) in Australia, and in accordance with additional requirements of NSLHD, the Chief Investigator is responsible for ensuring the following:

1. The HREC is notified of anything that might warrant review of the ethical approval of the project, including unforeseen events that might affect the ethical acceptability of the project.
2. Proposed amendments to the research protocol or conduct of the research which may affect the ethical acceptability of the project, and are submitted to the HREC for review, are copied to the Research Governance Officer.
3. Proposed amendments to the research protocol or conduct of the research which may affect the ongoing site acceptability of the project are to be submitted to the Research Governance Officer.
4. The annual report acknowledgment from the Lead HREC should be submitted to the Research Governance Officer.

Standard forms and additional guidance documents are available on the Research Office Website:
http://www.nslhd.health.nsw.gov.au/AboutUs/Research/Office

Yours sincerely

Kylie Becker
Research Governance Officer
Research Office - Northern Sydney Local Health District **TRIM RESD/15/6682**

People caring for people

NORTH SHORE
PRIVATE HOSPITAL

North Shore Private Hospital
ABN 67 059 183 596
3 Westbourne Street
St Leonards NSW 2065
Telephone: 02 8425 3000
Facsimile: 02 8425 3970
www.northshoreprivate.com.au
www.ramsayhealth.com.au

Friday, 9 October 2015

Nia Angharad Luxton
Macquarie University - Department of Psychology
Balaclava Road
North Ryde, NSW 2109

Dear Nia,

HREC Reference number: NSPHEC 2015-LNR-013
Project title: Electronic cigarettes in Australia: knowledge, attitudes and potential applications in perioperative care

Thank you for submitting the above research project for ethical review. This project was considered by the North Shore Private Hospital Ethics Committee Chair on 8 October 2015.

I am pleased to advise you that the NSPH Ethics Committee has granted ethical approval for this research project.

The reviewed documents include:

Document	Version	Date
Letter of support from NSPH DCS Sue Engele		06/10/2015
NSLHD Protocol template	1	22/09/2015
Participant Qualtrics Questionnaire		22/09/2015
Participant Information Sheet and Consent Form	2	22/09/2015
LNR NEAF form		18/09/2015
Study protocol		18/09/2015
Participant survey		18/09/2015
External researcher CV (Nia Angharad Luxton)		18/09/2015
External researcher letter from Head of Cardiothoracic Surgery NSLHD, Dr David Marshman		18/09/2015
Copy of scope of liability insurance, along with certificate of currency		18/09/2015

Ramsay Health Care
Celebrating 50 years of
people caring for people
1964 - 2014

WSLHD Research Governance Officer
Room 2050 Research & Education Network Building
Westmead Hospital
Cnr Hawkesbury and Darcy Roads
Westmead NSW 2145

Telephone: (02) 9845 9634
Facsimile: (02) 9845 9636
Email: margaret.piper@health.nsw.gov.au

31 March 2016

Katrina Rose
Physiotherapy Dept
Westmead Hospital

Dear Ms Rose

Research Office reference: 4597
HREC reference number: LNR/15/HAWKE/356
SSA reference number: LNRSSA/16/WMEAD/48
Project title: Electronic cigarettes in Australia: knowledge, attitudes and potential applications in perioperative care
Protocol number: version 3 dated 8 March 2016

Thank you for submitting a Low/Negligible Risk (LNR) application for site authorisation of this project. I am pleased to inform you that site authorisation has been granted for this study to take place at the following site:

- Westmead Hospital

The approved information and consent documents for use at this site are:

- Participant Information Sheet and Consent Westmead Hospital version 2 dated 9 March 2016 based on master version 2 dated 8 March 2016

- Letter to Western Sydney Local Health District Cardiothoracic Surgeons version 1

The following conditions apply to this research project. These are additional to those conditions imposed by the Human Research Ethics Committee that granted ethical approval:

1. Nia Luxton, Macquarie University researcher has been accredited as external researcher to conduct study visits within WSLHD

2. Proposed amendments to the research protocol or conduct of the research which may affect the ethical acceptability of the project, and which are submitted to the lead HREC for review, are copied to the research governance officer;

3. Proposed amendments to the research protocol or conduct of the research which may affect the ongoing site acceptability of the project, are to be submitted to the research governance officer.

Yours faithfully

Maggie Piper
WSLHD Research Governance Officer

c.c Nia Luxton, Building C3A, Balaclava Rd, Macquarie

WSLHD Research Governance Officer
Room 2050 Research & Education Network Building
Westmead Hospital
Cnr Hawkesbury and Darcy Roads
Westmead NSW 2145

Telephone: (02) 9845 9634
Facsimile: (02) 9845 9636
Email: margaret.piper@health.nsw.gov.au

31 March 2016

To Whom It May Concern

Research Office reference: 4597
HREC reference number: LNR/15/HAWKE/356
SSA reference number: LNRSSA/16/WMEAD/48
Project title: Electronic cigarettes in Australia: knowledge, attitudes and potential applications in perioperative care

Nia Luxton is an external researcher from Macquarie University, who will be undertaking the following study activity:

- liaising with physiotherapy and cardiothoracic staff about the study
- informing potential participants about the study
- consenting participants and
- conducting interviews

at Westmead Hospital for the above study from 31 March 2016 to 1 November 2017.

Nia Luxton is being supervised by Katrina Rose, Physiotherapy Dept, Ph: 9845 6500 whilst at Westmead Hospital.

The Research Governance Officer has sighted the following ID of Nia Luxton:

- Driver Licence number: 13893911
- Macquarie University student card number 43904769.

Stafflink: 60072118

Please contact me if you have any queries on 9845 9634.

Yours faithfully

Maggie Piper
WSLHD Research Governance Officer

c.c Katrina Rose, Physiotherapy Dept, Westmead Hospital

WSLHD Research Governance Officer
Room 2050 Research & Education Network Building
Westmead Hospital
Cnr Hawkesbury and Darcy Roads
Westmead NSW 2145

Telephone: (02) 9845 9634
Facsimile: (02) 9845 9636
Email: margaret.piper@health.nsw.gov.au

31 March 2016

Katrina Rose
Physiotherapy Dept
Westmead Hospital

Dear Ms Rose

Research Office reference: 4597
HREC reference number: LNR/15/HAWKE/356
SSA reference number: LNRSSA/16/WMEAD/48
Project title: Electronic cigarettes in Australia: knowledge, attitudes and potential applications in perioperative care
Protocol number: version 3 dated 8 March 2016

Thank you for submitting a Low/Negligible Risk (LNR) application for site authorisation of this project. I am pleased to inform you that site authorisation has been granted for this study to take place at the following site:

- Westmead Hospital

The approved information and consent documents for use at this site are:

- Participant Information Sheet and Consent Westmead Hospital version 2 dated 9 March 2016 based on master version 2 dated 8 March 2016

- Letter to Western Sydney Local Health District Cardiothoracic Surgeons version 1

The following conditions apply to this research project. These are additional to those conditions imposed by the Human Research Ethics Committee that granted ethical approval:

1. Nia Luxton, Macquarie University researcher has been accredited as external researcher to conduct study visits within WSLHD

2. Proposed amendments to the research protocol or conduct of the research which may affect the ethical acceptability of the project, and which are submitted to the lead HREC for review, are copied to the research governance officer;

3. Proposed amendments to the research protocol or conduct of the research which may affect the ongoing site acceptability of the project, are to be submitted to the research governance officer.

Yours faithfully

Maggie Piper
WSLHD Research Governance Officer

c.c Nia Luxton, Building C3A, Balaclava Rd, Macquarie

Appendix B: Patient information sheet

Hospital Logo

Title	Electronic cigarettes in Australia: Knowledge, attitudes and potential applications in perioperative care.
Coordinating Investigator	Nia Angharad Luxton
Associate Investigator(s)	
Location	

Part 1 What does my participation involve?

1 Introduction

You are invited to take part in this research project, which is called the Electronic cigarettes in Australia: knowledge, attitudes and potential applications in perioperative care.

You have been invited because you have been identified as a current or former smoker by the clinical staff. Your contact details were obtained from clinical staff in the ward/pre-admission clinic.

Before you decide whether or not you wish to participate in this study, it is important for you to understand why the research is being done and what it will involve. Please take the time to read the following information carefully and discuss it with others if you wish.

Please read this information carefully and ask questions about anything that you don't understand or want to know more about.

Participation in this research is completely voluntary. If you don't wish to take part, you don't have to. If you decide you want to take part in the research project, you will be asked to sign the consent section.

By signing it you are telling us that you:
• Understand what you have read
• Consent to take part in the research project
• Consent to the use of your personal and health information as described.
You will be given a copy of this Participant Information and Consent Form to keep.

2 What is the purpose of this research?

The purpose of this research is to explore the potential use of electronic cigarettes in the perioperative period of cardiothoracic surgery. Stopping smoking is highly preferable prior to and after heart and lung surgery to reduce possible complications after surgery. However, for some individuals stopping tobacco use is difficult.

This study aims to determine the attitudes and beliefs of electronic cigarettes as a possible way to reduce the harm caused by tobacco in people having heart and lung surgery. Patients scheduled for cardiothoracic surgery, and their surgeons, will be asked their views on electronic cigarettes in general, and whether they seem like a possible way of reducing cigarette smoking prior to cardiothoracic surgery. This information has not been gathered in Australia up until now. Similar studies have been completed in the USA and the UK.

The results of this research will be used by the researcher Nia Angharad Luxton as part of her requirements for the Doctor of Philosophy degree at Macquarie University in Sydney. This research has been initiated by the researcher, Nia Angharad Luxton from the Department of Psychology, Faculty of Human Sciences.

3 What does participation in this research involve?

If you agree to participate in this study, you will be asked to sign the Participant Consent Form. The steps involved in this study are:

- A short interview (face to face) and an electronic survey (on a handheld computer) to complete during the interview.
- The study will be recorded by Nia Luxton, on paper, through the electronic survey and also audio-recorded to ensure nothing is missed.

This research project has been designed to make sure the researchers interpret the results in a fair and appropriate way and avoids study doctors or participants jumping to conclusions.

4 Other relevant information about the research project

- Participation in this study will not cost you anything, and you will not be paid for participating.
- The study is overseen by the Head of Cardiothoracic Surgery Department at X Hospital.

5 Do I have to take part in this research project?

Participation in any research project is voluntary. If you do not wish to take part, you do not have to. If you decide to take part and later change your mind, you are free to withdraw from the project at any stage without any consequences. If you do consent to participate, you may withdraw at any time. If you decide to withdraw, you will be asked to complete and sign a 'Withdrawal of Consent' form, provided to you by the researcher.

Your decision whether to take part or not to take part, or to take part and then withdraw, will not affect your routine care, your relationship with professional staff or your relationships at X Hospital.

6 What are the possible benefits of taking part?

This study aims to further medical knowledge and awareness of electronic cigarettes as a potential tool to reduce tobacco-related surgical complications in the future, but it may not directly benefit you.

7 What are the possible risks and disadvantages of taking part?

You may feel that some of the questions that are asked are stressful or upsetting. If you do not wish to answer a question, you may skip it and go to the next question, or you may stop immediately. If you become upset or distressed as a result of your participation in the research project, the research team will be able to arrange for appropriate support.

Part 2 How is the research project being conducted?

8 What will happen to information about me?

Each participant will be given a unique alphanumerical code, which will be used when recording data generated by the survey or interview. Participants will be referred to using pseudonyms or code, e.g. Patient '1' only.

The information you give about yourself will be non-identifiable except for the consent form, on which you print your name and sign. The consent form and all data collected will be stored securely. Electronic copies of the data recorded during the interview and questionnaire will be stored on a password-protected laptop. Hard copies and back-up electronic data stored on a password-protected USB will be stored in a

locked filing cabinet in the office of Dr Ross Mackenzie, Department of Psychology at Macquarie University. The researcher Nia Luxton, and her supervisors, Dr Ross Mackenzie and Associate Professor Lisa Wynn are the only individuals who will have access to the data.

Data will be stored for a minimum of five years from the most recent publication of the research. Data will be destroyed after that date using Macquarie University's confidential document destruction facilities.

The personal information that the research team collect and use is information from the questionnaire and the semi-structured interview questions.

There is a possibility that data collected for this study may be useful to future studies. Any data used would meet the same standards of confidentiality safekeeping followed for this study, and we would seek approval of relevant ethics committees to use the data in future studies.

It is anticipated that the results of this research project will be published and/or presented in a variety of forums. In any publication and/or presentation, information will be provided in such a way that you cannot be identified, as no personal identifiers will be noted by the researcher.

Any information obtained for the purpose of this research project that can identify you will be treated as confidential and securely stored. It will be disclosed only with your permission, or as required by law.

9 Complaints and compensation

If you suffer any distress or psychological injury as a result of this research project, you should contact the research team as soon as possible. You will be assisted with arranging appropriate support.

10 Who is organising and funding the research?

This research project is being conducted by Nia Angharad Luxton. It is being funded by Macquarie University Postgraduate Fund.

11 Who has reviewed the research project?

All research in Australia involving humans is reviewed by an independent group of people called a Human Research Ethics Committee (HREC). The ethical aspects of this research project have been approved by the Northern Sydney Local Health District Human Research Ethics Committee. This project will be carried out according to the *National Statement on Ethical Conduct in Human Research (2007)*. This statement has been developed to protect the interests of people who agree to participate in human research studies.

12 Further information and who to contact

The person you may need to contact will depend on the nature of your query. If you want any further information concerning this project or if you have any problems which may be related to your involvement in the project, you can contact the researcher on 0404856160 or any of the following people:

Research contact person

Name	Nia Angharad Luxton
Position	PhD student, Department of Psychology, Macquarie University
Telephone	02 9850 6393 / 0404856160
Email	Nia-anghard.luxton@students.mq.edu.au

For matters relating to research at the site at which you are participating, the details of the local site complaints person are:

Site contact person for complaints (specific to each hospital)

Name	
Telephone	
Email	

If you have any complaints about any aspect of the project, the way it is being conducted or any questions about being a research participant in general, then you may contact:

Reviewing HREC approving this research and HREC Executive Officer details

Reviewing HREC name	Northern Sydney Local Health District Human Research Ethics Committee
HREC Executive Officer	Research Ethics Manager
Telephone	02 9926 4590
Email	NSLHD-research@health.nsw.gov.au

Hospital Logo

Consent Form

Title	Electronic cigarettes in Australia: Knowledge, attitudes and potential applications in perioperative care.
Coordinating Investigator	Nia Angharad Luxton
Associate Investigators	
Location	

Declaration by Participant

I have read the Participant Information Sheet or someone has read it to me in a language that I understand.

I understand the purposes, procedures and risks of the research described in the project.

I have had an opportunity to ask questions and I am satisfied with the answers I have received.

I freely agree to participate in this research project as described and understand that I am free to withdraw at any time during the project without affecting my future care.

I understand that I will be given a signed copy of this document to keep.

Name of Participant (please print) _____

Signature _____ Date _____

Declaration by Researcher[†]

I have given a verbal explanation of the research project, its procedures and risks and I believe that the participant has understood that explanation.

Name of Researcher[†] (please print) _____

Signature _____ Date _____

[†] An appropriately qualified member of the research team must provide the explanation of, and information concerning, the research project.

Note: All parties signing the consent section must date their own signature.

Hospital Logo

Form for Withdrawal of Participation - *Adult providing own consent*

Title	Electronic cigarettes in Australia: Knowledge, attitudes and potential applications in perioperative care.
Coordinating Investigator	Nia Angharad Luxton
Associate Investigators	
Location	

Declaration by Participant

I wish to withdraw from participation in the above research project and understand that such withdrawal will not affect my routine care, or my relationships with the researchers or site name.

Name of Participant (please print) _____

Signature _____ Date _____

In the event that the participant's decision to withdraw is communicated verbally, the Researcher must provide a description of the circumstances below.

Note: All parties signing the consent section must date their own signature.

Appendix C: Methodology

As outlined in Chapter 1: Introduction, there is little research on the use of electronic cigarettes in the clinical context, particularly in the area of cardiothoracic surgery worldwide and in Australia. The research presented in this thesis aimed to explore the knowledge and views of clinicians and patients about the potential role of electronic cigarettes as a smoking cessation aid in the perioperative period. Table 1.1 provided a brief overview of the methodology used in this thesis. This appendix gives a brief explanation of the research design and the methodology that supports it, and why this particular approach was chosen.

Context: The perioperative period of cardiothoracic surgery and smoking cessation

The perioperative period for major surgery, such as cardiothoracic surgery, in NSW public and private hospital sectors involves the cardiothoracic surgeon and a multidisciplinary team that includes anaesthetists, nurses and physiotherapists. At different stages of the patient's perioperative journey, different team members provide patient centred care more closely than at other stages (Figure C.1).

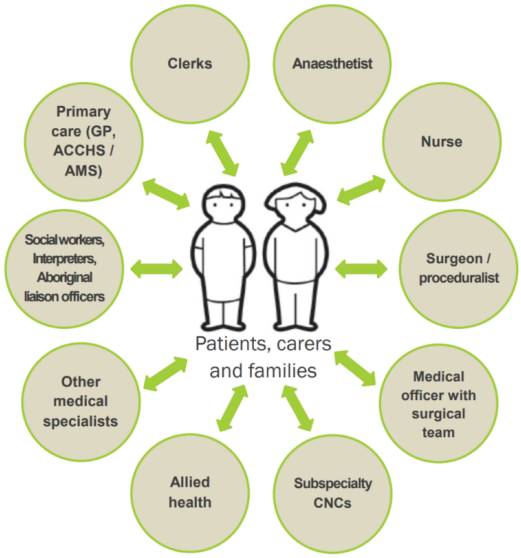


Figure C.1 The perioperative multidisciplinary team in Australia. Source: Agency for Clinical Innovation (2016).

For example, before and after hospital admission, primary healthcare providers, such as the patient's general practitioner (GP), provide care. Preoperatively, at different time intervals, it is the surgeon,

anaesthetist, preadmission nursing staff and physiotherapists. Intraoperatively, it is the surgeon, the anaesthetist and the operating theatre nursing team. Postoperatively, the patient is primarily cared for by the surgeon and surgeon's medical team, the cardiothoracic ward nursing team and physiotherapists. If the hospital has a clinical nurse consultant, or the surgeon or team has a cardiothoracic case manager, they will be involved throughout each stage.

In Australia, the preadmission clinic is an outpatient clinic that ensures patients are comprehensively prepared for surgery and hospital stay prior to admission (Agency for Clinical Innovation, 2016). The purpose of preadmission is to optimise the patient's health, ensuring the best surgical outcome by conducting multidisciplinary interviews in order to commence any necessary preadmission medication or treatment; explain the surgical procedure, risks and expected outcomes; determine options and preferences for hospital care and treatment, as well as patient concerns; assess the need for postoperative rehabilitation, the presence of a support person or carer, the home environment, and any social issues which need to be attended to; and to obtain the patient's informed consent.

The six hospital sites that were included were three public tertiary hospitals and three private hospitals where the cardiothoracic surgeons operated (ethics information in Appendix A). These were:

1. Royal North Shore Hospital (public) and North Shore Private Hospital (private)

2. Royal Prince Alfred Hospital (public) and Macquarie University Hospital (private)

3. Westmead Hospital (public) and Westmead Private Hospital (private).

Each of the six hospital sites included in this thesis has developed and implemented its own preadmission clinic model. In the three public hospitals, all patients scheduled for elective cardiothoracic surgery are required to attend the clinic unless they were transferred from another hospital (and admitted as an inpatient), lived interstate, in rural or remote areas, or their diagnosis or state of health prohibited this. Each patient is interviewed by a nurse, physiotherapist, anaesthetist and a member of the surgeon's medical team, and undergoes various tests, such as chest x-rays, blood tests and spirometry, in accordance with the surgeon's protocol. At the time of the interviews for this thesis, the three private hospitals did not have a multidisciplinary preadmission clinic for

cardiothoracic patients. These patients were assessed and received preoperative information through telephone calls (nursing), or face-to-face on their hospital admission the day before surgery (nursing, physiotherapists and anaesthetists).

As noted in Chapter 1: Introduction, current evidence supports that assistance and support for smoking cessation is recommended to occur at each clinician-patient contact throughout the perioperative period. The NSW Health website provides extensive information for clinicians working in public hospitals that includes current clinical smoking cessation guidelines, information on electronic cigarettes, and information on the NSW Health Smoke-free Health Care Policy (NSW Health, 2015, 2018). This policy states that: all NSW health buildings and grounds are smoke free except for designated outdoor smoking areas; all patients should be asked about their smoking status on admission; and those who smoke should be offered brief intervention to manage their nicotine dependence. In addition clinicians are expected to be able to provide effective evidence-based management of nicotine dependence; document the patient's smoking status and actions taken to support patients to manage their nicotine dependence; monitor patients for withdrawal symptoms and cravings and ensure these are adequately controlled during their admission; and arrange follow-up support on discharge including a referral letter to the patient's GP and referral to NSW Quitline 13 7848. In contrast, private hospitals are neither mandated under the NSW Health Smoke-free Health Care Policy to have smoke free areas nor their clinicians to provide cessation advice and pharmacotherapy.

Study design: Studies I–III

As noted in Chapter 1: Introduction, the aims of this thesis are to: firstly, examine the views and practices of Australian cardiothoracic clinicians about electronic cigarettes, and the potential role of electronic cigarettes to reduce postoperative complications caused by tobacco smoking and create a sustained quit attempt; and secondly, to examine the awareness, use and beliefs of electronic cigarettes and their potential role as a smoking cessation aid in the perioperative period in patients diagnosed with coronary artery disease or lung cancer awaiting cardiothoracic surgery. In order to achieve these aims both qualitative and quantitative research methodology were employed.

Quantitative research typically aligns with a positivist paradigm, where there is belief in an external reality that can be "discovered" through the use of rigorous experimentation. Qualitative research often takes a more constructivist approach, believing that reality is created by individuals. A qualitative exploratory design involving one-on-one interviews with both clinicians (Study I and II) and patients (Study III) formed the foundation of this thesis, because beliefs and views are subjective and context-specific. The transcribed data from all interviews were analysed using the qualitative approach of "framework" analysis in order to elicit common themes, identify trends and association in the data, and generate an understanding of the knowledge, beliefs and views of the clinician and patient population. Framework analysis is not aligned to any particular epistemological, philosophical or theoretical approach, and can be used with a range of qualitative approaches (Gale et al., 2013).

In addition to the qualitative interviews, Study III included a patient survey, previously used in the perioperative patient population (Kadimpati et al., 2015; Nolan et al., 2016). The aim of the mixed methods design was to provide complementary data on the topic of electronic cigarettes as a tool to reduce or stop smoking in the perioperative period, and triangulate data sources. According to Shih (1998) there are two main reasons for triangulation: to confirm findings, or add to the completeness of findings; and to increase the depth and understanding of a phenomenon through the combination of methods and theories. The use of multiple types of inquiry may yield concurring or conflicting results and offer opportunities for richer, more comprehensive findings, while posing new opportunities for a deeper understanding of the data and consideration of further research questions (Rapport et al., 2018).

Studies I and II

In order to determine the views of clinicians about electronic cigarettes as a method of smoking cessation, the aim of the first part of the semi-structured interviews was to assess the knowledge and views of the clinicians about tobacco use in the perioperative period; the importance placed on a patient's perioperative abstinence; their methods of delivering smoking cessation advice; and knowledge of the 5A's approach to smoking cessation recommended either by NSW Health (2015) or by the RACGP (2014). These findings form the basis of Study I. The aim of the second part of the

interview, which forms the basis of Study II, was to explore the clinicians' views about electronic cigarettes as a smoking cessation method. Their awareness and knowledge about current regulations surrounding electronic cigarettes and their comfort in talking with patients about electronic cigarettes was explored. Similarly, clinicians' views of the potential role of electronic cigarettes to achieve tobacco smoking abstinence prior to cardiothoracic surgery in patients who cannot or will not cease despite advice were also examined.

Data analysis

All clinician interviews were audio recorded and transcribed verbatim by a professional service. Transcriptions of the interviews did not include names or any other identifying information that could be linked back to the clinicians. Interview data was coded and organised using NVivo version 11 Software (QSR International).

For both studies (I and II), the six phases of thematic analysis as proposed by Braun and Clarke (2006) were used:

1. Familiarisation with the interview transcripts was undertaken by reading, re-reading and listening to the audio-recording.

2. The generation of initial codes was created to organise the data in order to identify and develop themes and a coding frame was generated to help answer the research questions in a balanced way (Fereday & Muir-Cochrane, 2006). The codes were entered as nodes (categories) into NVivo version 11 Software (QSR International). To test the reliability of the code framework for analysis and determine the applicability of the code to the raw information (Boyatzis, 1998), a fellow researcher separately coded six to eight interviews (Study I and Study II were coded by two different supervisors). The results were compared, and more inductive codes were suggested.

3. Identifying initial themes. The codes and sub-codes from the data that referred to particular meanings and language of the clinicians were created into potential themes which were clustered under headings that directly related to the research questions (Braun & Clarke, 2006; Crabtree & Miller, 1999).

4. The themes were reviewed and organised by re-reading the coded text and refining some coding and identifying potential new themes.

5. The major themes were defined.

6. The interpretation process was achieved after several iterations for the text, codes and themes to establish an explanatory framework that clarified the views of the clinicians about tobacco use and smoking cessation in the perioperative period, and the role of electronic cigarettes.

The final phase of the analysis process differed between Studies I and II. In Study II, a deductive phase was undertaken that was informed by the Behaviour Change Wheel (BCW) (Michie, Atkins & West, 2014). This is a theoretically driven framework based on multiple models of health behaviour, designed to enable the systematic development of interventions for supporting behaviour change. It is underpinned by the 'COM-B' model which consists of three necessary conditions for a given 'Behaviour' to occur: (1) 'Capability' (psychological/physical); (2) 'Opportunity' (physical/social); and (3) 'Motivation' (reflective/automatic) (see Figure C.2).

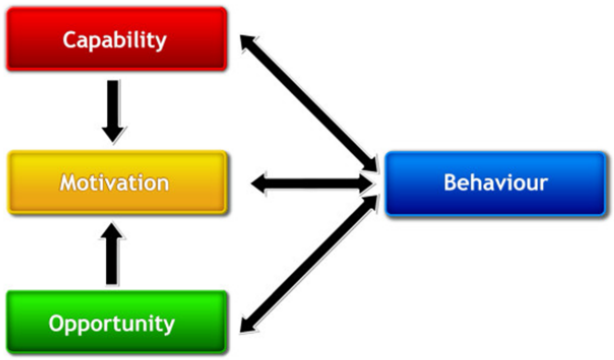


Figure C.2 The COM-B system – a framework for understanding behaviour. Source: Michie, Atkins and West (2014).

In Study II on the views of clinicians about electronic cigarettes and smoking cessation in the perioperative period of cardiothoracic surgery, the themes were related back to the research question

and the extant literature, and selected extracts of clinicians' views were chosen (Braun & Clarke, 2006).

Research design for Study III

Mixed-method research involves philosophical assumptions that guide the direction of the collection and analysis of data and the mixture of qualitative and quantitative data in a single study or series of studies. Through the use of quantitative and qualitative approaches in combination, the end result is proposed to be a better understanding of the research problem than either approach alone (Creswell & Plano Clark, 2017). For example, quantitative survey research would allow for the study of a larger cohort of cardiothoracic patients awaiting surgery in NSW or throughout Australia, and the results would be more generalisable to the Australian patient population. However, the results would provide little understanding to the context or setting in which patients are experiencing their cardiothoracic surgical journey. On the other hand, qualitative research methodology offers depth and breadth to individual patients' experiences but is often regarded as deficient because of the personal interpretations made by the researcher, and limited generalisability due to small sample sizes (Creswell & Plano Clark, 2017).

Based on extant studies and literature from experts in the areas of perioperative smoking cessation, Study III involved a quantitative survey about smoking and electronic cigarettes that has been previously used in the perioperative period (Kadimpati et al., 2015; Nolan et al., 2016). The preceding face-to-face interview used the same questions on electronic cigarettes, with the view that more open-ended responses will elicit more qualitative, detailed accounts of the knowledge and use of electronic cigarettes, and their beliefs on the potential advantages and disadvantages of electronic cigarettes in general and prior to surgery.

The survey, created in Qualtrics, the survey software recommended by Macquarie University, collected basic demographic data, background information, the patient's smoking history and the Fagerström Test for Nicotine Dependence. It also measured the patient's knowledge of health risks of smoking prior to surgery on a valid 4-item scale (Yu et al., 2013), but the "Perception of Health Risk"

questions were adapted to exclude the 3-item health concern index from the original research (Kadimpati et al., 2015). These were: 1. "How much do you think your health would benefit if you were to quit smoking for good?"; 2. "How worried are you, if at all, that smoking will damage your health?"; and 3. "How worried are you, if at all, that smoking will cause problems with your surgery?" with responses including "not at all", "a little" and "very much" (Kadimpati et al., 2015). This decision was made jointly between the researcher and a supervisor (RM) as it was considered that the questions would cause distress to patients awaiting cardiothoracic surgery in the preoperative period. The reasoning was based on current Australian research that suggests patients diagnosed with a tobacco-related disease, such as lung cancer, may feel unnecessary stigma, guilt regarding their smoking history and other negative feelings (Lung Foundation Australia, 2018), and also on the researcher's extensive clinical background and the supervisor's research experience.

Data analysis for Study III

Firstly, data from the survey were entered into Microsoft Excel and analysed using the computer software Statistical Package for Social Science (SPSS – version 21.0 Inc Chicago, IL, USA) and $p<0.05$ was defined as statistically significant. Both descriptive and inferential statistical analysis was used to explore the patient population, including any differences between grouping variables (e.g. smoking history, gender, residence, level of education, intention to quit prior to surgery, electronic cigarette items), and in-depth relationships between variables (Barnes & Lewin, 2011).

Data from the patient interviews were audio recorded and transcribed verbatim by a professional service. Transcriptions of the interviews, and survey information in Qualtrics and Microsoft Excel, did not include names or any other identifying information that could be linked back to the patients. Interview data was coded and organised using NVivo version 11 Software (QSR International). The framework approach for interview data analysis was used to label, classify and organise data in relation to main themes, concepts and categories (Ritchie et al., 2013).

In this study, a convergent parallel mixed method study design was used where implementation of the quantitative and qualitative components of the study occurred during the same phase of the research process, thus prioritising both methods equally (Creswell & Plano Clark, 2017). Moreover, the quantitative and qualitative components of this study were independently analysed and then, during final interpretations of the study, findings were triangulated to present an overall interpretation of the study results (Figure C.3).

Figure C.3 Mixed-method design to address thesis aim 2

Research reflexivity and rigour

It is recognised that within data analysis, the process of interpretation of data is a reflexive exercise through which meanings are made rather than found (Mauthner & Doucet, 2003). It is also argued that qualitative data researchers need to show sensitivity on how they interpret a social situation or process. By reporting how and why they did what they did from a particular background and set of values, they can help the reader determine whether, or how, the researchers' perspectives influenced their conclusions (Altheide & Johnson, 2011).

The importance of being reflexive was realised by the researcher when conducting the research, and the researcher remained constantly aware of any biases and preconceived assumptions to smoking, addiction and electronic cigarettes, which may influence the interviews and interpretations of the findings. Moreover, the exposure to media internationally and in Australia throughout the study presented the researcher with often inconsistent and contradictory information about electronic

cigarettes, and required frequent reflections on the effect of information on the researcher's attitude towards electronic cigarettes and interpretation of the data.

Rigour refers to the quality of the research, and trustworthiness ensures that the study findings are representative of the experiences of participants in relation to the study processes and procedures, and that these experiences are offered by the participants themselves (Rapport et al., 2018). Rigour and trustworthiness in qualitative research are analogous to validity and reliability normally associated with quantitative research. Speziale, Streubert and Carpenter (2011) suggest that if a researcher has demonstrated rigour throughout their qualitative study, then the experiences of their participants have been accurately interpreted and represented. In order to establish 'rigour' in the qualitative aspects of the three studies, the researcher applied a set of criteria by Sandelowski (1986), based on the work of Guba and Lincoln (1981): credibility, auditability, fittingness and confirmability.

Credibility refers to the truth of findings as judged by others related to research (Sandelowski, 1986). This was established through extended engagement of the researcher with the subject matter, and repeated peer debriefing with PhD supervisors, peers and colleagues. These individuals had vast experience in a wide variety of research methods (qualitative, quantitative and mixed methods), the clinical environment, and areas of smoking, smoking cessation and electronic cigarettes (Long & Johnson, 2000). Auditability refers to providing an audit trail which can be easily followed and understood (Sandelowski, 1986), and this was provided to the supervisors throughout the research process. Fittingness involves the use of other literature to support or refute concepts found in the data (Sandelowski, 1986). Throughout the study, the researcher discussed and related major themes and findings of the studies to previously reported research on and around the topic of smoking cessation and electronic cigarettes in the perioperative period. Confirmability, established when standards of credibility, auditability, and fittingness have been demonstrated, has been shown by the researcher throughout the data analysis and interpretation and portrayed in the three published studies of the thesis.

Researcher's position

Through my position as a clinical cardiorespiratory physiotherapist, I have seen the negative impact of smoking on people and their families. I have also seen the persistent lack of cessation support and resources offered throughout the perioperative period, and beyond for over 20 years in the UK and Australia. Therefore, I came to this research driven by a need to understand why clinical smoking cessation guidelines were not adhered to despite the widespread knowledge that smoking leads to postoperative complications and either recurrence or occurrence of lung cancer or a cardiovascular event. Additionally, I had developed a curiosity about electronic cigarettes through conversations with patients and families as they attempted to quit smoking after many other unsuccessful attempts with other cessation methods.

There have been positive steps towards the implementation of smoking cessation guidelines through the course of this research, including the release of the Cancer Institute NSW framework, with clearer guidance for local health districts and hospitals to embed smoking cessation support in the healthcare environment. Private hospitals have also become more proactive in their smoke-free policies, although staff education and engagement is still lacking, and should be addressed for the benefit of the patient.

I do not view electronic cigarettes as harmless, nor a panacea to create a tobacco-free society. However, at the end of my research, I feel that electronic cigarettes may be a feasible form of NRT in the perioperative period, for certain patients for whom nicotine dependence and psychological or socio-economic factors mean the struggle to quit before and after surgery is extremely difficult. Electronic cigarettes, coupled with behavioural support, may be useful to prevent a return to smoking in the stress of imminent cardiothoracic surgery and afterwards, postoperatively, as patients recover from what is often an intense, harrowing experience and negotiate a life without smoking.