NEW ZEALAND NURSES ORGANISATION | TŌPŪTANGA TAPUHI KAITIAKI O AOTEAROA

PERIOPERATIVE NURSES COLLEGE N.Z.N.O

The Dissector

Journal of the Perioperative Nurses College of the New Zealand Nurses Organisation

September – November 2024 Volume 52, Number 2

MEDICAL IMAGING
MRI safety: avoiding risks related to MRI scanning

CLINICAL
Physiological impact of acute intervention: trachea and endotracheal intubation

RESEARCH REPORT
Electrosurgical Smoke Control Practices among NZ operating theatre personnel: A qualitative study

FROM THE ARCHIVES
Parental presence in the anaesthetic care unit

SIMEON MEDICAL

PUSHING TECHNOLOGY TO EXCELLENCE

Keyport

Specialist Medical Equipment and Services

www.keyport.co.nz

Tel: 0800 Keyport Email: sales@keyport.co.nz

Sim.MOVE 800

Business-class with high-end characteristics

A table for all occasions: SIMEON presents a mobile operating table for maximum OR flexibility.

Combining SIMEON's 20 years' in manufacturing medical technology products for the OR, the all new Sim.MOVE 800 is a true multi-functional operating room table.

Developed in close cooperation with surgeons, the Sim. MOVE 800 is a practical user-friendly product that makes working in the OR easier while helping increase patient safety.

Universally applicable for all common applications and specialist areas with an extremely durable 454 kg (static) maximum load.

- General Surgery
- Neurosurgery
- Thoracic surgery
- Minimally Invasive surgery
- Gynecology and urology
- ENT/CMF/Ophthalmology

SIMEON MEDICAL your OR solution provider

Spring has sprung…

Tēnā koutou katoa. Welcome to the September-November issue of *The Dissector*. It's definitely late spring here and I'm very grateful that the days are getting longer and warmer again.

It feels like we've had another tough winter, though perhaps not so much due to cold and wet weather this year. Hopefully we're starting to see the end of the winter ills and chills. I do hope that you've been taking time to care for your own health and wellbeing, which is so important for nurses as we spend every day looking after others.

As I write this, I am looking forward to attending the Perioperative Nurses College (PNC[NZNO]) conference in Wellington in October. Now that we have biennial conferences, it feels like it's been a long time since we have been able to gather together. I'm really looking forward to connecting with my colleagues throughout the country. I hope to see you there.

Look out for full coverage of the 2024 PNC Conference in the December-February issue. There is a lot to cover!

Post-graduate study

In this issue we have two articles based on post-graduate study. It's so wonderful to see research studies and assignments published in *The Dissector* and they are a wonderful way to share your learning with others. If you are currently studying (or have recently finished), we welcome your contributions. You can find out more by reading our writing guidelines.

Electrosurgical smoke control practices

Electrosurgical smoke plume has been the discussion of many articles in previous issues of *The Dissector*. In this issue first time author Assunta Rodrigues conducted an exploratory-descriptive qualitative research study, aiming to develop a better understanding of operating room staff's attitude towards personnel's attitudes towards electrosurgical smoke evacuation and how it influenced their practice. Assunta and her research supervisor Rhona Winnington have provided us with an overview of the study, including findings, discussion and recommendations, which are relevant to all nurses working with electrosurgical devices in the operating rooms.

Tracheal and Endotracheal Intubation

Marvin Jr. Gonzales has provided an article based on a post-graduate assignment from completing a Postgraduate Certificate in Specialty Care (Perioperative Nursing) from Whitireia. Marvin writes about the physiology of the respiratory system and describes the nursing implications for a patient when injury occurs to the trachea during endotracheal tube insertion.

MRI Safety

Our medical imaging article is from Liying Duan, winner of the PNC Best Article award last year. Liying writes about Magnetic Resonance Imaging (MRI) arguing that, if safety guidelines are not strictly followed, MRI can be dangerous for both the patient and staff. Liying reviews the risks related to MRI scanning and provides key information required to ensure the safety of all people in the MRI environment.

50th Anniversary

We continue to re-publish award-winning perioperative nursing articles for our 50th anniversary this year. Thanks again to Karen Hall for delving into the archives for us, even from her holiday abroad! The third of our award-winning articles is Chris Brace's *Parental Presence in the post anaesthesia care unit* (PACU). Chris's article discusses the concept of parental presence in the PACU, arguing the benefits to staff, paediatric patients and their parents. This historical article, published in 1999 (Vol. No. 3) yet again demonstrates nursing practice concepts that remain thought-provoking and relevant in today's clinical environment.

Editorial Committee

We are looking for an Editorial Committee member with a medical imaging background. If you are interested in joining us, please consider submitting a letter expressing your interest with a copy of your CV to the PNC secretary on pnc.sec@xtra.co.nz and include *The Dissector* Chief Editor on dissector.editor@gmail.com. For further information on the role and responsibilities of the editorial committee please contact the Chief Editor.

Noho ora mai

— Bron Taylor, Chief Editor

The Dissector
The official Journal of the Perioperative Nurses College of the New Zealand Nurses Organisation (PNCNZNO).
www.nzno.org.nz/groups/colleges/perioperative_nurses_college

September – November 2024, Volume 52, Number 2
The Dissector is published quarterly (March, June, September, December) on behalf of the College by Advantage Publishing Ltd.

EDITOR: BRON TAYLOR
Email: dissector.editor@gmail.com

ADVERTISING: MICHAEL ESDAILE
Email: michael@advantagepublishing.co.nz
Tel: 09 416 5309 / 027 495 4510

CIRCULATION *The Dissector* is emailed direct to all financial members of PNC, NZNO as well as paid subscribers, including medical industry representatives, libraries and nurse training institutions.

FOUNDING EDITOR: Pam Marley (1974 – 1979)

EDITORIAL MATERIAL The Editorial Committee welcomes articles, reports, book reviews, letters to the editor, practice issues, exemplars, case study experiences, research papers/projects, regional news etc. Please send your ideas to: dissector.editor@gmail.com

All editorial material is reviewed by the Editorial Committee. Whilst every effort is made to ensure accuracy, the Publishers and their agents take no responsibility whatsoever for errors, omissions, or any consequences of reliance on this material or the accuracy of information. The inclusion or exclusion of any product or advertisement in no way means the Publisher or the Perioperative Nurses College advocate or reject its use in any way.

AUTHOR GUIDELINES The Editorial Committee has developed Author Guidelines designed to help first-time authors, as well as those who have published previously. They are available by clicking this link.

CORRESPONDENCE The Editorial Committee welcomes all correspondence intended for publication. Correspondence should be addressed to the Editor, Bron Taylor: dissector.editor@gmail.com or call: 027 323 2857

PNC,NZNO WEBSITE
http://www.nzno.org.nz/groups/colleges/perioperative_nurses_college
SSN: 1174-7579

THE DISSECTOR

Contents

SEPTEMBER – NOVEMBER 2024
Volume 52, Number 2

3 EDITORIAL
Chief Editor Bron Taylor celebrates springtime...

6 TABLE TALK
Thanks for the memories: Perioperative Nurses College Chair Cassandra Raj bids farewell...

10 NEWS
Operating theatre nurses who worked at Waikato Hospital between the 1960s and 2015 are invited to a reunion — on May 17, 2025.

12 MEDICAL IMAGING
MRI accidents are the least frequent among all medical accidents but if safety guidelines are not strictly followed, MRI can be dangerous for both the patient and staff. Liying Duan provides the details...

17 CLINICAL
Marvin Jr Gonzales explores the physiology of the respiratory system, (the airway) and details the nursing implications for the patient when injury occurs to the trachea during endotracheal tube insertion.

20 FROM THE ARCHIVES
Chris Brace discusses the concept of parental presence in PACU and the implications for nurses and provides background information, discusses the benefits to all parties and highlights a deficiency in in patient care the author perceives.

24 RESEARCH REPORT
Despite increasing evidence on the hazardous nature of electrosurgical smoke (ESS), inconsistent electrosurgical smoke evacuation (ESSE) is a concern among operating theatre (OT) personnel at a large tertiary hospital in New Zealand (NZ). Assunta Rodrigues and Rhona Winnington explore the issues...

30 INDUSTRY NEWS
3M spins off healthcare into new company; Propax and Multisorb now with Multigate NZ; Operio – preventing Surgical Site Infections.

30 WEBINAR REVIEW
Acute Behavioural Disturbance in the PACU.

INDEX TO ADVERTISERS
Business Cards directory 31
ANSELL: Gammex non-latex gloves..... 9
CUBRO: Skytron Aurora Four 5
MEDIX 21: Operio SteriStay..... 7
Keyport: Sim.MOVE 800 OR table 2
Keyport: Simeon Surgical Lights.....32
Terumo: AGANI™ Needles 11

Effortless focus control

See precise detail without repositioning the light head

Skytron's Aurora Four surgical light allows surgical teams to see precise detail without repositioning the lighthead, adjusting the spot size or leaving the sterile field. The focal point adjusts according to the surgical team's preference – with just one twist of the handle.

Discover the Skytron Aurora Four

Enquire now at cubro.co.nz or call 0800 101 255

Cubro®

Thanks for the memories

It is with great sadness that I deliver my last Table Talk for one of the most valuable journals of New Zealand's perioperative nursing practice, *The Dissector*. The last two years have been truly successful, challenging and rewarding.

Acknowledgements

I would like to thank first and foremost Leanne Dalley, Secretary of Perioperative Nurses College (PNC) of New Zealand Nursing Organisation (NZNO). Leanne on my left, has been a constant support and an amazing sounding board throughout my time as Chairperson and I have grown alongside her to deliver to our members the best support, guidance and PNC[NZNO] representation I could offer, both nationally and internationally. Thank you Leanne.

Standing beside me on my right-hand side has been Suzanne, our NZNO Professional Nurse Advisor for PNC[NZNO]. The immense mentorship, leadership and insights have allowed such instrumental personal growth I could ever had imagined. Thank you Suzanne.

Surrounding all of us, including myself, has been the National Committee of Regional Representatives of PNC[NZNO], the Perioperative Practice Committee and *The Dissector* Editorial Committee. These members I am truly thankful to for their support, advice and ability to continue to strive for best practice for our patients and nurses of perioperative care. Thank you.

Achievements

Over the last two years, PNC[NZNO] and perioperative nursing in New Zealand have worked hard, brushed off the last threads of pandemics and natural disasters, and taken on the challenging government changes. These two years have been busy with pay equity, bargaining acts that have rolled after each other, leveraging health and safety in the regions and trying to raise the profile of a nurse and define the role of the nurse in the perioperative space. We are now using our political leverage to fight for staff safety and patient safety. Although we are in the thick of these negotiations, we can use what we learnt from past years to guide what we need as nurses and continue to deliver high quality and safe nursing practice, both in the wards and perioperative environments.

I want to thank all those who have worked in these spaces and supported each other to rise to each occasion and embrace the future. Our ability to keep the spirit of nursing true and continually deliver safe practice and protect our patients for safe surgery has been an amazing effort. I especially would like to thank the National Committee and sub-committees of PNC[NZNO] for a challenging, busy and active year. We have persevered to deliver our member needs and requests, our strategic plan including regular, relative, and nursing focused education and we have dedicated our time and effort to uphold the profession of perioperative nursing in New Zealand.

Some of our contributions include:

- Crate Weight Standard update with NZSSA in early 2024;
- NZNO constitutional reviews -2024 NZNO Conference;
- Free perioperative webinars continued to be delivered by the regions;
- Medical Sciences Council review and response to AT changing workforce (ongoing);
- Conference development for 2026 (ongoing);

Left to right: AORN representative Rebecca Vortman, PNC's Cassandra Raj, International Federation of Perioperative Nursing (IFPN) President Patrick Voight, FPN AORN Board member and AORN President, Nakeisha Tolliver, and AORN representative Deborah Spratt at the European Operating Room Nurses Association Global Conference in May.

- RNAA (anaesthetic nursing) Skills and Knowledge framework review (ongoing);
- 2024 Regional rules structure and development;
- Multiple submissions to practices and changes that intersect with perioperative practice in Aotearoa New Zealand;
- International meetings with IFPN, AORN and ACORN.

All this work coincides with our strategic aims and plan of providing excellence in patient care, ensuring PNC[NZNO] is a healthy and sustainable organization, with a strong perioperative nursing workforce contributing to the on-going professional development of perioperative nurses.

Conference 2024

Speaking of highlighting perioperative achievements, education and research, our 48th Biennial Conference held in Wellington from October 17-19 provided a major contribution.

This year's theme was '*Embracing the future: Everything counts*'. The conference aimed to deliver recent perioperative research, initiatives and case studies by nurses for nurses. All those who attended will have come away richer for the experience, supporting colleagues who presented and sharing their quality improvements, successes and hard mahi for perioperative practice in Aotearoa, New Zealand.

Education was delivered by poster presentations, breakout sessions, free paper presentations including keynote speakers specialising in perioperative practice and healthcare. A full report will be in the December-February issue. Look out for that.

Continued on page 8.

MEDIX21™

Clean Air Everywhere

Operio®, SteriStay® and Surgicube

✓ Smart ✓ Simple ✓ Safe

SteriStay®

A unique instrument table that protects your instruments and sterile products from airborne contamination.

Operio®

Ultra-clean air anywhere.

SurgiCube®

Ultra-clean protected area where it is needed the most.

Available exclusively from Medix21

www.medix21surgical.co.nz

Medix 21, 27 Jarden Mile, Ngauranga, Wellington 6035 **E:** camille@medix21.co.nz **P:** +64 21734 762

Opportunities for perioperative impact

Finally, I round out this last *Dissector* Table Talk of mine by sending out a challenge to all perioperative nurses to know and act upon our three most important key strategies which will support and guide you in your workplaces, but most of all protects our patients in the perioperative continuum of care.

1. Nurses remain central to the composition of the perioperative team

Aotearoa New Zealand remains focussed on retaining registered nurses and enrolled nurses as the team of the perioperative workforce. PNC[NZNO] is a key stakeholder in the responsiveness to the creation of other perioperative workforces and is working to ensure nurses in New Zealand maintain the representation of perioperative healthcare professionals.

Be a part of the change that affects your workplace.

2. Workforce development affecting surgical health targets

PNC[NZNO] continues to be a part of workforce development and raises concerns that healthcare professionals in the perioperative space need urgent succession and recruitment to sustain the need for planned elective care including acute and cancer surgery. PNC[NZNO] is concerned that workforce developments are not sufficient and that alternatives may be utilised to fill the gaps; i.e., Anaesthetic Technicians and Healthcare Assistants.

Be a preceptor to student nurses and graduating nurses in your workplace

3. Role of the nurse in Perioperative environment

Last year in July, Te Whatu Ora, Health New Zealand published the health workforce plan that documented large workforce gaps in staffing levels in surgical services. We need to ensure that nurses practice in the positions that require nurses. Understanding the role of the nurse is the first step in valuing our profession. We need to make an impact. We need to make a mark so employers and managers know that nurses are making the decisions and the choices that impact on perioperative healthcare and patient outcomes. The choices that lean on the science of standards, the choices that lean on the evidence of science. This is the role of the nurse and this is our role.

Spain's EORNA Conference Convenors, Amparo Rubio San Pedro (left), Esther Espunyes (right) flank PNC Chair Cassandra Raj.

Lead nursing in the perioperative space

"The respect of nursing and nurses is earned through the integrity of nursing, this is ours to uphold". – Cassandra Raj

Cassandra Raj Chairperson 2022 - 2024
Perioperative Nurses College
Tōpūtanga Tapuhi Kaitaiki O Aotearoa

Below: IFPN Board members at the 11th EORNA Global conference, Valencia Spain. This was in May, well before the city experienced a catastrophic flood.

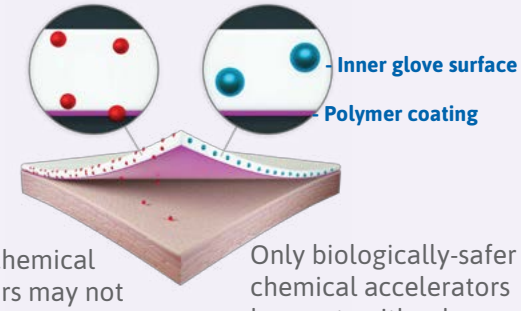
Skin-Friendly, Non-Sensitising PI Surgical Gloves with PI-KARE™ Technology

PI-KARE™ Technology eliminates standard chemical accelerators known to cause allergic contact dermatitis for low dermatitis potential; and, has resulted in the world's first full range of skin-friendly, non-sensitising Polyisoprene (PI) surgical gloves.

PI-KARE™
Skin-friendly, non-sensitizing
PI Technology

Traditional PI Products

PI Products with PI-KARE™ Technology



Standard chemical accelerators may not remain within the glove film and its residue, upon contact with skin, could result in Type IV chemical allergies and sensitivities.

Only biologically-safer chemical accelerators known to either be completely consumed during manufacturing or remain within the glove film and with better tolerance to skin, are used.

For more information, visit www.ansell.com/wei, or to purchase, visit www.eboshealthcare.co.nz

Featured products in the GAMMEX® Non-Latex PI range:

GAMMEX® PI
Exceptional instrument handling and grip

GAMMEX® PI Micro
15% thinner than Ansell's standard PI surgical gloves

GAMMEX® PI Underglove
Green colour for easy glove breach identification

GAMMEX®

Waikato Perioperative Nurses' Reunion planned in 2025

Operating theatre nurses who worked at Waikato Hospital between the 1960s and 2015 are invited to a reunion — on May 17, 2025.

Mark Saturday May 17, 2025 in your diary. This is the planned date for the reunion. It will include a few people still working. The event is being organised by Heather Glen, Jean Pettersen and Pauline Thomas, themselves all retired Waikato perioperative nurses.

It is not the first reunion of these nurses. It is 14 years since the last one and as Pauline Thomas puts it, "We are becoming an aging demographic", so it is timely to hold this soon. She anticipates between 50 and 80 attendees on the day.

The event is really a homage to this tight-knit group of nurses who were specially trained in the operating theatre during a unique period of time in the history of nursing. Perioperative nursing, which includes recovery nursing, was all learned in this arena.

Much was happening in surgery throughout that time. Techniques such as laparoscopic, general and thoracoscopic surgical procedures were being developed.

After the milestone of the first open heart surgery was achieved by Barrett Boyes in Auckland in 1958, cardiac surgery became a regular occurrence, as did the influx of other new surgical techniques, developments and refinements. This saw growing complexities in the operating theatre, which placed real demands for all working there, but also some truly amazing results.

Thomas herself was present at the first separation of conjoined twins at Waikato Hospital. Glen was very involved in organising both this, the first, and the second separation of conjoined twins.

Organisers of the Waikato operating theatre nurses reunion: Pauline Thomas (left), Heather Glen and Jean Pettersen.

DISPOSABLES...

This period of surgery saw the development of neuro and eye surgery, advancement in orthopaedic procedures, obesity and organ transplantation, so everything became more technical. Meanwhile we witnessed the move to disposable equipment as glass, dressings and other 'tools of the trade' were replaced by disposable equivalents.

"These were special times", comments Thomas. "There was a great deal of camaraderie, which helped us deal with the situations we were thrown into, many of us at a young age. We were dealing with life and death on a daily basis."

The reunion involves a lunch, display and presentation at Sky City, Hamilton, a wonderful opportunity for everyone to catch up, reminisce and share tales of the theatre. There may also be an opportunity to view a modern-day Waikato Hospital Theatre on Sunday May 18.

Right now, the organisers are looking for contacts. Many of the nurses have married, moved and changed address, and whilst the committee has a database of names and addresses, they need help finding some of the old team.

If you have contacts with fellow nurses, please email Pauline with names and email addresses to: omegahealth44@gmail.com so she can spread the word about the reunion.

Sky City Hamilton is the venue for the May 17, 2025 Waikato Operating Theatre Nurses reunion.

Terumo solutions for patient care

Needles for Filling and Filtering

Terumo offers clinicians flexibility with a range of blunt fill needles. Blunt fill needles minimise the risk of needlestick injuries, and a thin-walled cannula allows for faster medication draw-up, saving time.

- 90° or 40° blunt bevel to suit your application
- Thin walled cannula allows for faster draw up of medication
- DEHP and Latex free

Unisharp blunt fill needles have a red protective cap for quick identification.

The Unisharp blunt fill needle with 5 micron filter provides further protection to your patient by reducing particles when withdrawing medications from glass vials.

AN*1838N
AGANI drawing up blunt needle

UDR38
Unisharp blunt fill needle with red protective cap

UDF38
Unisharp blunt fill needle with 5 micron filter and red protective cap

Brand	Product Code	NZ Order Code	Colour	Bevel Type	Gauge	Length	Inner Box Qty	Carton Qty
						mm	Each	Each
AGANI	AN*1838N	1143998		Blunt 90°	18G	38	100	10000
Unisharp	UDR38	1179963		Blunt 40°	18G	38	100	10000
Unisharp	UDF38	1179964		Blunt 40°	18G	38	100	5000

Terumo Australia Pty Ltd
Macquarie Park NSW 2113 Australia
Mangere Auckland 2022 New Zealand
E: cs_australia@terumo.co.jp

T: 1800 837 866
T: 0800 66 77 57

MRI safety:

Avoiding risks related to MRI scanning

By Liying Duan

Abstract Magnetic Resonance Imaging or MRI is a valuable diagnostic tool using strong magnets and radio waves to produce detailed three dimensional images of particularly soft tissue organs. MRI accidents are the least frequent among all medical accidents. However, if safety guidelines are not strictly followed, MRI can be dangerous for both the patient and staff. Strict protocols, patient screening and both patient and staff education are critical to ensure patient and staff safety. This article reviews risks related to MRI scanning and highlights the key information that all staff need to be vigilant about to ensure the safety of all people in the MRI environment.

Key words: magnetic resonance imaging (MRI), MRI risks, patient screening, staff education

Introduction

Magnetic resonance imaging (MRI) safety is not a new topic, especially in the radiology department. All imaging staff working in radiology have some knowledge of the magnetic field relating to the MRI machine and that metal objects must be excluded from the MRI scanning room. However, even for professionals, especially those new to the environment or under pressure with staff shortages, working overtime, emergency events, or personal distractions, they may not always be as vigilant as necessary with screening procedures.

The general public often have no understanding of the difference between imaging modalities. While they may know that MRI involves a tunnel, there is typically limited understanding of the technology or risks, if it is their first scan. It is the health professional's duty to provide patients with safe care, maintain their own safety and meanwhile offer high quality and cost-effective care. This article, based on a PowerPoint developed for radiology nurse education at Te Toka Tumai, Auckland, offers a refresher on MRI safety knowledge and provides a reminder of the need for continued vigilance with screening and the importance of patient and staff education.

Magnetic Resonance Imaging (MRI)

MRI is a unique modality using powerful and rapidly changing magnetic fields, radio waves and a computer to generate detailed diagnostic three dimensional images. It offers detailed imaging of organs and tissues throughout the body to detect injury and disease processes, without the need for x-rays or "ionising" radiation. It is particularly useful for detailed imaging of the brain, spinal cord and nerves, as well as muscles, ligaments and tendons. Because it is minimally invasive and carries no risk of radiation exposure, MRI is widely used for diagnostic imaging (Inaguma et al., 2023; Mittendorff, Young & Sim, 2021).

If safe practices are followed, there are no known side-effects of a MRI examination (Inaguma et al., 2023; SMRT Safety Committee (SSC), 2017-2018).

To generate images, the MRI system uses three magnetic fields: the static, radio-frequency (RF) and the time-varying gradient magnetic field. The static magnetic field is produced by a large and powerful magnet.

There are three types of MRI magnets: permanent magnets, resistive magnets and superconductive magnets (SSC, 2017-2018). Most clinical magnets are superconducting utilising very cold cryogen gases to maintain the static magnetic field (Cross, Hoff & Kanal, 2018). Because turning the magnet off, known as quenching, involves the release of dangerous cryogenic gases, the magnet is always left on, meaning the machine is dangerous even when the scanner is not in operation (SSC, 2017-2018).

The MRI signal is created by radio-frequency (RF) pulses. The transmit RF coil inside the MRI scanner transmits the RF energy to the patient, then a receive coil, positioned around the patient's body in the area being imaged, detects signals from the patient. The gradient coils of the MRI system produce gradient magnetic fields that spatially vary in strength across the patient to help localise the signal for image formation.

Risks associated with MRI

MRI accidents are the least frequent among all medical accidents (Inaguma et al., 2023). However, if safety guidelines are not strictly followed, the MRI procedure can be dangerous for both the patient and the staff. The three magnetic fields each have their own safety risks, including magnetic forces on metals, acoustic noise, tissue

heating and burns, nerve stimulation and biomedical implant and device risk. All these risks can potentially cause significant harm or even death to people around the MRI scanner (Mittendorff et al., 2021).

Health professionals working in radiology must have appropriate understanding of these risks to ensure adverse events are avoided.

In this article, issues associated with these three electromagnetic fields are discussed, specifically the effects associated with metallic devices internal and external to patients and staffs. Other risks, such as the injection of gadolinium-based contrast agents, will not be addressed in this article.

... the magnet in a 1.5 Tesla scanner produces a magnetic field about 30,000 times stronger than that produced by the Earth.

MRI risks related to static magnetic field

The strong static magnetic field is the primary concern related to MRI safety (Cross et al., 2018). According to Shah & Aran (2023), the magnet in a 1.5 Tesla scanner produces a magnetic field about 30,000 times stronger than that produced by the Earth. The powerful magnetic field of the MR system can attract certain ferromagnetic metals, such as iron, and cause them to move suddenly and violently. This is known as the projectile or missile effect and carries the potential for severe injury and even death to people in the object's flight path (Mittendorff et al., 2021; SSC, 2017-2018). Stronger magnetic field strength equals stronger magnetic attraction, especially at the edges of the scanner bore (SSC, 2017-2018).

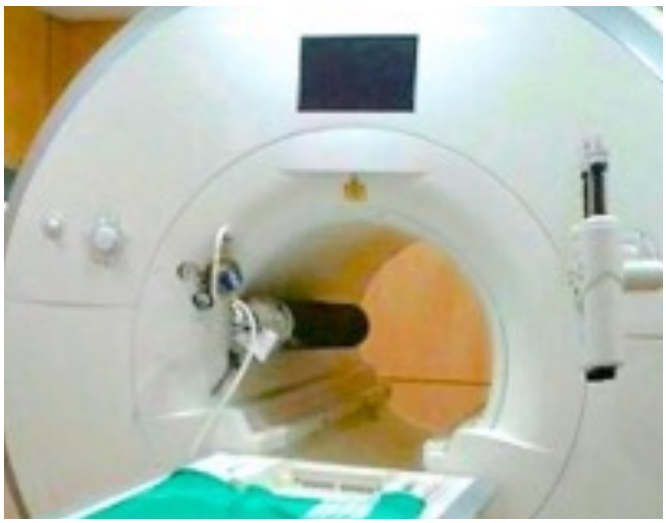
Any ferrous objects inadvertently brought into the MRI scanner room can be drawn into the magnetic field with force and potentially into the scanner. A paper clip may travel up to 80kms/h towards the MRI scanner in a 1.5 Tesla environment (SSC, 2017-2018). The speed of these objects attracted to the powerful magnet is enormous, and the trajectory is unknown and often erratic, leading to both potential harm and possible fatal accidents. Therefore, any person accessing the MRI room should be thoroughly screened to prevent any ferrous metallic objects such as screwdrivers, scissors, knives, and oxygen tanks from entering the room. Strict guidelines regarding access, responsibilities and training should be established and followed to avoid the potential risks and ensure competent and safe practice within the MRI environment.

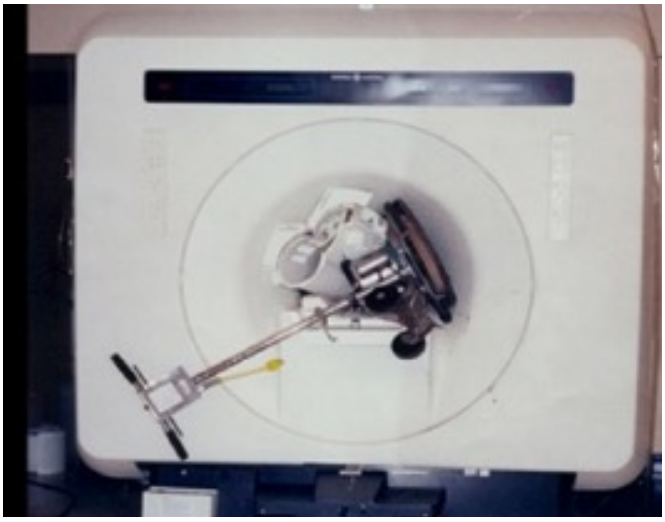
MRI risks related to radiofrequency field (RF)

The main risk of the RF field is the induction of an electrical charge within the body leading to RF burns. Burns are the most frequently reported adverse incident associated with MRI (Mittendorff et al., 2021). According to Mittendorff and his colleagues (2021), 59 percent of MRI adverse events reported in 2019 by the FDA's incident management system (MAUDE) related to thermal injury. Burns caused through MRI scanning are mainly due to electrically conductive materials brought into the scanner, direct contact with RF coils, proximity burns from contact with the scanner bore itself or an electrical loop formed by the patient's body (Mittendorff et al., 2021).

Because metals conduct electricity, when devices containing

Examples of RF induced burns (Images from Shellock, n. d., www.MRIsafety.com, as cited in Mittendorff et al., 2021): (A) fourth-degree burn immediately after MRI examination on a 5-week-old baby, caused by an MR Unsafe pulse monitor. This resulted in amputation of the forearm58 (B) burn resulting from an MR Unsafe pulse oximeter on the finger, post-escharotomy (C) second-degree burn after MRI examination from invisible metallic microfibres in clothing (D) first-degree burn around a tattoo after MRI.





Examples of projectile accidents in the MRI environment, clockwise from left: oxygen cylinder, wheelchair, stretcher bed and floor polisher. (Images from, Shellock, n. d., www.MRIsafety.com, as cited in Mittendorff et al., 2021)

metals are placed within the RF magnetic field, a concentration of electrical currents induced by RF can potentially cause excessive heating, leading to severe tissue damage (Mittendorff et al., 2021). A patient who had deep brain stimulation electrodes implanted for Parkinson's disease suffered permanent neurological damage when having an MRI scan of the lumbar spine (SSC, 2017-2018). Therefore, Mittendorff et al. (2021) pointed out that obtaining a thorough patient medical history is necessary to identify any previous surgery and/or injuries involving implanted devices prior to an MRI examination.

Because the skin itself is conductive, during RF deposition an electrical current can be induced at an area of highest resistance, such as where a closed loop is formed by fingers and thighs touching and can produce enough heat to cause tissue burns (Mittendorff et al., 2021). To minimize the risks of burns, it is important to ensure distance between the patient and the bore of the scanner and that no skin surfaces touch each other by using insulating materials. Meanwhile, application of RF power transfers energy to the patient, leading to variable degrees of temperature rise (Nordin et al., 2024), requiring particular care for geriatric or diabetic patients for whom the sensations of heat can be particularly disturbing.

MRI risks related to gradient magnetic field

The interaction between the static magnetic field and the gradient magnetic fields during scanning makes air vibrate and leads to a very high acoustic noise level. Exposure to noise in excess of 85 decibels can cause permanent damage to the hair cells in the inner ear, leading to hearing loss (Kihlberg et al., 2022). Sound levels in MRI can routinely be over 85 decibels which can potentially cause auditory damage and lead to tinnitus, discomfort, and hearing loss (Kihlberg et al., 2022). Hearing protection should be provided for all persons remaining in the scanner room.

Electrical currents can be induced by the changing magnetic field gradients, which can damage implants containing electronics. Changing gradients can also induce electric fields in tissue, stimulate peripheral nerves and result in the patient experiencing sensations of tingling, tapping and/or pain (Cross et al., 2018). The severity depends on the pulse sequence, the patient position and the sensitivity of the patient.

Accidents do happen

All these potential risks exist and accidents, though less common, do happen. In New Zealand, there was an accident reported by The New Zealand *Herald* in 2014 (Wynn, 2014). A knife flew out of a man's pocket while he was having an MRI brain scan in an Auckland

hospital, hitting him in the face and causing serious eye trauma and an orbital fracture. When the scan started, the technician noticed the man was moving. He removed keys from his pocket then the pocketknife. The closed knife flew out at high speed and hit him in the face.

In 2019, a radiology nurse was seriously injured at a hospital in northern Sweden, when caught in the strong magnetic field of the MRI scanner and pulled against it (Fornell, 2019). The accident occurred in the mobile MRI truck located near the hospital entrance. A patient was in the MRI system undergoing an imaging examination when the accident happened. The hospital said the nurse went to the patient and was apparently wearing a weight vest containing ferrous metal. Two security guards from the hospital came to the site to help. Both suffered minor injuries. The X-ray nurse was treated at the intensive care unit at the hospital. The patient in the MRI machine was uninjured.

Accidents can be fatal

Without adherence to the safety guidelines serious consequences can occur. A six-year-old boy died after undergoing an MRI exam at a New York-area hospital when the machine's powerful magnetic field jerked a metal oxygen tank across the room, crushing the child's head (ABC News, 2001). The canister fractured the skull and injured the brain of this young patient, resulting in his death two days later. It was a routine imaging procedure performed post-surgery for a benign brain tumor.

Another fatal accident happened in early 2023 in Brazil. A Brazilian man accompanying his mother for an MRI scan later died from injuries he received when a concealed handgun he was wearing pulled from his waistband, struck the MRI machine, discharged and shot him in the abdomen (Mcrae, 2023). Clinical staff reportedly instructed both the patient and his mother to leave all metal items outside the scanning room as a matter of standard procedure, however the 40-year-old failed to do so despite verbal and written request.

Classification of accident causes

In order to increase the safety of MR examinations and reduce the incidence of future accidents, staff require a thorough understanding of MRI risks. Inaguma and colleagues conducted an exploratory analysis of accidents involving MRI ferromagnets based on the Japanese database of adverse medical occurrences (Inaguma et al., 2023). From a total of 104,659 accident reports over nine years, 172 involving the presence of ferromagnetic objects in the MRI room were extracted and analysed. 'Failure to check' was the most common cause, accounting for 69 percent of all cases, followed by 'lack of knowledge' at 16 percent (Inaguma et al., 2023).

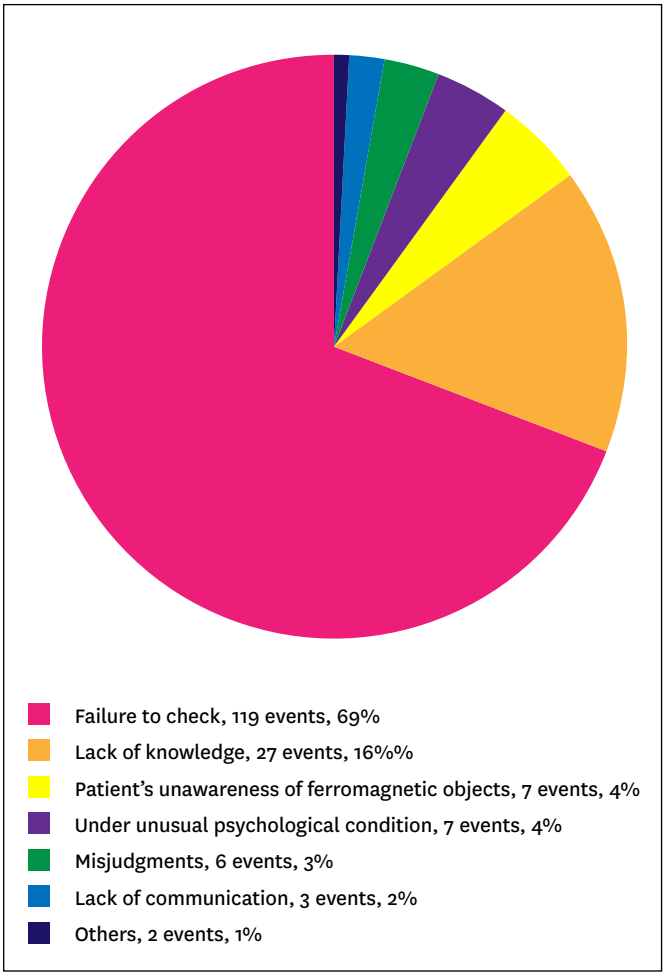


Fig 1. The classification of accident causes. (Inaguma et al., 2023)

From left: Full thickness finger burn from a pulse oximeter (from Sung et al under CC BY); Skin-to-skin contact conductive loop ("kissing") burns on the hand and thigh (from Vister et al under CC BY)

How to be safe in MRI environment

To create a safe MRI environment, staff require sound knowledge of the physical principles of the MRI scanner and must understand the associated safety risks and how to avoid adverse events from occurring.

There are a wide variety of published resources and guidelines available to ensure safety in the MRI environment. The Zone system recommended by the American College of Radiologists is widely adopted to restrict access to the static magnetic field in the MRI scanner (Shah & Aran, 2023). It starts with Zone I in the radiology waiting area and attached corridors to Zone IV in the magnet room, with increasingly restricted patient and staff access. There are signs in each area indicating passage into different zones, with increasing warnings about magnetic fields. This design format reduces the chances of individuals accidently entering the MRI scanner room.

Appropriate safely screening prior to persons entering the MRI control room and MRI exam room is essential. All patients need to be screened and well informed before entering the scanning room using a written information and screening form to clarify and confirm prior surgeries or accidents potentially involving metal implants or devices. This needs to be reinforced by face-to-face verbal questions and discussion prior to the scan. Implantable devices must be identified by patient report, medical record, or screening to confirm whether they are MRI safe, conditional, or unsafe. It is vital that patients remove all metallic belongings in advance of an MRI examination, including external hearing aids, watches, jewelry, cell phones, and items of clothing that have metallic threads or fasteners. Additionally, makeup, nail polish, or other cosmetics that may contain metallic particles should be removed if applied to the area of the body undergoing the MRI examination.

Thermoregulation around the site of new tattoo (less than two weeks old) can heat up and make the ink spread. Also, some clothing items such as athletic wear (e.g., yoga pants, shirts, etc.), socks, and braces, may contain metallic threads or metal-based anti-bacterial compounds can heat up and cause burns. Therefore, MRI facilities typically require patients to remove all potentially problematic clothing items prior to undergoing an MRI.

During the examination, hearing protection is needed and cables or extremities must not form conductive loops or touch the bore of the magnet. Communication with the patient should also be maintained with the patient so they can alert staff to any issues.

Screening for staff is essentially the same as for patients. New nursing staff must be orientated to MRI safety and complete an MRI safety assessment. Guidelines, manuals and checklists should be developed, implemented and adhered to at all times. On-going education should be provided for staff and patients to prevent accidents involving the risk of magnetic objects in the MR scanner room. Caution is required with emergency situations, geriatric, and pediatric patients because of the potential unreliability of their information.

Equipment commonly found on inpatients such as ankle weights, pedometers, clips, and clamps also pose significant risk. All clinical support equipment should be screened for safety and labelled clearly as MRI safe before passage into the MRI room.

Conclusion

Most MRI-related incidents result from deficiencies in screening and or the lack of properly controlling access. To promote safety in the MRI environment, all staff need to understand the key aspects of the MRI system and environment, along with safety issues and risks. The importance of careful MRI safety screening prior to entering the MRI environment is critical to prevent dangerous objects from entering the scan room. All the patients undergoing MRI need to be informed and educated about the screening process. Clear communication and close collaboration among multidisciplinary team members is also an important aspect of protecting individuals from MRI system related accidents and injuries.

With careful screening, efficient communication, and continuous training, the risk for MRI-related accidents can be vastly reduced and a safe MRI environment ensured.

About the author:

Liying Duan *completed her Bachelor of Nursing through Massey University in Wellington in 2006 and her Master of Nursing with First Class Honours from Massey University in Auckland in 2022. She has many years of experience in the cardiothoracic speciality and also worked in women's health outpatient service for five years. She currently works fulltime in the Radiology Department at Greenlane Clinical Centre, Auckland.*

References

ABC News (2001). *Boy, 6, Killed in Freak MRI Accident*. https://abcnews.go.com/US/

Cross, N., M., Hoff, M., & Kanal, K. M. (2018). Avoiding MRI-related accidents: A practical approach to implementing MR safety. *Journal of the American College of Radiology, 15* (12), 1738-1744.

Fornell, D. (2019). *Nurse injured in MRI accident at Swedish hospital*. https://www.itnonline.com/article/nurse-injured-mri-accident-swedish-hospital

Inaguma, K., Kotani, T., Kishida, S., Sakuma, T., Ueno, K., Iijima, Y., Kajiwara, D., Okuyama, K., Sakashita, K., Okuwaki, S., Nakano, S., Suzuki, N., Nokariya, S., Umeda, R., Akazawa, T., Inage, K., Shiga, Y., Minami, S., Aoki, Y., & Ohtori, S. (2023). Medical Accidents Related to Ferromagnetic Objects Brought into the MRI Room: Analysis of the National Multicenter Database by Orthopaedic Surgeons. *Spine Surg Relat Res, 7*(1), 96-102. https://doi.org/10.22603/ssrr.2022-0110

Kihlberg, J., Hansson, B., Hall, A., Tisell, A., Lundberg, P. (2022). Magnetic resonance imaging incidents are severely underreported: a finding in a multicentre interview survey. *Eur Radiol. 32*(1), 477–488. http://doi.org/10.1007/s00330-021-08160-w

Mcrae, M. (2023). *Freak accident kills man after MRI machine triggers loaded handgun*. https://www.sciencealert.com/

Mittendorff, L., Young, A., & Sim, J. (2021). A narrative review of current and emerging MRI safety issues: What every MRI technologist (radiographer) needs to know. *Journal of Medical Radiation Sciences, 69* (2), 250-260. https://doi.org/10.1002/jmrs.546.

Nordin, L. E., Åberg, K., Kihlberg, J., Owman, T., Hansson, B., Björkman-Burtscher, I. M., Petersen, C., & Lundberg, P. (2024). ESR essentials: basic physics of MR safety-practice recommendations by the European Society for magnetic resonance in medicine and biology. *European Radiology*, 1-8. https://doi.org/10.1007/s00330-024-10999-8

Questions and answers in MRI (2024a). *Projectile injuries.* https://mriquestions.com

Questions and answers in MRI (2024b). *Thermal injuries.* https://mriquestions.com

Shah, A., & Aran, S. (2023). A Review of magnetic resonance (MR) Safety: The essentials to patient safety. *Cureus,15*(10), e47345. http://doi.org/10.7759/cureus.47345

Shellock, F. G.(n.d.) www.MRIsafety.com

SMRT Safety Committee (SSC). (2017-2018). *MRI safety, Level 1: Basic training for all staff in the MRI environment* [Video]. YouTube. https://www.youtube.com/watch?v=VzdSqYkMlRw

Wynn, K. (2014). *Man stabbed in eye during brain scan*. https://www.nzherald.co.nz/nz/man-stabbed-in-eye-during-brain-scan/

Physiological impact of acute intervention:

Trachea and endotracheal intubation

By Marvin Jr Gonzales

Abstract Within this article the physiology of the respiratory system, (the airway) is explored and the nursing implications for the patient when injury occurs to the trachea during endotracheal tube insertion. The trachea is the conduit for air passage, but also for mucociliary clearance and the warming and humidification of air. A patent airway is critical to the survival of the human body by enabling perfusion of tissue and damage to the trachea can have a detrimental effect on the patient's life.

Key words Airway, endotracheal intubation, tracheal injury

Introduction

A patent airway is critical to the survival of the human body. The airway or the respiratory system is vital to supply oxygen and maintain organ function (Mekonnen et al., 2022). In this article, the respiratory system will be referred to, as the 'airway'. The normal and abnormal physiology of the airway will be analysed, in relation to the physiological consequences of an acute intervention. The acute intervention is the intubation of a patient using an endotracheal tube.

Moreover, nursing implications for a patient with tracheal injury following endotracheal intubation will be explored with a reflection on the author's nursing practice, contrasted and compared with evidence from current literature.

Physiology of the Respiratory system

Oxygen and carbon dioxide exchange is critical to life. The respiratory system is the main system responsible for ventilation and gaseous exchange (Tortora & Derrickson, 2014). The exchange of gases involves delivering oxygen to the blood stream, while receiving and expelling waste gases such as, carbon dioxide (Farrell, 2017).

The airway is comprised of multiple organs including the nose, oropharynx, larynx, trachea, bronchi, bronchioles and the lungs. These organs facilitate the process of gas exchange in the lungs. Each different lobe in the lungs contain many small alveoli which is the primary site of gas exchange from the environment and the bloodstream. For example, perfusion of tissue begins and occurs through the alveoli in the lungs by transporting oxygen into the capillary network where oxygen enters the arterial system, ultimately perfusing tissue (Haddad & Sharma, 2022).

Anatomy of the upper and lower respiratory tracts

Anatomically, the airway is divided into two sections, the upper and lower respiratory tracts (Van-Scott et al., 2013). The upper airway is comprised of extra thoracic components, including the nasal cavity, oral cavity, nasopharynx, oropharynx and larynx (Mete & Akbudak, 2018). Functionally, the upper airway warms and filters inspired air to enable the lower respiratory tract to proceed with diffusion or gas exchange (Farrell, 2017). The upper airway of an adult human is constantly filled with airflow from the external environment with air consistently introduced and expelled from the body through the nasal and oral cavities Kumpitsch et al. (2019).

The nasal cavity and nasopharynx have a large surface area of complex paths that receive the air from the environment. The nasal cavity has rigid walls that act as supporting structures to give strength and reduce the likelihood of obstructions in the airway lumen. These respiratory organs are responsible for receiving, warming, filtering and humidifying inhaled air (Van-Scott et al., 2013). In the nasopharynx, the inspired air comes in contact with a large surface area of ciliated mucous membranes that moistens and warms the inspired air to body temperature, before subsequently, transferring air into the epiglottis and larynx (Farrell, 2017). The epiglottis works primarily to deflect any liquids and solids that are

travelling through the oropharynx airway and directs them to the oesophagus (Van-Scott et al., 2013).

Meanwhile the cartilaginous larynx, located midline-anterior to the neck, transmits air from the oropharynx and nasopharynx to the trachea and the tracheobronchial tree (Patwa & Shah, 2015).

The larynx is an important organ in the airway that also protects the lower respiratory tract from aspirating food into the trachea. For example, the larynx has multiple receptors, that when stimulated produce a cough reflex that expels any liquids or solids from the airway (Van-Scott et al., 2013). Additionally, the larynx contains the vocal cords which are responsible for generating sound (Suarez-Quintanilla et al., 2022).

From the upper respiratory tract, air moves further down to the lower respiratory tract, comprised of the tracheobronchial tree (Mete & Akbudak, 2018). The structure of the tracheobronchial tree includes the trachea, bronchi and terminal bronchioles (Van-Scott et al., 2013). It consists of a series of complex conducting airways that deliver gases from the upper airway to the trachea, down to the alveoli and vice versa (Patwa & Shah, 2015). Respiratory structures that branch from the trachea are mainly conducting pipes for gases as there is no gas exchange that occurs within these structural organs.

The trachea is a conducting airway that has vital functions in maintaining the normal physiology of airway conduction. It is a hollow cylindrical-shaped conduit that serves as a passage of air between the larynx and bilateral bronchi (Farrell, 2017). The trachea begins at the base of the cricoid cartilage and branches off into the right and left mainstem bronchi at the carina (Almanzar & Danckers, 2022).

The trachea is composed of smooth muscle and cartilaginous rings that are structurally placed at different intervals ascending and descending the trachea (Farrell, 2017). It contains smooth muscle membranes posteriorly and 18 to 22 D-shaped cartilaginous rings anteriorly and laterally which play a crucial role in maintaining an open airway lumen by providing stability and rigidity to the tracheal wall (Farley & Schlicksup, 2022; Farrell, 2017). Furthermore, the posterior smooth muscles membranes of the trachea provide flexibility to allow the passage of food to the oesophagus (McCance & Huerter, 2014).

A patent trachea is vital to life as a conduit for air passage, but also for mucociliary clearance and the warming and humidification of air. Mucociliary clearance by the trachea is achieved by tracheal glands, cilia and goblet cells in the mucosa (Brand-Saberi & Scafer, 2014). Mucociliary clearance is critical to protect the airway from harmful materials such as viral and bacterial pathogens, gaseous materials and particles. Mucociliary clearance by the trachea is critical to ensuring the lungs remain in a sterile condition for efficient functioning (Bustamante-Marin & Ostrowski, 2017).

Injury to the airway

Considering the airway's critical functions, damage to its structures is detrimental to life. There are multiple risk factors that may cause injury to the airway. Studies suggest the aetiology of injury to the airway includes iatrogenic causes, blunt trauma, penetrating trauma, aspiration and inhalation of liquid (Farley & Schlicksup, 2022; Santiago-Rosado et al., 2022). Research suggests iatrogenic causes to be one of the most common causes of airway injuries (Farley & Schlicksup, 2022; Grewal et al., 2018; Kumar & Cascella, 2022).

Endotracheal intubation is one of the main causes of iatrogenic airway injuries. Research conducted by Farley and Schlicksup (2022) focusing on injuries within the trachea and tracheobronchial tree, claimed endotracheal intubations predispose patients to complications, including infection, stricture, oedema, vocal cord paralysis and decreased lung function. These findings concur with the research of Hatipoglu et al. (2016), who suggest trachea and tracheobronchial tree injuries also include symptoms such as cough, stridor, haemoptysis, dyspnoea and tachypnoea. Both papers concluded that injuries occurring within these structures create high potential for mortality and morbidity.

Endotracheal tube intubation related iatrogenic injury affects the normal physiology of the trachea and the airway. The normal physiology is affected by trauma to the trachea following prolonged insertion of the endotracheal tube. For example, injuries can occur within the trachea by creating pressure on its surrounding structures from over-inflation of the cuff or the use of an incorrect endotracheal tube size. The trachea is placed under strain and pressure and may develop a longitudinal tear around the membranous components of the cervical and intrathoracic areas. Over inflation of the cuff results in an injury to the proximal segment of the trachea (Farley & Schlicksup, 2022; Grewal et al., 2018).

Endotracheal intubation also potentially alters the normal physiology of the laryngeal airway. Research conducted by Kumar and Cascella (2022) suggests laryngeal injuries commonly occur to patients after endotracheal intubations, clinically manifesting with varying severity of oedema, granulation, ulceration and decreased vocal cord mobility ultimately resulting in narrowing of the airway lumen. Furthermore, luminal narrowing of the airway from laryngeal oedema contributes significantly to patient breathing difficulties and/or stridor post-extubation. Their research also found post-extubation, stridor to be the leading cause of patient reintubation (Kumar & Cascella, 2022). This finding is critical because Kumar and Cascella (2022) in turn identified reintubation as a result of post endotracheal intubation stridor as a significant risk factor in patient mortality and morbidity.

The normal physiology of the laryngeal airway is altered by the inflammatory response triggered by an endotracheal intubation. The pathologic process that affects normal physiology usually begin after intubation, but only presents clinically after the expulsion of the endotracheal tube (Kumar & Cascella, 2022). For example, thereafter when the patient is intubated, pressure generated by the tube triggers an inflammatory reaction at the site of contact between the tube and surrounding membranes. Prolonged contact and pressure by the tube and the inflated cuff on surrounding structures of the laryngeal airway causes superficial mucosal damage, ultimately resulting in swelling and ulceration of the laryngeal airway. Most specifically, damage to mucosal membranes of the larynx has patients complaining of a sore throat, dysphasia or dysphagia, post-operatively. If not treated carefully, these symptoms create the cascade of poor health outcomes such as difficulty breathing, stridor and reintubation (Kumar & Cascella, 2022). Moreover, Kumar and Cascella (2022) identified the risk of tracheal and laryngeal airway injury post endotracheal intubation occurs significantly in patients undergoing head and neck surgery.

Nursing Implications

A clinical experience while caring for a patient undergoing comprehensive head and neck surgery identified the need for the author to understand the risk and complications of prolonged endotracheal intubation. A patient was undergoing comprehensive head and neck surgery for a malignant tumour. Appropriate and accurate nursing implications for this patient was critical for positive

health outcomes. For example, prior to the surgery, a surgical and anaesthetic plan was devised by the multidisciplinary team in order to identify and gather correct instruments for surgery and for delivering anaesthesia. Both surgical and anaesthetic teams identified endotracheal tube to be the anaesthesia delivery method. Following this, the nursing team, along with the anaesthetic team, ensured the correct size endotracheal tube was present and the preference of using low-pressure cuffs and ancillary equipment, such as stylets and bougies, were available.

The findings from Farley and Schlicksup (2022) and Cardillo et al. (2022) supported the interventions completed by the nursing, surgical and anaesthetic team. Both research papers suggested the need for a pre-operative briefing to acquire ancillary equipment, such as those mentioned above, as well as other equipment to aid in a difficult intubation, such as a flexible bronchoscope to aid in visualization and avoidance of airway injury. Furthermore, appropriate training and utilisation of trained medical personnel is paramount to avoid airway injury. The skill and knowledge of the medical personnel plays a key role in preventative treatment. For example, untrained professionals may cause improper manipulation of the airway and incorrect usage of endotracheal tube and cuff size that contribute to increased risk for airway injury (Farley & Schlicksup, 2022; Cardillo et al. 2022).

The research conducted for this essay has had a positive influence on the author's nursing practice by enhancing his knowledge of the risks and complications of endotracheal intubation. Within the author's nursing practice, he will continue to promote positive health outcomes for the patient by continuing to provide appropriate instruments to support trouble-free smooth patient intubation of a patient. The literature has provided crucial guidance about the range of different instruments available to support difficult intubations. The author has been educated about the importance of supporting the anaesthetic team during the intubation process including physical support through assisting with passing of instrumentation, or the physical act of collecting needed equipment for successful and safe intubation of patients. The literature has impacted the nursing practice of the author by enhancing his knowledge of the risks and complications of endotracheal intubation, and what to expect when caring for patients with endotracheal tubes both intraoperatively and postoperatively. Furthermore, the literature also enhanced the ability of the author to identify post endotracheal tube complications in a patient, thus enhancing his ability to react in a timely fashion to deteriorating clinical situations.

Conclusion

A patent airway is critical to the survival of the human body by enabling perfusion of tissue. The normal physiology of the airway has been discussed along with its abnormal responses to an acute intervention. The risk of airway injury is enhanced by the usage of endotracheal tubes for intubation. Tracheal and laryngeal oedema has been identified as leading outcomes of iatrogenic injury that alters the normal physiology of the airway. The pressure being generated by the process of intubation causes an inflammatory response in the body that manifests in varying clinical symptoms which health professionals must be able to identify and react accordingly to maintain positive health outcomes for patients.

About the author:

Marvin Jr. Gonzales, *is a registered nurse working within the perioperative department of Christchurch Hospital as an acting clinical nurse specialist in Otolaryngology. He was born in Davao City, Philippines migrating to Christchurch in 2007. His journey into nursing was sparked by his mother who worked as a registered nurse in the Philippines. From a young age he knew nursing was his calling and embarked on his training in 2016, enrolling within Ara Institute of Canterbury. His transition to nursing practice clinical placement was in the operating theatre at Christchurch hospital, in cardiothoracic. This opened his eyes to the wonderful world of perioperative nursing practice. After graduating he accepted a job working within the Otolaryngology specialty.*

References

Almanzar, A., & Danckers, M. (2023, February 5). *Laryngotracheal stenosis*. StatPearls. https://www.ncbi.nlm.nih.gov/books/NBK554561/

Brand-Saberi, B. E. M., & Schäfer, T. (2014). Trachea: Anatomy and physiology. *Thoracic Surgery Clinics*, *24*(1), 1-5. https://doi.org/10.1016/j.thorsurg.2013.09.004

Bustamante-Marin, X. M., & Ostrowski, L. E. (2017). Cilia and mucociliary clearance. https://doi.org/10.1101/cshperspect.a028241

Cardillo, G., Ricciardi, S., Forcione, A. R., Carbone, L., Carleo, F., Di Martino, M., Jaus, M. O., Perdichizzi, S., Scarci., M., Ricci, A., Iacono, R. D., Lucantoni, G., & Gallucio, G. (2022). Post-intubation tracheal lacerations: Risk-stratification and treatment protocol according to morphological classification. *Frontiers in Surgery*, 9, 1-9. https://doi.org/10.3389/fsurg.2022.1049126

Farrell, M. (2017). Smeltzer and Bare's textbook of medical-surgical nursing (4th Australian and New Zealand ed.). Lippincott Williams and Wilkins.

Farley, L. S., & Schlicksup, K. E. (2023, February 21). *Tracheal injury*. StatPearls. https://www.ncbi.nlm.nih.gov/books/NBK547677/

Grewal, H. S., Dangayach, N. S., Ahmad, U., Ghosh, S., Gildea, T., & Mehta, A. C. (2018). Treatment of tracheobronchial injuries: A contemporary review. *Chest*, *155*(3), 595-604. https://doi.org/10.1016/j.chest.2018.07.018

Haddad, M., & Sharma, S. (2022, July 18). *Physiology, Lung*. StatPearls. https://www.ncbi.nlm.nih.gov/books/NBK545177

Hatipoglu, Z., Turktan, M., & Avci, A. (2016). The anesthesia of trachea and bronchus surgery. *Journal of Thoracic Disease (11)*8, 3442-3451. Retrieved from PubMed.gov database.

Kumar, A., & Cascella, M. (2022). *Post intubation laryngeal edema*. StatPearls. https://www.ncbi.nlm.nih.gov/books/NBK560809/

Kumpitsch, C., Koskinen, K., Schöpf, V., & Moissl-Eichinger, C. (2019). The microbiome of the upper respiratory tract in health and disease. *BMC Biology (17)*, 1-20. https://doi.org/10.1186/s12915-019-0703-z

McCance, K. L., & Huether, S. E. (2014). *Pathophysiology: the biological basis for disease in adults and children*. St. Louis: Elsevier Mosby.

Mekonnen, T., Cai, X., Burchell, C., Gholizadeh, H., Cheng, S. (2022). A review of upper airway physiology relevant to the delivery and deposition of inhalation aerosols. *Advanced Drug Delivery Reviews*, *191*. https://doi.org/10.1016/j.addr.2022.114530

Mete, A., & Akbudak, I. H. (2018). Functional anatomy and physiology of airway. *Intech Open*. http://dx.doi.org/10.5772/intechopen.77037

Patwa, A., & Shah, A. (2015). Anatomy and physiology of respiratory system relevant to anaesthesia. *Indian Journal of Anaesthesia*, *59*(9), 533. Retrieved from EBSCO Host.

Santiago-Rosado, L. M., Sigmon, D. F., & Lewison, C. S. (2022, July 5). *Tracheal trauma*. StatPearls. https://www.ncbi.nlm.nih.gov/books/NBK500015/

Suárez-Quintanilla, J., Fernández Cabrera, A., & Sharma, S. (2022). Anatomy, head and neck: Larynx. In StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing. https://www.ncbi.nlm.nih.gov/books/NBK538202/#_ NBK538202_pubdet_

Tortora, G. J., & Derrickson, B. H. (2014). *Principles of anatomy and physiology*. Hoboken, NJ: Wiley.

Van Scott, M. R., Chandler, J., Olmstead, S., Brown, J. M., & Mannie, M. (2013). Airway anatomy, physiology and inflammation. In W.J. Meggs (ed.). *The toxicant induction of irritant asthma, rhinitis, and related conditions* (1st ed., pp. 19-61). Springer Link.

Parental presence in the anaesthetic care unit

This issue's From the Archives article was first published in the July 1999 issue of *The Dissector* (Vol. 27, No. 3). Thanks to Karen Hall for her diligence in the archives of the New Zealand Nurses Organisation.

By CHRIS BRACE BN, RGON

ABSTRACT

THE trauma of hospitalisation on children has been reduced dramatically by the liberalisation of hospital policies in regard to unrestricted visiting by families/whanau. Although access to operating theatre remains restrictive, this move has encouraged the presence of parents in the anaesthetic room at the time of induction. In line with this more liberalised movement is the concept of parental presence in the Post Anaesthetic Care Unit (PACU) immediately post operatively. While there has been considerable progress on parents being present at induction, few hospitals have a policy that allows parents in their PACUs.

This paper discusses the concept of parental presence and implications for nurses. It provides background information, discusses the benefits to all parties and highlights a deficiency in in patient care that the author perceives.

MAJOR changes in the expectations of parents when children are hospitalised have occurred over the last 30 years, with parents now expecting to play a major role in the healthcare of their child. In past years, parents were required to remain separated from their child and accept the decisions of medical teams without either their input or opinion.

Nowadays, parents expect to be part of the healthcare team within the hospital setting, developing a partnership with health professionals to achieve positive outcomes for their children. This increased participation of parents in the care of their children is widely considered to have improved the quality of care for the hospitalised child (Calley and Smith, 1991).

Although unrestricted visiting in the hospital ward and the encouragement of parental involvement with the child's care has lessened the trauma of hospitalisation for the child, this liberty and encouragement' often stops at the entrance to the operating theatres. There has been a slow increase of parents welcomed into the anaesthetic room to be with their child at induction, but there has been little welcome into PACUs. The decision to allow parents into the PACU is often based on tradition or policies rather than family needs (Jackson et al,1997).

Parental presence in the anaesthetic room

The movement for the *liberalisation* of parental visiting rights was encouraged by child psychologists in the late 1950s as the adverse impact of separation from parents on the child in hospital was recognized.

Around 1967, numerous international studies on the effects of parental presence during a child's anaesthetic induction indicated that children were less anxious and less distressed when accompanied by parents.

These studies also showed there were no lasting effects on children not accompanied by parents, other than separation anxiety (Holt and Maxwell, 1994).

Johnson et al (1992) reported that when parents had difficulty coping with the stress of their child's induction, this stress appeared to affect the child dramatically and these children were more anxious than children whose parents did not accompany them. LaRosa, Nash et al. (1995) stated that a premedication generally is not required if the parent is present at induction, thus with the elimination of sedation before surgical procedures, there is often a shortening of the recovery time following anaesthesia.

Anaesthetists remain deeply divided on the question of parental presence in the anaesthetic room with reasons varying from risk of infection, the speed of of the development of complications on induction and the level of anxiety in the parent, which may influence the child (Johnston et al., 1992).

Hannallah and McGill (1992) found that of the anaesthetists who encouraged parental presence at the time of induction, few were happy about parents being present during recovery time due to the volatility of children as they emerge from anaesthesia.

There has been a slow increase of parents welcomed into anaesthetic rooms with their children in New Zealand, with parental presence during induction of anaesthesia still remaining controversial. With the acceptance of parents into the anaesthetic room at induction, the concept of parents in the PACU immediately following surgery should seriously be considered. It is a natural progression from parents being present at induction to allowing access to the PACU, as the induction period is a time of operational emergencies just as common as the emergence period. The benefits of a child going under anaes-

thesia calmly becomes extremely significant to the PACU nurse with the short acting anaesthetic agents that are in favour and readily available today. These agents make the it more likely the child will emerge from the anaesthetic in the same psychological state as they were at induction i.e. distressed, or calm and relaxed.

Stress on the hospitalised child

Human beings consciously and unconsciously accept a situation as harmful, potentially harmful or challenging. The degree of stress given to each situation is relative to the effects of that situation on a person's well-being. While in hospital, the child experiences unfamiliar routines and equipment, as well as painful procedures in which typically, the child responds with anxiety brought about by fear of the unknown.

In this threatening environment, the child depends on the parent for support, therefore it is not surprising that separation anxiety experienced by both the child and the parent takes on a particular importance when surgery is involved (Hannallah and McGill, 1992).

One of the greatest fears of children undergoing surgery is separation from their parents.

Anticipation of a surgical procedure can be extremely stressful to both parent and child, with the child's stress being increased by the parent's tension and anxiety. The child's ability to adjust to the hospital may depend upon how the parent adjusts to the situation. This adjustment consists of the parent's ability to control anxiety, give emotional support, accept the reality of the child's illness and handle visiting opportunities. Some parents cope with stress by selectively restricting their awareness of a situation; others engage in actively seeking more information and discussing experiences whereas still others will use avoidance and active coping to help prevent emotional trauma secondary to hospitalisation.

Therefore, hospitals should consider the ability to modify the experiences to meet the adjustment capabilities of both child and parent. The child who continues to have a degree of control over a situation will remain less anxious and fearful, empowering the parent to adapt and cope with the situation (Korsh 1991).

Numerous studies over the last few decades have demonstrated the negative psychological effects of *hospitalisation* on children (Vernon et al., 1989). Along with these studies, nurses have endevoured to relate to the concern of decreasing distress experienced by children who are hospitalised.

Evaluation the levels of anxiety and stress placed upon the situation of the child undergoing surgery and entering the theatre area by the parents is an indication as to how the child will cope with the new experience. The whole atmosphere of a large impersonal PACU is not conducive to a stress-free recovery. Children are surrounded by adult patients, with no familiar sights or sounds, an environment that may influence them to become distressed, agitated and difficult to calm. Even if the parent is required in the PACU, there can be a delay as parents may have to wait in a ward or cafeteria, often a distance from the theatre suites, in which time the child has frequently become distraught.

Although pre-operative preparation has been largely addressed, little has been done to reunite the parent and child in the strange and stressful immediate post-operative environment. The child is surrounded by strange people in 'funny clothes' while parents pace the hallways, wondering "is my child awake yet'?" or "it's been ages, what has happened?"

Benefits of parental presence

Schaffer and Emerson (1994) identify three stressful periods in a child's hospitalisation. Firstly, the admission to hospital; secondly, the painful procedures; and thirdly the immediate post-operative period.

If the immediate post-operative period is one of the most stressful periods for a child, nurses must ask themselves if they are wasting a valuable asset to a child's care by excluding parents from the PACU. Parental presence has been found to be beneficial in the anaesthetic room and it is likely to be equally as beneficial in the similarly stressful environment of PACU.

Kain et al. (1996), in a study of parental presence in the PACU, indicated that by being present in the PACU after surgery, both parents and child were reassured.

There has been, and undoubtedly will continue to be, controversy surrounding whether there should be parental presence in the PACU and with most hospitals containing a PACU which cares for both adults and children, there has been slow progress towards accepting this scenario.

A paediatric hospital in Auckland has a policy for parental visiting in the PACU that has been successfully in use for a number of years, resulting in the children being more relaxed and co-operative if repeat visits to the area are required as there is a positive memory (Auckland Hospital 1995). Undoubtedly the fact that all the patients are children has made it easier to implement such a policy whereas the combined child/adult PACU means a far more complicated scenario and requires an entirely different focus to the process. It is quite possible though for hospitals to designate a small area of PACU to the paediatric patients and thus enable parents to be present.

Parental visiting in the PACU can be a positive experience for both parents and child, as well as a useful purpose being served.

Parents state that visiting has a reassuring effect on them and they believe it has a similar effect on their children. They also believe they are able to reassure their children simply by their

presence and their ability to comfort and physically hold them. They believe it is not necessary to physically care or undertake tasks for their children but see their role as comforter.

Nursing issues

The majority of complications following surgery will occur in the PACU, with 75 percent of all anaesthetic complications occuring in the PACU (Drain, 1994),

Therefore it is an area of unpredictabilily where every patient has the potential for complication. Because of this, children may be placed into an area where potentially it may be psychologically unsafe for them to be.

The argument voiced by PACU nurses against parents being present is usually "if something happens we do not have time to take care of the patient and the parent also" (Murphy, 1994). When considering this issue, remember that if a patient is injured during PACU care, and this is caused by the nurse's negligence, the nurse is liable whether or not the family member is present. If a parent faints or is in need of the nurse's attention, by transferring that attention to the parent it could be argued that this action would reduce the care provided to the patient.

Principle Four of the Code of Conduct for Nurses and Midwives written by the Nursing Council of New Zealand states "the nurse takes care that a professional act or omission does not have an adverse effect on the safety and well-being of patient/clients" (Nursing Council of New Zealand, 1995).

Even though the nurse's responsibility is to the patient, she/he has an unwritten responsibility to use reasonable care to prevent a parent from injury whilst in the PACU. Nurses' concerns may then be valid. If a situation is not planned and carefully controlled, the·nurse may not have time to take care of both the parent and the child.

Policy issues

Whether parents should or should not be allowed to visit their children in the PACU should be a carefully considered institutional policy that has taken into consideration both the advantages and the problems that could arise. There must be a clear, decisive policy based on sound principles which includes:

1, Preparation — Parents should be told ahead of time what to expect and what will be expected of them so that the experience is safe and positive for all concerned. If time permits, a pre-operative visit to PACU is encouraged.

2, Restrictions — The parent's role should be outlined carefully and restricted to the purpose for which they are present and those only that they are able to perform, e.g. provi.de comfort and reassurance.

3, Liaison — There should be a liaison nurse/person made available to co-ordinate visits.

4, Emergency plans — There should be a procedure that all staff are familiar with for quickly and safely removing the parent from the situation before an emergency arises.

The parents should always be given the choice of not being present if they so wish.

Under no circumstances should nursing resources take into consideration a parent being present and this policy must provide for additional resources if and/or when required.

It is important that a decisive policy is formulated so that each individual nurse has the confidence to make rational decisions regarding parental presence, without feeling care of the child will be compromised.

As there are few hospitals in New Zealand with separate PACUs for adults and children, issues of confidentiality and privacy arise. Human nature means there will always be the parent who is more interested in the other patients once they have assured themselves that their child's condition is satisfactory.

This important issue must be debated and a process formulated to prevent as little breaching of patients' rights to privacy and confidentiality. This can be accomplished by the use of curtains or mobile screens and ensuring there is always someone available to escort the parents when they arrive or leave the unit.

The role of the PACU nurse

Parental visits to the PACU can have a positive effect on patient care by providing children with reassurance, security, comfort and emotional support (Fina et al, 1997).

The primary focus of the PACU nurse is the patient — whether child or adult. The nurses' decision on whether the parent should be admitted to the PACU is therefore totally dependent on how she/he perceives the child's condition, despite preoperative expectations of the parent. The final decision must be the individual nurse's responsibility to determine.

Clear guidelines must be available to the nurse to enable her/him to make that decision. Children are unpredictable and will often react in a way opposite to what is expected of them. It is certainly true that a parent knows their child better than the nurse, but no one, not even the parent, can predict the child's behaviour.

Children develop specific attachments to individuals and a fear of strangers at approximately seven months of age (Schaffer and Emerson, 1994).

In my experience, little benefit is gained by a parent being present, unless there is an exceptional reason, with infants younger than seven months as one is able to comfort and reassure the majority of this age group with a cuddle. The benefit of parental presence in this age group is undoubtedly to the parent.

There are times when the parent should be encouraged to be

with the child immediately. The parent of a child who repeatedly needs to return for a procedure or a parent who may have more knowledge of the child's condition than the nurse is a welcome addition to the PACU team e.g. the child with epidermolysis bullosa, a condition so rare that the parent is often far more knowledgeable about the care needed than the nurse.

Guidelines for parental visits

Theatre tours pre-operatively have been introduced in some hospitals which allay apprehension and ensure a familiarity with surroundings and attire. The difficulty in arranging a pre-operative visit to the PACU is expanded by the fast turnaround of bed allocation in the wards, which means the child is often not admitted until the day of surgery. This frequently allows no time for pre-operative·visits or any in-depth education to be given.

Hospitals should provide an area close to the operating theatres which can be used as a waiting room for parents as it is often difficult to find parents immediately post operatively due to the surgical team's inability to predict the length of time in surgery. Guidelines for the expectations of parents in the PACU should be drawn up and given to parents when the child is first admitted, or at a pre-admission visit.

The activity which is occurring in the PACU at the time is an issue that will affect whether to be in favour of a parental visit. Parents should not be allowed to enter the PACU until the child's airway is considered to be safe , vital signs are stable and until the child is screened off from any patient present to avoid a breach of privacy.

When parents are admitted to the PACU, an explanation of the equipment being used should be given and if possible, the parent should be encouraged to nurse the child, comforting and talking to them, thus helping to maintain the focus onto the child and away from other patients. Parents may require gentle guidance on when and how to comfort their child as the atmosphere may be overwhelming and frightening.

Research into the effects of parent/child hospitalisation have assisted in the acceptance of parents' increased participation in the care of their children. This increased parental participation has flowed into the operating theatres with an increase in the number of parents being present at induction in the anaesthetic rooms. Despite these moves, the PACU remains an area where parents are discouraged visit more than encouraged within New Zealand.

PACU nurses should be encouraging the presence of parents into their PACUs, focusing on the positive gains from this and utilising the parent's presence to improve the care to the child whilst under their care. Clear policies should be formulated to assist nurses in assessing the appropriateness of parents in the PACU and clearly state what the expectations are from the parents.

Parental participation in the care of their child in PACU can be beneficial to patients and families, as well as be rewarding to nurses. Therefore, are PACU nurses wasting a valuable asset to their patient care? Literature would point to the answer to this question being in the affirmative.

Although logically parental presence may be difficult to encourage in combined adult/child PACUs, the benefits to parents, child and the nurse would prove to be advantageous.

PACU staff must focus on the advantages to the parents and child of encouraging parental presence in the PACU.

About the author: *Chris Brace is the Charge Nurse of the Post Anaesthetic Care Unit, Operating Theatres, Waikato Hospital. She has been in this position for the last five years, coming from a background of Intensive Care nursing. She is a RGON and gained her Bachelor of Nursing in 1997 from Waikato Polytechnic*

REFERENCES

1. Auckland Hospital (1995). Policy for Parental Visiting In the PACU.

2. Calley, P. and Smith, L. (1991) A study of role negotiation between nurses and the parents of hospitalised children. *Jour.Adv.Nurs.* 16; 772-781.

3. Drain, B. (1994). The Post Anaesthesia Care Unit 3rd ed. Pennsylvania: Saunders.

4. Fina, D.K., Lopas, L.J., Stragmore, J.H., Santucci, P.R. (1997) Parental participation in the Post Anaesthesia Care Unit: Fourteen Years of Progress at one Hospital. *J. Perianes Nur.* 12; 3:152-162.

5. Hannallah, R.S. and McGill, W.A. (1992). Parental presence during induction of anaesthesia in children. *Seminars in Anaesthesia* Vol. XI; 3: 259-26-I.

6. Holt, L. and Maxwell, B. (1994). Paediatric Orientation Programs. *AORN Journal* 54; 3: 324-240.

7. Jackson, L.B., Marcell, J., Benedict, S. (1997). Nurses attitudes towards parental visitation on the Post Anaesthesia Care Unit. *J. Perianes Nur.* 12; 1: 2-6.

8. Johnston, C.C., Bevan, J.C., Haig, M.J. (1992). Parental presence during anaesthesia intubation. *AORN Journal* 47; 1:78-83.

9. Kain, Z.N., Ferris, C.A., Mayes, LC. and Rimar, S. (1996) Parental presence during induction of Anaesthesia. *Paed. Anaesthesia*; 6: 187-193.

10. Korsh, B. (1991). The child and the operating room. *Anesthes.* 43: 251-257.

11. LaRosa-Nash, P.A., Murphy, J.M., Wade, L.A. (1995) Implementing a parent present induction programme. *AORN Journal* 61; 3: 101-105.

12. Murphy, E.K. (1992) OR Nursing Law. *AORN Journal* 46; 1: 120-124.

13. Nursing Council of New Zealand (1995) Codes of Conduct for Nurses and Midwives.

14. Schaffer, H.R., Emerson, P.E. (1994). The Development of social attachments in infancy. *Monogr.Soc.Res.Child Dev.*; 29: 1-77.

15. Vernon, D., Brown, B.E., Murton, S. (1989). The psychological responses of children to hospitalisation and illness. *J. Perianes. Nurs.*; 6: 241-250.

Exploring Electrosurgical Smoke Control Practices among Operating Theatre Personnel: A QUALITATIVE STUDY

By Assunta Rodrigues and Rhona Winnington

Abstract: Despite increasing evidence on the hazardous nature of electrosurgical smoke (ESS), inconsistent electrosurgical smoke evacuation (ESSE) is a concern among operating theatre (OT) personnel at a large tertiary hospital in New Zealand (NZ). This exploratory-descriptive qualitative (EDQ) study aimed to develop a better understanding of OT personnel's attitude towards ESS and how it influenced their ESS control practice. Using semi-structured interviews with OT personnel and a reflexive thematic data analysis approach, findings revealed that ESSE is poorly implemented in laparoscopies. Education of OT personnel across disciplines about ESS and its evacuation could influence positive attitudes toward ESS control practice to promote a healthy, smoke-free OT environment for patients and personnel.
Keywords: Electrosurgical smoke, surgical smoke/plume, smoke evacuation, diathermy smoke and compliance.

Introduction

ESS is generated during electrosurgical tissue dissection in the operating theatre (OT). ESS is equivalent to unfiltered cigarette smoke containing toxic, mutagenic and carcinogenic by-products of combustion (Croke, 2020; Hill et al., 2012; Tan & Russell, 2019; Tomita et al., 1981; Vortman et al., 2021).

OT personnel's exposure to ESS during laparoscopic and robotic surgeries may cause eyes, nose and throat irritation, headache, dermatitis, dizziness, pulmonary conditions, blood disorders (Ball & Gilder, 2022; Zakka et al., 2020) and transmission of human papillomavirus (Hu et al., 2021) and Hepatitis B (Kwak et al., 2016).

Concerns were raised about the potential transmission of SARS-CoV-2 through ESS (Bogani et al., 2021). In patients, inadequate evacuation of ESS during laparoscopic surgery increases the risk of carbon monoxide toxicity (Marsh, 2012) and port-site metastasis in tumour resection (Mowbray et al., 2013). Moreover, the presence of viable bacteria in ESS can cause surgical-site infections, leading to higher hospitalisation costs (Schultz, 2015). The occupational hazard posed by ESS in the OT demands effective control measures to protect both healthcare personnel and patients (Stanley, 2019; Vortman et al., 2021; Zakka et al., 2020).

Despite the availability of ESSE devices and policies, the implementation of effective ESS control measures remain inconsistent worldwide (Giersbergen et al., 2019; Tan & Russell, 2019).

NZ Health and Safety at Work Strategy states that work-related respiratory diseases are preventable when utilising appropriate control measures, but data on this is lacking (New Zealand Government, 2018).

The NZ Ministry of Health (MOH) began a campaign towards a smoke-free nation by 2025 (MOH, 2021), however the critical need for a healthier smoke-free work environment to benefit OT patients and personnel has not received much impetus. Nevertheless, there is growing international momentum towards addressing ESS, with legislation enacted in parts of Australia and several American states (AORN, 2021; New South Wales Government, 2015; WorkSafe Victoria, 2021), and mandatory ESSE policies being adopted by several European countries (Watters et al., 2022).

Both, the NZ Nurses Organisation and Perioperative Nurses College endorse the elimination of ESS (Manchester, 2018; McCamish, 2018), yet there is currently no national-level mandate. As such, there is a dearth of qualitative research on ESS control practices among OT personnel (Ball & Gilder, 2022; Stanley, 2019), with very few studies on ESSE in nursing literature (Vortman et al., 2021).

Objectives

To explore and develop a greater understanding of OT personnel's attitudes toward ESS and ESS control practices, and to mitigate the risks of ESS exposure for both patients and personnel.

Method and methodology

The methodological framework for this study is EDQ research, which entails both exploration and in-depth description of the phenomenon of interest (Hunter et al., 2019).

This research, conducted between May 2021 to June 2022,

Table 1: Inclusion and Exclusion criteria

Inclusion Criteria	Exclusion Criteria
OT personnel working for more than six months at the hospital and have encountered ESS during electrosurgical procedures	Senior management such as Charge Nurses
Participants from all genders, ethnicities, and various surgical sub-specialties between the ages of 23 to 65 years	Non-clinical OT personnel
Participants who voluntarily signed their informed consent	Nurses from the first hospital, the researcher was a Charge Nurse there
Surgeons, Anaesthetists, Anaesthetic Technicians from both hospitals but Nurses only from the second hospital	

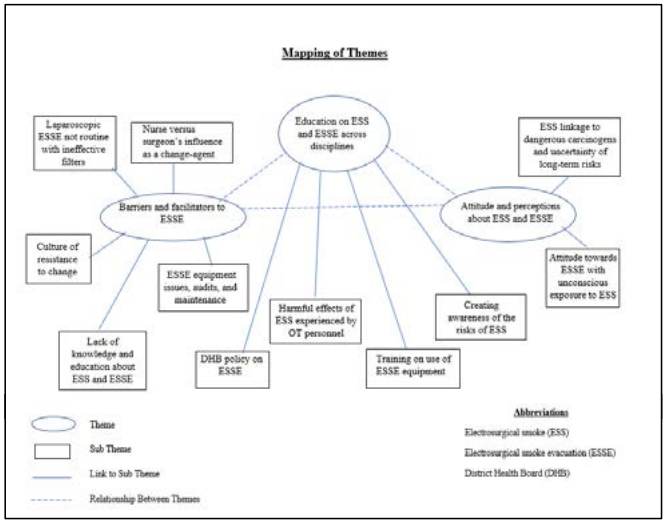


Figure 1. Thematic mapping

Table 2: Semi-structured interview protocol

Questions began with "please can you tell me", and were used to probe further
What does the term ESS mean to you?
How has your understanding of ESSE been developed?
If, how and from whom do new OT personnel learn to effectively evacuate ESS?
What are the barriers and enablers of effectively evacuating ESS within the OT?
Why do you think OT personnel do not consistently utilise ESSE?
How do you feel about the current ESSE practice at your hospital?

involved two hospitals within a large district of Te Whatu Ora Health NZ, consisting of a total of 16 operating theatres covering a wide range of surgical specialties, namely orthopaedics, obstetrics, gynaecology, urology, ear, nose and throat and general surgeries.

Participant recruitment occurred using an advertising poster strategy detailing the research project and the contact email of the gatekeeper (Cooper & Bogossian, 2020). A purposeful sample of six OT personnel including two nurses, two surgeons, an anaesthetist and an anaesthesia technician, who met the inclusion and exclusion criteria (see Table 1) were recruited for individual semi-structured virtual interviews (Hunter et al., 2019; Cooper & Bogossian, 2020).

A participant information sheet and consent form were forwarded to potential participants. Ethical approval was granted by Auckland University of Technology Ethics Committee, reference number 21/276 and the study registered with locality authorisation.

Data collection and analysis

The researcher conducted semi-structured interviews that lasted 60 minutes, during non-working hours at the participants' convenience to mitigate researcher-participant power imbalance (Hunter et al., 2019). Open-ended questions were asked regarding attitudes and perceptions about ESS, and its control practices in the OT (see Table 2). Following written and verbal consent to participate, interviews were audio-recorded and transcribed verbatim by the researcher.

A reflexive thematic data analysis approach was followed as shown in Table 3 (Braun & Clarke, 2021). A blackboard was utilised to collate relevant codes with data extracts and analyse codes. This facilitated a combination of codes to form potential themes using thematic mapping (Braun et al., 2019). The researcher developed the codes and themes that led to the identification of three major themes (see Figure 1). This was then reviewed and agreed by the supervisor.

Findings

Table 4 shows the participants' demographic characteristics.

ESS was identified as a controllable occupational hazard in the OT. However, these findings emphasize inconsistent ESSE with inherent risk of ESS exposure to OT patients and personnel. Data analysis unveiled three major themes:

1. Education on ESS and ESSE across disciplines
2. Attitudes and perceptions about ESS and ESSE
3. Barriers and facilitators to ESSE

Findings indicated OT personnel's knowledge and awareness of the risks of ESS are directly related to their attitude towards and perception of ESS, which in turn is found to influence their ESS control practice. Participants reported experiencing routine odour of ESS in the OT, nausea, headaches, and in one instance, a metallic taste when diathermy accidentally came in direct contact with metallic implants. They expressed concerns about potential lung damage, exacerbation of pre-existing conditions, transmission of carcinogens from electrosurgically dissected malignant tissue, and plausible COVID-19 transmission risks through aerosolised ESS.

Education on ESS and ESSE across disciplines

Participants emphasized that the key to achieving consistent and effective ESSE is by educating all OT personnel across disciplines about ESS and ESSE. Importantly, only one participant had received training on surgical smoke safety, and most participants were unaware of the potential risks associated with ESS (see Table 5).

Table 3: Six-phase Thematic Analysis process (Braun & Clarke, 2021, p.331)

Phase	Name of the Phase	Description of the process
One	Data familiarisation and writing familiarisation notes	Transcribing data, reading and re-reading the data and making notes
Two	Systematic data coding	Subjective coding of interesting features of the data in a systematic fashion across the entire data set, collating data relevant to each code
Three	Generating initial themes from coded and collated data	Codes conceptualised as analytical tools by the researcher to develop potential iterative themes by collating data
Four	Developing and reviewing themes	Checking if the themes work as patterns of shared meaning, united by an idea or a central concept by generating a thematic 'map' of the analysis
Five	Refining, defining, and naming themes	Ongoing analysis to refine the specifics of each theme, generating clear definitions and names for each theme and the overall story of the analysis
Six	Writing the report	Listing of final themes with vivid, compelling data extracts and final analysis of selected extracts relating to the research question, producing a scholarly report of the analysis

Attitude and perceptions about ESS and ESSE

Participants who perceived ESS as harmful displayed a positive attitude towards ESSE, recognising its importance and complexity. Concerns were raised that the potential harm of ESS was not highlighted in the OT compared to other occupational hazards. They noted the lack of caution in practicing ESSE among OT personnel, resulting in inadvertent exposure to hazardous ESS. They drew a parallel between ESS and cigarette smoke, highlighting its link to carcinogens and expressed uncertainty about long-term health risks (see Table 6).

Barriers and facilitators to ESSE

A significant barrier to effective ESS control practices among OT personnel was the lack of knowledge and education about ESS and ESSE. Other barriers included a resistant culture to change, noisy ESSE equipment, bulky diathermy pencil with inadequate length for deep cavities and ineffective laparoscopic filters with infrequent use of ESSE in laparoscopies, which was often surgeon dependent. Facilitators for ESSE included regular audits and maintenance of ESSE equipment, as well as the potential influence of nurses as change-agents to promote ESSE. Participants emphasized that education on ESS and ESSE across disciplines was the cornerstone for achieving consistent and effective ESSE (see Table 7).

Notably, participants perceived laparoscopies as the largest barrier to ESSE (see Table 8).

Discussion

The study revealed inconsistent and ineffective ESS control practices, as well as attitudes and perceptions towards ESS in the OT, aligning with existing national and international literature (Giersbergen et al., 2019; Holmes, 2016; McCamish, 2018; Steege et al., 2016). Poor ESSE compliance was reported in laparoscopic surgeries. However, existing research comparing ESS in open versus laparoscopic surgery is limited, with few relevant studies (Hsu et al., 2022; Kameyama et al., 2022; Mintz et al., 2020). Furthermore, the misunderstanding of participants regarding the danger of ESS during laparoscopies is problematic given that substantial amounts of ESS confined within the abdominal cavity is absorbed into the patient's bloodstream via the peritoneum, with potentially harmful effects (Dobrogowski et al., 2015). Yet, one study revealed that one-third of surgeons switched to open appendicectomy due to laparoscopic ESSE inconsistencies and only a third had access to laparoscopic ESSE devices (Ielpo et al., 2020).

Participants reported ineffective laparoscopic ESSE filters that impaired surgical site visibility, prolonging intraoperative time and often a laparoscopic portal valve is opened to let out the pressurised ESS intermittently, exposing OT personnel to hazardous ESS. These findings align with the study by Choi et al. (2014), who argue that appropriate ESS control measures should be taken due to short and long-term ESS exposure risks. While the use of ESSE during laparoscopies is specifically problematic, the more general opinion is that ESSE is not given adequate attention in the OT. This is demonstrated through participants' lack of knowledge regarding the composition and harmful effects of ESS and mechanisms for maintaining safety, with local policies requiring updating (Ball & Gilder, 2022; Lotfi et al., 2022). Specifically, despite acknowledging the noxious odours of ESS, OT personnel appear to remain reticent to use ESSE, perhaps due to lack of effective equipment, or potentially lack of appropriate education (Giersbergen et al., 2019), with regular updates required (Tan & Russell, 2019). A lack of confidence in setting up the local exhaust ventilation was identified in this study, and this may have contributed to the inconsistent use of ESSE, as highlighted by Steege et al. (2016).

Interestingly, this study noted the dependence of OT personnel

Table 4: Participants' demographics

Participant No.	P1	P2	P3	P4	P5	P6
Profession	Nurse	Anaesthesia Tech	Nurse	Surgeon	Surgeon	Anaesthetist
Years of experience	4.5	28	2	10	27	11
Gender	F	M	M	M	F	M
Age group (yrs)	23-40	50-65	23-40	23-40	40-50	23-40
Prior training in surgical smoke safety	No	No	Yes	No	No	No

Table 5: Education on ESS and ESSE across disciplines
"Number one is education! So, people need to have the knowledge of the harms of ESS. Have education I think for the entire staff and then if everybody is on the same page … in addition they also need to know what options are available for evacuation. People should feel that they can be open to talking about it [ESSE]. So, for instance if there is a particular surgeon that's not using the smoke evacuator then a colleague or a nursing staff member should be able to speak up." (P4)
"First of all, education of everybody involved in theatre. Regular testing of the [ESSE] equipment that we use and education. I think, these are the two key things." (P5)

Table 6: Attitude and perceptions about ESS and ESSE
"I would put it [ESS] as (tone of voice stresses) harmful and hazardous!… If you are burning cancerous tissues and that's being released out into the atmosphere around you and if you are breathing that straight into your lungs, there are risks of having any kind of transmission." (P1)
"In theory it [ESS] means a bloody bad smell (sighs). It can be pretty, pretty nasty (facial expressions) if we don't use the evacuator. I don't know exactly what it (ESS) contains. The risks might be damage to lungs over periods of time. Some people might have pre-existing conditions, in which it just makes worse." (P2)
"Some of our patients are intubated and they have a closed-circuit airway but if they got spinal anaesthetic, they will be inhaling surgical smoke as well which they might inhale those toxic substances." (P3)
"The theoretical risk of being carcinogenic, similar to cigarette smoke in a way.… There is also risk of transmitting infectious diseases, another theoretical risk of transmitting cancer particles or other metastatising other materials.… It's like whenever we are doing any operation, we need to pay attention to the safety of the staff including things like radiation where we always wear radiation shields but for some reasons when it comes to smoke evacuation people are a little bit less cautious. People think that when you are doing laparoscopic surgery, the smoke is often contained and is not so much of an issue." (P4)
"I think it (ESSE) is a really important issue, I think that one needs to be talked and spoken about more." (P6)

on nurses in promoting the use of new technologies for safe practice which places nurses in the forefront for positive changes in ESSE. Findings revealed that it is not always a surgeon's decision but the nurses trying to save on resources and costs, hence not utilising ESSE for short colorectal cases. However, Steege et al. (2016) argue that the decision about utilising ESSE should not be made at the discretion of an individual practitioner when the whole team and the patient is exposed to hazardous ESS. Likewise, Tokuda et al. (2020) support minimising ESS risks to OT patients and personnel which should take priority compared to costs of ESSE systems, and its effectiveness should increase OT personnel's awareness of its benefits over drawbacks. Furthermore, Matthews (2016) argues that cost cannot be utilised as an excuse for failing to protect OT personnel from ESS. Despite noting that ESSE is a crucial component of safe surgical practice, a team approach is required to ensure OT personnel and patients remain safe. Yet, this can be problematic if surgeons are reluctant to engage in the use of ESSE for a variety of reasons (Swerdlow, 2020), thus exposing all involved to the harmful effects of toxic ESS (Steege et al., 2016).

Moreover, in this study 33 percent of participants perceived ESS as toxic or noxious stimuli, comparing it to cigarette smoke, that is harmful to OT patients and personnel. This concurs with a seminal study by Tomita et al. (1981) that proved one gram of electro-surgically ablated tissue is equal to the mutagenicity of smoking six unfiltered cigarettes. Additionally, UK researchers in a plastic surgery OT proved that ESS produced on a daily average was equivalent to 27-30 cigarettes (Hill et al., 2012). It can be strongly argued that all participants in this study recognised that ESS should warrant as much attention as any other OT hazard. However, two out of six participants identified that there is a perceived lack of organisational support in recognising ESS as a safety hazard when compared to x-ray radiation and sharps. These findings concur with Ball (2012) and Steege et al. (2016), who argue that strong leadership support is a key indicator of

Table 7: Barriers to ESSE
"I think minimal sort of education and training around it (ESSE). We were sort of shown how to use the smoke evac machine, and that's once you know how to turn it on and that's kind of all that is done …" (P1)
"It could depend on the surgeon. I think a lot of the new young surgeons use it all the time I suppose … but it could be to do with culture like, (laughs) you know, they don't usually use it, so why use it now, kind of thing." (P2)
"A lot of my experience is that staff actually don't know how to set up a smoke evacuator so that it can go in sync with (smiling) the diathermy machine and we often see they are plugging it in, but nobody has actually checked the machine is actually working alongside the diathermy machine." (P3)
"I remember working with a lot of surgeons who weren't keen on change, as a lot of people are, but we were sort of encouraged by nurses that it's what we should be using and then there was a gradual trend towards everyone using it (ESSE). I personally haven't undergone any sort of formal training on smoke evacuation or the hazards of it. The majority of it was learnt from nursing colleagues." (P4)
"We have training on the principles of electrosurgical, the use of electrosurgery but nothing in terms of evacuation of the smoke. There is absolutely no training!" (P5)

Table 8: Laparoscopies as the largest barrier to ESSE
"I think … everybody, every case should be using an evacuator, but they don't, I know that.… And laparoscopic surgery, all they cause is the abdomen fills up with smoke they evacuate it into the air (frowns). Otherwise, where else will you evacuate? Yeah, you can always smell it!" (P2)
"For laparoscopic I find that the smoke evac, smoke filter thing doesn't actually work all that well. So, what most people tend to do, is open a port, let out all of the smoke (laughs) into the atmosphere, which is obviously not the ideal way of doing it but is probably very commonly done in practice.… I think that's a big area to focus on." (P4)
"You hear the occasional stories of various colleagues who say, 'I get a really bad headache' and some lists which they do, they do a lot of diathermy and smoke just billows up everywhere." (P6)

compliance with ESSE; ESS should be recognised as a hazard, with availability of ESSE equipment and a policy mandate to promote compliance with ESSE.

Strengths and Limitations

Strengths of this study lie in the voluntary participation of OT personnel and the congruence, consistency, and auditability of the EDQ methodology. Rigorous research methods ensured the representation of participants' voices. Limitations include the time constraint of completing the study within a year and a small sample size limiting generalisability to all surgical specialties. Sole data analysis by the researcher may have introduced unintentional bias.

Implications for Practice

Laparoscopies were identified as a primary challenge to effective ESSE, emphasising the need for targeted interventions. This study revealed a significant lack of education and training among OT personnel about ESS and ESSE, contributing to complacency and tolerance of ESS. Education across disciplines about ESS and ESSE, backed by management support and policy update is pivotal for enhancing knowledge, creating positive attitudes toward ESSE and addressing existing barriers. Senior OT leadership, in collaboration with surgeons, should explore contemporary and cost-effective ESSE equipment, especially for laparoscopies.

Recommendations

Evidence-based recommendations were developed to integrate the study findings into practice (see Table 9).

It is imperative for all OT personnel, hospitals and relevant organisations to collectively advocate for the adoption of ESSE guidelines by WorkSafe NZ, aligning with legislation. The proposed action plan for effective implementation of recommendations to ensure continuous quality improvement will follow the Institute for Healthcare Improvement strategy using Plan-Do-Study-Act cycles, grounded in the Johns Hopkins Evidence-Based Practice model (Dang et al., 2021, p. 64).

Conclusion

ESS poses a controllable occupational hazard in the OT, demanding concerted efforts to mitigate risks for patients and personnel. The key to effective and consistent ESSE lies in comprehensive education of OT personnel across disciplines about ESS and ESSE, coupled with robust leadership support, fostering a positive attitude towards ESSE to overcome barriers especially during laparoscopic and robotic surgery. This study offers valuable insights into ESS control practices among diverse OT personnel in a tertiary hospital within NZ, augmenting existing literature on ESSE compliance. Future research should delve deeper into ESS control practices across diverse hospital settings with a larger sample size for comparative analysis.

Table 9: Recommendations

1.	Update the hospital policy on ESSE (Fencl, 2017; Ogg, 2021).
2.	Develop and implement an education programme on ESS and ESSE across disciplines with PowerPoint presentations and hands-on training/practice by ESSE company representatives focussed on educating all OT personnel (Chavis et al., 2016).
3.	Raising awareness of the risks of ESS by displaying posters (York & Autry, 2018).
4.	Update surgeons' preference cards in consultation with surgeons with appropriate ESSE products and find solutions to barriers (Chavis et al., 2016).
5.	Ensure availability of appropriate ESSE equipment and supplies with material resource centre to streamline ESSE supply inventory (Chavis et al., 2016).
6.	Introduce an electronic prompt on the intra-operative record for documenting the usage of ESSE as currently there is no documentation of ESSE (Ostapovych & Vortman, 2022).
7.	Regular feedback from OT personnel on ESSE equipment and supplies; to acquire new products to meet contemporary needs by contacting smoke evacuation product representatives from multiple companies to trial samples for open and laparoscopic procedures (York & Autry, 2018).
8.	Carry out intraoperative prospective observational audits on effective usage of ESSE and retrospective documentation audit on ESSE annually for quality assurance (Fencl, 2017).
9.	Garner management support to recognise and introduce ESS as an occupational hazard on the Health and Safety register by monitoring compliance and reporting non-compliance of ESSE (Vollweiler, 2017).
10.	Disseminate research findings to participants and the wider perioperative community through conference presentation and publication.

It is imperative for all OT personnel, hospitals and relevant organisations to collectively advocate for the adoption of ESSE guidelines by WorkSafe NZ

About the Authors:

Assunta Rodrigues *MHPrac (Nsg), PGCert (Perioperative Specialty Nsg), RN conducted the research and wrote the manuscript. She is an Associate Clinical Charge Nurse, Operating Theatre Coordinator at North Shore Hospital, Auckland with over 30 years of operating theatre experience. Her areas of interest are research, quality improvement and patient safety. She is currently a member of the International Council on Surgical Plume Inc. (ICSP), Clarence, NY as well as the Institute for Healthcare Improvement (IHI), Boston, MA.*

Rhona Winnington *PhD, MA, BA (Hons), BSc (Hons), RN was a Senior Lecturer in the Department of Nursing, Auckland University of Technology who supervised the research, reviewed, and edited the manuscript. Her clinical expertise is emergency nursing and community palliative care. She is currently an Associate Professor at the University of West of Scotland. Her research interests include end-of-life care provision, assisted dying and the influence of gender on healthcare received.*

REFERENCES

AORN. (2021). Advocating for surgical smoke evacuation legislation. *AORN Journal, 114*(4), 17. https://doi.org/10.1002/aorn.13527

Ball, K. (2012). Compliance with Surgical Smoke Evacuation Guidelines: Implications for Practice. *ORNAC Journal, 30*(1), 14–37. https://doi.org/10.1016/j.aorn.2010.06.002

Ball, K., & Gilder, R. E. (2022). A Mixed Method Survey on the Impact of Exposure to Surgical Smoke on Perioperative Nurses. *Perioperative Care and Operating Room Management, 26*(1), 1–9. https://doi.org/10.1016/j.pcorm.2021.100232

Bogani, G., Ditto, A., De Cecco, L., Lopez, S., Guerrisi, R., Piccioni, F., Micali, A., Daidone, M. G., & Raspagliesi, F. (2021). Transmission of SARS-CoV-2 in Surgical Smoke during Laparoscopy: A Prospective, Proof-of-Concept Study. *Journal of Minimally Invasive Gynecology, 28*(8), 1519–1525. https://doi.org/10.1016/j.jmig.2020.12.026

Braun, V., Clarke, V., Hayfield, N., & Terry, G. (2019). Thematic Analysis. In P. Liamputtong, (Eds.), *Handbook of Research Methods in Health Social Sciences* (pp. 843–860). Springer. https://doi.org/10.1007/978-981-10-5251-4_103

Braun, V., & Clarke, V. (2021). One size fits all? What counts as quality practice in (reflexive) thematic analysis? *Qualitative Research in Psychology, 18*(3), 328–352. https://doi.org/10.1080/14780887.2020.1769238

Chavis, S., Wagner, V., Becker, M., Bowerman, M. I., & Jamias, M. S. (2016). Clearing the Air About Surgical Smoke: An Education Program. *AORN Journal, 103*(3), 289–296. https://doi.org/10.1016/j.aorn.2016.01.007

Choi, S. H., Kwon, T. G., Chung, S. K., & Kim, T.-H. (2014). Surgical smoke may be a biohazard to surgeons performing laparoscopic surgery. *Surgical Endoscopy, 28*(1), 2374–2380. doi:10.1007/s00464-014-3472-3

Cooper, S., & Bogossian, F. (2020). Managing a Research Project: Roles and Processes. In D. Whitehead, C. Ferguson, G. LoBiondo-Wood, & J. Haber (Eds.), *Nursing and Midwifery Research: Methods and appraisal for evidence-based practice* (6th ed., pp. 346–365). Elsevier Australia.

Croke, L. (2020). Protecting perioperative personnel and patients from surgical smoke. *AORN Journal, 111*(4), 13–15. doi:10.1002/aorn.13028

Dang, D., Dearholt, S. L., Bissett, K., Ascenzi, J., & Whalen, M. (2021). *Johns Hopkins Evidence-Based Practice for Nurses and HealthCare Professionals: Model & Guidelines* (4th ed.). Sigma Theta Tau International.

Dobrogowski, M., Wesołowski, W., Kucharska, M., Paduszyńska, K., Dworzyńska, A., Szymczak, W., Sapota, A., & Pomorski, L. (2015). Health risk to medical personnel of surgical smoke produced during laparoscopic surgery. *International Journal of Occupational Medicine and Environmental Health, 28*(5), 831–840. doi:10.13075/ijomeh.1896.00374

Fencl, J. (2017). Guideline Implementation: Surgical Smoke Safety. *AORN Journal, 105*(5), 488–497. https://doi.org/10.1016/j.aorn.2017.03.006

Giersbergen, M. Y., Alcan, A. O., Kaymakei, S., Ozsaker, E., & Dirimese, E. (2019). Investigation of Surgical Smoke Symptoms and Preventive Measures in Turkish Operating Rooms. *International Journal of Health Sciences and Research, 9*(1), 138–144.

Hill, D. S., O'Neill, J. K., Powell, R. J., & Oliver, D. W. (2012). Surgical smoke - A health hazard in the operating theatre: A study to quantify exposure and a survey of the use of smoke extractor systems in UK plastic surgery units. *Journal of Plastic, Reconstructive and Aesthetic Surgery, 65*, 911–916. doi:10.1016/j.bjps.2012.02.012

Holmes, S. (2016). Factors affecting surgical plume evacuation compliance. *Journal of Perioperative Nursing in Australia, 29*(4), 39–42. https://doi.org/10.26550/2209-1092.1010

Hsu, F. L.-T., Ho, T.-W., Chang, C., Wu, J.-M., & Lin, M.-T. (2022). Chemical composition of smoke produced by open versus laparoscopic surgery for cholecystectomy. *HPB*. https://doi.org/10.1016/j.hpb.2022.02.002

Hu, X., Zhou, Q., Yu, J., Wang, J., Tu, Q., & Zhu, X. (2021). Prevalence of HPV infections in surgical smoke exposed gynecologists. *International Archives of Occupational and Environmental Health, 94*(1), 107–115. https://doi.org/10.1007/s00420-020-01568-9

Hunter, D. J., McCallum, J., & Howes, D. (2019). Defining Exploratory-Descriptive Qualitative (EDQ) research and considering its application to healthcare. *Journal of Nursing and Health Care, 4*(1), 1–7. http://dl6.globalstf.org/index.php/jnhc/article/view/1975

Ielpo, B., Podda, M., Pellino, M., Pata, F., Caruso, R., Gravante, G., & Di Saverio, S. (2020). Global attitudes in the management of acute appendicitis during COVID- 19 pandemic: ACIE Appy Study. *British Journal of Surgery, 108*(6), 717–726.

Kameyama, H., Otani, T., Yamazaki, T., Iwaya, A., Uehara, H., Harada, R., Hirai, M., Komatsu, M., Kubota, Ak., Katada, T., Kobayashi, K., Sato, D., Yokoyama, N., Kuwabara, S., Tanaka, Y., & Sawakami, K. (2022). Comparison of surgical smoke between open surgery and laparoscopic surgery for colorectal disease in the COVID-19 era. *Surgical Endoscopy, 36*(1), 1243–1250. https://doi.org/10.1007/s00464-021-08394-1

Kwak, H. D., Kim, S.-H., Seo, Y. S., & Song, K.-J. (2016). Detecting hepatitis B virus in surgical smoke emitted during laparoscopic surgery. *Occupational and Environmental Medicine, 73*, 857–863. https://doi.org/10.1136/oemed-2016-103724

Lotfi, M., Sheikhalipour, Z., Zamanzadeh, V., Aghazadeh, A., Khordeforoush, H., Rahmani, P., & Akhuleh, O. Z. (2022). Attitude, preventive practice and perceived barriers among perioperative and anesthesia nurses toward surgical smoke hazards during the COVID-19 outbreak. *Perioperative Care and Operating Room Management, 26*(1), 1–8. https://doi.org/10.1016/j.pcorm.2021.100234

Manchester, A. (2018). The Dangers of Surgical Plume. *Kai Tiaki Nursing New Zealand, 24*(6), 30.

Marsh, S. (2012). The Smoke Factor: Things You Should Know. *Journal of Perioperative Practice, 22*(3), 91–95. https://doi.org/10.1177/175045891202200303

Matthews, S. (2016). Preventing Harm from Surgical Plume. *Kai Tiaki Nursing New Zealand, 22*(6), 26–27.

McCamish, J. (2018). Surgical Plume Survey 2018. *The Dissector , 46*(1), 28–30.

Ministry of Health New Zealand. (2021). *Proposals for a Smoke-free Aotearoa 2025 Action Plan*. https://www.health.govt.nz/publication/proposals-smokefree-aotearoa-2025-action-plan

Mintz, Y., Arezzo, A., Boni, L., Baldari, L., Cassinotti, E., Brodie, R., Uranues, S., Zheng, M., & Fingerhut, A. (2020). The risk of COVID-19 transmission by laparoscopic smoke may be lower than for laparotomy: A narrative review. *34*(1), 3298–3305. https://doi.org/10.1007/s00464-020-07652-y

Mowbray, N., Ansell, J., Warren, N., Wall, P., & Torkington, J. (2013). Is surgical smoke harmful to theatre staff? A systematic review. *Surgical Endoscopy, 27*(9), 3100–3107. https://doi.org/10.1007/s00464-013-2940-5

New Zealand Government. (2018). *Health and Safety at Work Strategy 2018-2028*. https://www.mbie.govt.nz/dmsdocument/4306-health-and-safety-at-work-strategy-consultation-supporting-information

New South Wales Government. (2015). *Work Health and Safety: Controlling Exposure to Surgical Plume*. https://www.dir.ca.gov/dosh/doshreg/Surgical-Plume-and-Smoke/NSW-Work-Health-and-Safety.pdf

Ogg, M. J. (2021). Guideline for Surgical Smoke Safety. In AORN, *Guidelines for Perioperative Practice* (pp. 1033–1064). AORN. https://aornguidelines.org/guidelines/content?sectionid=173725179&view=book#245934340

Ostapovych, U., & Vortman, R. (2022). Implementing a Surgical Smoke Evacuation Policy and Procedure: A Quality Improvement Project. *AORN Journal, 115*(2), 139–146. https://doi.org/10.1002/aorn.13603

Schultz, L. (2015). Can Efficient Smoke Evacuation Limit Aerosolization of Bacteria? *AORN Journal, 102*(1), 7–14. https://doi.org/10.1016/j.aorn.2015.04.023

Stanley, K. (2019). Diathermy smoke shown to be hazardous, so why are we not protecting ourselves? *Journal of Perioperative Practice, 29*(10), 321–327. doi:10.1177/1750458919877786

Steege, A., Boiano, J. M., & Sweeney, M. H. (2016). Secondhand smoke in the operating room? Precautionary practices lacking for surgical smoke. *American Journal of Industrial Medicine, 59*, 1020–1031. doi:10.1002/ajim.22614

Swerdlow, B. N. (2020). Surgical smoke and the anaesthesia provider. *Journal of Anaesthesia, 34*(1), 575–584. https://doi.org/10.1007/s00540-020-02775-x

Tan, E., & Russell, K. (2019). Surgical plume and its implications: A review of the risk and barriers to a safe work place. *ORNAC Journal, 37*(3), 33–47. https://doi.org/10.26550/2209-1092.1019

Tokuda, Y., Okamura, T., Maruta, M., Orita, M., Noguchi, M., Suzuki, T., & Matsuki, H. (2020). Prospective randomized study evaluating the usefulness of a surgical smoke evacuation system in operating rooms for breast surgery. *Journal of Occupational Medicine and Toxicology, 15*(13), 1–10. https://doi.org/10.1186/s12995-020-00259-y

Tomita, Y., Mihashi, S., Nagata, K., Ueda, S., Fujiki, M., Hirano, M., & Hirohata, T. (1981). Mutagenicity of smoke condensates induced by CO2-laser irradiation and electrocauterization. *Mutation Research/Genetic Toxicology, 89*(2), 145–149. https://doi.org/10.1016/0165-1218(81)90120-8

Vollweiler, M. (2017). Is Your Hospital Smoke Free? *The Dissector , 45*(1), 12–13.

Vortman, R., McPherson, S., & Wendler, C. M. (2021). State of the Science: A Concept Analysis of Surgical Smoke. *AORN Journal, 113*(1), 41–51. http://doi.org/10.1002/aorn.13271

Watters, D. A., Foran, P., McKinley, S., & Campbell, G. (2022). Clearing the air on surgical plume. *ANZ Journal of Surgery, 92*(1), 57–61. https://doi.org/10.1111/ans.17340

WorkSafe Victoria. (2021). *Managing surgical plume exposure in healthcare*. https://www.worksafe.vic.gov.au/managing-surgical-plume-exposure-healthcare

York, K., & Autry, M. (2018). Surgical Smoke: Putting the Pieces Together to Become Smoke-Free. *AORN Journal, 107*(6), 692–703. https://doi.org/10.1002/aorn.12149

Zakka, K., Erridge, S., Chidambaram, S., Beatty, J. W., Kynoch, M., Kinross, J., & Purkayastha, S. (2020). Electrocautery, Diathermy, and Surgical Energy Devices: Are Surgical Teams at Risk During the COVID-19 Pandemic? *Annals of Surgery, 272*(3), e257–e262. doi:10.1097/SLA.0000000000004112

Acute Behavioural Disturbance in the PACU

This webinar on acute behavioural disturbance was enlightening for the healthcare professionals who attended, especially those working in the post anaesthesia care unit (PACU).

Anastasia James, PACU Clinical Nurse Educator, adeptly navigated through the complexities of managing patients who exhibit behavioural disturbances post-surgery, offering valuable insights and strategies backed by literature.

The webinar began with an introduction to Anastasia's work and an outline of key concepts to be explored in the presentation, as well an explanation of the underlying causes of acute behavioural disturbance in these post-op patients.

As Wellington Hospital is a trauma hospital with high acuity patients, the incidence for Acute Behavioural Disturbance is high, compared to neighbouring private hospitals with elective surgeries under general anaesthesia.

PACU nurses in Anastasia's workplace did not feel safe or comfortable enough to approach patients whilst they were exhibiting these behaviours and there was no appropriate guideline to safely direct staff in what to do.

The Delirium Clinical Care Standard (2021) was used as a guiding document in how to navigate such interactions.

The standard indicated such acute behaviours should be dealt with promptly as patient and staff safety is prioritised. PACU nurses want to limit injury, contamination of surgical wounds, pulling out of arterial or peripheral lines, and indecent exposure, amongst other things, for the patient.

For staff members, the aim is also to limit injury from aggressive behaviours, verbal abuse, task overloading, managing other patients who get affected and other theatres finishing their cases and wanting to come out to PACU.

Anastasia discussed the role of anaesthesia, opioids, and various stress responses to surgery as significant contributors to acute agitation, aggression, confusion, and delirium in these patients.

The contributing pre-operative factors identified were that elderly patients with existing delirium had a higher incidence of post-op delirium. Other factors included males over 65-years of age, Māori/Pacific patients, those with anxiety, depression, drug and alcohol use histories, as well as patients whose surgery had previously been cancelled.

Post-operative contributing factors included pain and the type of operation, as well as the presence of urinary catheters or peripheral lines.

The PACU team implemented preventative measures to reduce the risk of acute behavioural disturbance by ensuring baseline cognitive assessments are completed, providing good hydration, involving patients' trusted family members and utilising cognitive/mobility aids such as hearing aids and eyeglasses.

Anastasia addressed the root causes, stressing the importance of a multidisciplinary approach, the usage of practical techniques and effective communication strategies when dealing with acute behavioural disturbances. Moreover, de-escalation skills and non-pharmacological interventions underscored a holistic approach to patient care, minimising the need for restraints and sedation.

Anastasia reinforced this by ending the presentation with her message that in PACU the aim is to support and safely guide the patient through these emotions and behaviours, not to sedate the patient.

Attendee Feedback

Collectively, the 32 members who viewed the live presentation of this webinar praised the work presented by Anastasia, stating it was well structured and thoroughly researched, with 99 percent of viewers indicating they would highly recommend it to colleagues. They indicated that analysis of post-operative delirium gave valuable insight and the utilisation of tools such as the Richmond Agitation and Sedation Scale (RASS), as well as the Confusion Assessment Method (CAM – ICU) for the intensive care unit, allowed other PACU nurses across New Zealand to take to their respective units.

When asked to describe an area where respondents would improve/develop their professional practice, the majority identified a need to improve communication during de-escalation of acute behaviours within their units. They also highlighted the importance of ensuring staff are aware of the relevant guidelines and tools (such as those stated above), to guide the team in managing emergence delirium and agitation.

Respondents were asked how the webinar would assist in their decision making to address equity and the majority included the following three themes: incorporating whanau where possible, early detection of risk factors and early planning for PACU, and assessing whether guidelines are relevant and suitable for the patient.

To view this webinar, please go to Recorded Webinar #17 at https://myhealthhub.co.nz/pnc/

Reviewer: Finau Faka'i (ADHB)

Reference

Australian Commission on Safety and Quality in Health Care. (2021). *Delirium Clinical Care Standard*. Retrieved from https://www.safetyandquality.gov.au/sites/default/files/2021-11/delirium_clinical_care_standard_2021.pdf

Operio – preventing Surgical Site Infections

In New Zealand, Surgical Site Infections (SSIs) are estimated to account for 80 percent of all Hospital Acquired Infections (HAI). They occur in 2-4% of patients undergoing inpatient surgical procedures. Although most infections are treatable with antibiotics, SSIs can have a significant impact on morbidity and mortality after surgery.

In 2003, the estimated cost of treating hospital-acquired infections (HAIs) in medical and surgical patients in Auckland DHB public hospitals was $137 million per year.

SSIs are caused by bacteria that enter the incision during surgery.

Wellington-based **Medix 21 Surgical** reasons that prevention is better than cure, offering an innovative ultraclean air zone unit called **Operio** which ensures both the surgical site and instruments near the wound remain protected during the entire surgical procedure.

The ultraclean airflow is easily aimed over the surgical site or any other area where there is a need to keep the sterile integrity intact.

The Operio has a unique sterile single-use protective barrier. The unit circulates ambient air through a HEPA filtration system and cleans it to prevent dangerous, airborne bacteria carrying particles coming into contact with the surgical site, as well as surgical instruments near the surgical site. Apart from the ultraclean zones, the Operio also has a secondary effect on all ambient air in the room, with HEPA filtration of 400m^3/hour.

It comes in a mobile unit or it can be pendant mounted. Medix 21 Surgical has recently sold two units to HNZ Whanganui. HNZ Hutt is planning to soon place one in their new day cataract procedures.

It is a very cost-effective way to increase surgical procedure capacity outside the operating theatre.

Alternatively, it can be used to add another layer of protection from bacteria inside the operating theatre as it ambiently cleans the air. It can also be utilised in other parts of the hospital, like Radiology, where HEPA air filtration is required at a much-reduced cost to installing air filter systems in the ceiling.

The technology is also available in a dedicated instrument table (SteriStay) for prolonged procedures where instruments and implants are left out for long periods of time and infection is a big concern e.g. orthopaedics.

For more information on Operio, contact **Camille Furnandiz,** Surgical Sales Manager at Medix 21 Surgical, Mobile: **021 734 762**; 0800 633 4921 Email: camille@medix21.co.nz

3M spins off healthcare into new company

The diversified Minnesota-based US manufacturer 3M has separated its healthcare business into a new independent entity: Solventum Corporation. The separation took effect on April 1, 2024.

Prior to the separation, 3M healthcare had sales worth $US8.2 billion in 2023 and is made up of 22,000 employees globally. Solventum Corporation is listed on the New York Stock Exchange as SOLV.

"This is an important day for 3M and Solventum, and I extend my sincere congratulations to members of both teams who have made this possible," said 3M chairman and chief executive officer Mike Roman.

"Both companies are positioned to pursue their respective growth and tailored capital allocation plans, and I am excited to see both companies succeed as they innovate new solutions and create value for their respective stakeholders."

3M retained 19.9% of the outstanding shares of Solventum common stock, which will be monetized within five years following the spin-off.

"Solventum is now better positioned to create long-term value for shareholders through greater focus on our core business, an enhanced ability to execute on industry-specific growth and market strategies and tailored capital allocation strategies," says CEO Bryan Hanson.

For more information on Solventum in New Zealand, contact Raylene Bowmar-Wilson, rbowmar-wilson@solventum.com

Sim.LED 8000: REVOLUTIONARY & INNOVATIVE ILLUMINATION

High-end light quality for high-end applications

Impressive light quality

- Shadow-free light thanks to the patented SIMEON reflector technology 2.0
- Available in Single (SC) & Multi Color (MC)
- Optimization of illumination through active shadow management
- Impressive color rendering with CRI 88

Multidisciplinary use

- Excellent 2308 mm depth illumination
- Optimally illuminated light field at 160,000 lux in various field sizes
- Application-oriented field adjustment from 170 to 320 mm
- Positioning of the light head from +45° to -75°

Looking to the future

Sim.BIANCE dimmable endoscopic light

- Dimmable and customizable: light intensity adjustment related to the application
- Tough display: automatic reduction of display brightness to avoid interfering light in the operating room

High resolution camera systems

- The future of visualization: automatic camera preparation for the Sim.LED 8000 for
- 4K and HD camera systems as well as readiness for future camera technologies

SIMEON Medical's Sim.LED 8000 series offers a new era of surgical lights. The Sim.LED 8000 has a uniquely intuitive user philosophy and an outstanding and innovative illumination. Ideal for all applications, needs and challenges in every day surgery and for the most challenging and complex cases.

The new SIMEON operating light impresses especially with its efficiency, multidisciplinary use and superior active shadow management, enabling users with an unobstructed illuminated field.

Prepared for the future always. All Simeon OR lights are camera ready. Record crystal clear 4K recordings/images with the Sim.CAM 4K wireless camera system.
Easy installation, no need to worry about lengthy installations, the Sim.CAM can be easily retrofitted at any stage.

For more information please reach out to our dedicated experts at Keyport or check out Simeon's impressive range of surgical lighting on their web page - www.simeonmedical.com/en/

SIMEON MEDICAL

PUSHING TECHNOLOGY TO EXCELLENCE

KEYPORT
SPECIALIST MEDICAL EQUIPMENT & SERVICING

info@keyport.co.nz
www.keyport.co.nz