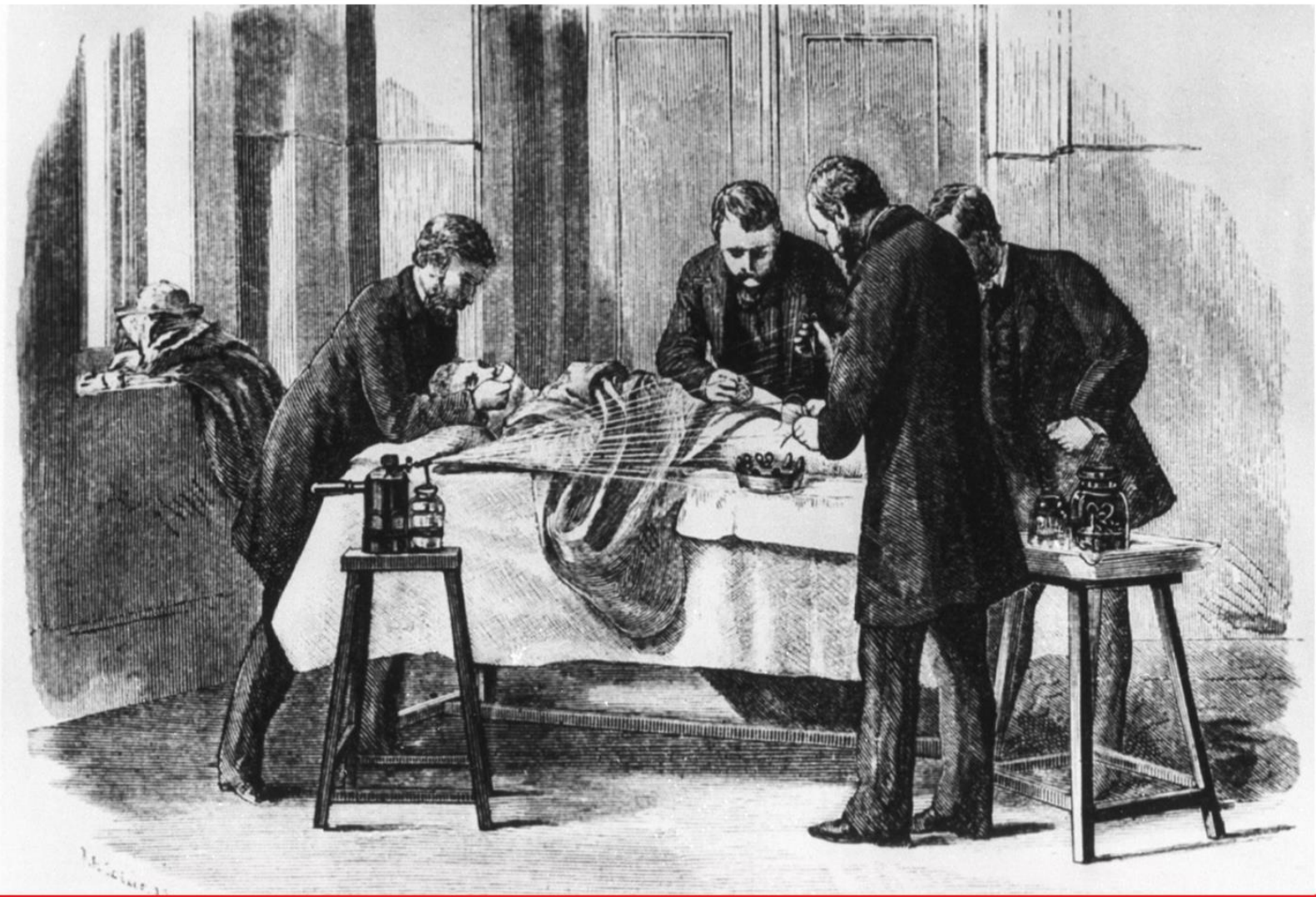
NSW SPECIAL COMMITTEE INVESTIGATING DEATHS UNDER ANAESTHESIA

ANNUAL REPORT 2020



60 YEARS OF SCIDUA

DISCLAIMER

All identifying information has been omitted to preserve anonymity.

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CLINICAL EXCELLENCE COMMISSION

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Executive Summary

The Special Committee Investigating Deaths Under Anaesthesia (SCIDUA) has been reviewing deaths since 1960. Because sedation and anaesthesia exist on a continuum of a decreased level of consciousness and use the same, or similar, drugs, the committee also reviews sedation-related deaths in New South Wales. For the purposes of this report, no distinction is made between anaesthesia-related and sedation-related deaths.

In New South Wales, under section 84 of the *Public Health Act 2010* it is mandatory for public and private facilities to report a death arising after anaesthesia or sedation for an operation or procedure to SCIDUA.

The estimated resident population in New South Wales, as reported by the Australian Bureau of Statistics for the December 2020 quarter, was **8,084,192**. Using the Admitted Patient Data Collection[1] to examine the number of episodes of anaesthesia administered (n=**666,825** episode end dates identified) for public (300,802) and private (366,023) hospital patients in 2020, against the number of patient deaths/separations, a total of **1,700** deaths occurred. Notifications received for the 2020 calendar year (n=**298**), identified 279 deaths occurred in public hospitals and 19 in private hospitals. Of these, SCIDUA classified 49 anaesthesia-related public hospital deaths and 7 private hospital deaths (n=**56**).

Activity for the committee in 2020 included 312 notified deaths, where death had occurred during, due to, or within 24 hours of, an anaesthetic or administration of sedative drugs for medical/surgical procedures. Of these, 260 deaths fell within the criteria of the terms of reference for SCIDUA, with 49 cases classified by the committee as being, wholly or partly, related to anaesthetic factors; as follows:

- **15 cases** where anaesthesia either directly caused, or substantially contributed to, the patient's death (Category 1 and 2)
- **34 cases** where a combination of anaesthesia and surgical factors contributed to the patient's death (Category 3)

Further analysis of the data identified that:

- Most of the patients were elderly, with 87.75% (n=43) of patients aged 72 years or older, and a further 12.24% (n=6) of patients aged between 16 and 63 years of age.
- Most patients were classified as critically ill with 61.22% (n=35) being ASA 4.
- 22.45% (n=11) of deaths related to anaesthesia occurred in the operating theatre.
- Median age of male patients is 81 years and female 85.5 years.

The committee reviews the anaesthesia-related deaths to identify any management choices it considers could be improved upon; these are called *correctable factors*. In 2020, the committee determined that 71.43% (n=35) of cases had *no correctable factor*. Data for the 14 cases with correctable factors shows:

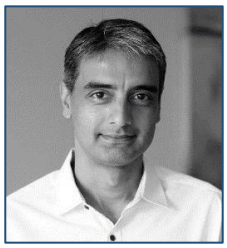
- **14 cases** classified as anaesthesia-related deaths had one or more correctable factors.
- 71.43% (n=10) of these cases were classified as Category 1 deaths.
- **10 cases** where the causal or contributing factor was associated with B(ii) *Airway maintenance*.

This report also includes data for 11 years (2010-2020), from the 3,273 notifications submitted by 99 hospitals (**Appendix E**), of which 16.28% (n=533) were identified as anaesthesia-related deaths. The highest correctable factor for anaesthesia-related deaths was A(i) - *Pre-operative Assessment* (n=52).

Australia remains one of the safest places in the world to undergo a surgical procedure. In 2020 the chance of any patient dying while undergoing a procedure was 0.03%. Further more, the chance of anaesthesia *contributing* to the death was 0.007%, with the chance of anaesthesia *directly causing* death being **0.002%**.

[1] **Source:** Admitted Patient, Emergency Department Attendance and Deaths Register, NSW Ministry of Health SAPHaRI, data extracted on 26 September 2022.

Members of the Committee



Dr Carl D'Souza

Chairman

Dr Frances Smith

Dr Elizabeth O'Hare

Dr Jonathon Gibson

Dr David McLeod

Dr Damien Boyd

Dr Benjamin Olesnicky

Dr Sarah Johnston

Acknowledgement

In reaching its 60th year, the Committee would like to acknowledge the past Chairmen of SCIDUA. Their contributions, enthusiasm and dedication are appreciated.

- Dr Cyril Cummins (Inaugural Chair)
- Dr E.S.A. Meyers
- Dr David Storey
- Dr John Warden
- Dr Brian Horan
- Dr Chris Borton
- Professor Ross Holland
- Dr David Pickford

Special thanks to **Dr Michelle O'Brien** for her commitment to SCIDUA for almost 15 years. Michelle stepped down as Medical Secretary in December 2020, prior to her retirement in 2021. Her expertise and wisdom will be missed.

Chairman's Foreword

Anaesthesia in New South Wales is incredibly safe. We maintain this incredible safety record despite the work landscape changing constantly. We are now in an era of operating on patients who previously would have been deemed too high risk, we now perform procedures which never existed previously, we now operate on patients in positions which are challenging and difficult. But through all of this we manage to keep our patients safe.

There are times however that despite our best efforts something untoward occurs. It is important when these events occur, they are talked about and analysed so future events are avoided.

The 2020 Report shines a light on the Safety of Anaesthesia. It also highlights cases from which Anaesthetists can learn from and refer to in the future when dealing with similar patients or operations.

The take home messages from these cases are similar to previous years – consideration of invasive monitoring, anticipatory vasopressors, securing and protecting the airway at the start of a case. All done to avoid a crisis later.

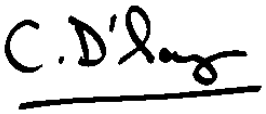
Some of these cases also demonstrate that some end-of-life patients and their families (and proceduralists) may not be aware that the addition of anaesthesia to their current health state can actually result in the end of life. Communication between the patient, families and proceduralists in this setting is very important to ensure everyone has a clear understanding of risks and benefits before embarking on any procedure.

When Professor Holland started the committee in 1960 it was a vastly different working environment. Anaesthetists did not have the sophisticated monitoring or equipment we take for granted and the education of anaesthetists was not as robust as it is today. As a result of this, anaesthetic-related deaths were much higher than we see now, particularly in the obstetric and paediatric population. The Article Professor Holland wrote in 1970[2] is reprinted in this report (**Appendix F**) and highlights just how far we have come as a profession in improving our safety record.

Once again, this report is not intended to be a Textbook on Anaesthesia, the reflection points are meant to stimulate conversations within the profession. Anaesthetists need to decide for themselves what works safely in their hands.

As in previous years, I am incredibly grateful to the anaesthetists who have so generously allowed me to use their cases so that others may learn, and future events are avoided.

I hope you enjoy reading the report and I hope you have many conversations as a result with your colleagues.



Dr Carl D'Souza

SCIDUA Chairman

SCIDUA
Special Committee Investigating Deaths Under Anaesthesia

[2] (1970), SPECIAL COMMITTEE INVESTIGATING DEATHS UNDER ANAESTHESIA REPORT ON 745 CLASSIFIED CASES, 1960–1968. Medical Journal of Australia, 1: 573-594. https://doi.org/10.5694/j.1326-5377.1970.tb116940.x

Throwback to the Early Days of SCIDUA

History provided from the words of Professor Ross Holland on the first 50 years of SCIDUA.

In 1960, when SCIDUA was first convened, the Labor Government was in administration and the Minister for Health was Mr W.F. (Billy) Sheahan.

Apart from politics, the economy of the early 1960s was quite different from today. Decimal currency was not introduced until 1966, the post-war wool boom provided a more secure financial start for the baby boomers, almost half of the population of New South Wales (3.8M) lived outside metropolitan Sydney with many rural communities equipped with a local hospital.

The decision for the preferential admission of servicemen to the Faculty of Medicine, University of Sydney, in 1951 resulted in a surplus of graduates and fewer post-graduate opportunities. Many graduates sought rural placement in general practice after only a few years of general hospital experience. However, anaesthesia was largely administered by General Practitioners in public hospitals, as there was an insufficient number of specialist anaesthetists, even in major inner-city hospitals. In 1960, there were only 39 Fellows of the Faculty of Anaesthetists in NSW.

Many small private facilities at the time did not provide the equipment needed for anything but the most basic of techniques. Most anaesthetists would be expected to bring their own anaesthetic machine, even gases, volatile agents, laryngoscope and endotracheal tubes.

This is reflected in the data for the early years of SCIDUA which reveals a spectrum of deaths from anaesthesia, during or before recovery. However, it is important to appreciate that an anaesthetic registrar in 1960 was in a very different situation. Supervision was often distant, or absent, working hours were prodigious, and the Faculty required only two years of clinical experience to sit the Final Fellowship examination.

The first interim report released by SCIDUA in 1963 resulted in many GPs voluntarily ceasing to administer anaesthesia. Public hospitals introduced the appointment of full-time Directors, supported by a modest increase in registrar numbers. Then in 1964, the “24-hour” rule came into effect for notifications to the Coroner, and notifications substantially increased.

The 8-category classification system was first adopted in the 1956 paper by Edwards, Morton, Pask and Wylie[3] and has been implemented by SCIDUA since its inception. The first three categories relate to deaths in which anaesthesia played a part:

- Where it was reasonably certain that death was caused by the anaesthetic agent or technique of administration, or in other ways coming entirely within the anaesthetist’s province.
- Similar cases, but in which there was some element of doubt as to whether the agent or technique was entirely responsible for the fatal result.
- Cases in which the patient’s death was caused both by the surgical and anaesthetic techniques.

In 1960, 56 deaths (33 Category-1; 5 Category-2; 16 Category-3) were classified by SCIDUA as being wholly or partially due to anaesthesia. Through the work of SCIDUA over the next 7 years (1960-1967), anaesthesia mortality showed a decline of approximately 40%.

In short, the files of SCIDUA not only reveal a most encouraging and satisfactory fall in anaesthesia attributable perioperative mortality, but also highlight the fact that in the present state of our knowledge and technology we are unable to prevent a greater number of deaths even where the treating team has performed to the highest standard.

[3] Deaths associated with anaesthesia: A report on 1,000 cases. https://associationofanaesthetists-publications.onlinelibrary.wiley.com/doi/10.1111/j.1365-2044.1956.tb07975.x

SECTION 1: COMMITTEE

1. Ministerial Committee

The NSW Special Committee Investigating Deaths Under Anaesthesia is an expert committee established by the Minister for Health and has been in operation since 1960. Its current terms of reference are:

> *'to subject all deaths which occur while under, as a result of, or within 24 hours after, the administration of anaesthesia or sedation for procedures of a medical, surgical, dental or investigative nature to peer review so as to identify any area of clinical management where alternative methods could have led to a more favourable result'*

The Minister for Health appoints members to the committee for a term of five years. The committee elects its own Chairperson, who must be a currently practising anaesthetist.

The committee has anaesthetists from a broad range of clinical specialties and professional organisations. Nominations for membership are invited from the Australian and New Zealand College of Anaesthetists (ANZCA), the Australian Society of Anaesthetists and academic departments of anaesthesia.

1.7 Why is this important?

Anaesthesia is not a medical therapy in itself but is performed so that a medical or surgical procedure can be performed. Ideally, there would be no adverse outcomes from the anaesthetic. Unfortunately, all current anaesthetic and sedative drugs are either cardiovascular and/or respiratory depressants and their administration is subject to human error. Additionally, the specialised equipment and monitors that are used may be subject to faults and/or incorrect use.

Anaesthetists monitor, interpret and react to changes in the patient's condition. These changes could be due to the underlying disease process, the patient's intercurrent diseases, interactions or reactions to drugs, or due to the surgical/medical procedure taking place and its complications.

It is important to look for emerging trends because anaesthetic, surgical and medical interventions change with time. It is also important to monitor anaesthetic outcomes and look for ways to reduce any adverse events.

We would like to see the notification of death submitted to SCIDUA as soon as possible after the event - while it is still fresh in the practitioner's mind. This is when small details are retained, which can aid in the analysis of an unfortunate patient outcome.

1.8 Legislative Protection and Confidentiality

The committee is afforded special privilege under section 23 of the *Health Administration Act 1982*. This legislation makes it an offence for a person who obtains information in connection with the work of the committee to disclose the information without obtaining the proper authorisation. In doing so, it is vital to preserve anonymity.

Confidentiality of all communications between the reporting anaesthetist and the committee is paramount. Information can only be released with the consent of the person who provided the information, or the approval of the NSW Minister for Health, or authorised delegate.

Permission was sought from each practitioner to share their cases in this report to assist in the prevention of future deaths under anaesthesia. SCIDUA would like to extend its gratitude to those generous practitioners.

1.9 Notifying Deaths to SCIDUA

The notification of a death arising after anaesthesia or sedation for operations or procedures is a mandatory requirement in New South Wales, regardless of whether the death proceeded for Coronial investigation. Public Health Organisations use the Death Review Database to assist them to classify deaths that meet the criteria requirements for SCIDUA.

Reporting to SCIDUA is required under section 84 of the *Public Health Act 2010* and applies:

> *'if a patient or former patient dies while under, or as a result of, or within 24 hours after, the administration of an anaesthetic or a sedative drug administered in the course of a medical, surgical or dental operation or procedure or other health operation or procedure (other than a local anaesthetic or sedative drug administered solely for the purpose of facilitating a procedure for resuscitation from apparent or impending death).'*

Some medical practitioners may be under the false impression that deaths which occur greater than 24 hours after administration of an anaesthesia are not reportable. This is not the case. If an intra-operative event occurs resulting in a patient's death, that death is reportable, even if it occurs days or weeks later.

Health practitioners are required to notify the death by emailing a completed report form (**Appendix B**) to: CEC-SCIDUA@health.nsw.gov.au.

With the recent increase in non-invasive procedures being undertaken by both physicians and radiologists, we have clarified the need for reporting of these cases. If local anaesthetic alone was administered to enable the procedure to be undertaken, there is no need to report this death to SCIDUA. If, however, any sedative agent was concurrently used, then this is considered a reportable death.

Cases may also be referred to SCIDUA by the CEC's Patient Safety Team and the Collaborating Hospitals' Audit of Surgical Mortality (CHASM) Program if there is concern that anaesthesia may have been a factor in a patient's death.

1.10 Review Process

All reported deaths are reviewed by the triage sub-committee which can either classify the death as due to factors not falling under the control of the health practitioner, or request further information from the reporting health practitioner, via a SCIDUA questionnaire (**Appendix C**), for the committee to further discuss the case and its classification.

The questionnaire is always sent if there is any suspicion that the anaesthetic or sedation was involved, or if the patient died during the procedure or in the recovery period. A questionnaire is also sent when there is a paucity of information on the initial notification form. The medical practitioner may wish to make further confidential information available to the committee that was not available in the patient's medical record.

When questionnaires are returned, all information is de-identified and distributed to members of the committee prior to its meetings for review. Cases are discussed at each meeting and classified. A confidential reply by the Chairperson is sent to the health practitioner explaining the committee's decision.

The committee manages its data in a secure Microsoft Access 2010/SQL server relational database. It stores data on patients and anaesthetists, as well as information collected from the notification form, questionnaire and triage sub-committee and committee meetings. The CEC is responsible for data management, ensuring accurate reporting, interpretation and verification of anaesthesia-related deaths.

1.11 System of Classification

SCIDUA cases are classified using a system agreed upon by the ANZCA Anaesthesia Mortality Sub-committee in 2006, revised in 2020. Categories are ordered into three main groups, as below.

Group A contains deaths where anaesthetic factors are thought to have played a role. The intention of the classification is not to apportion blame on individual cases, but to establish the contribution of the anaesthesia factors to the death. There are three categories:

Category 1	Where it is reasonably certain that death was caused by the anaesthesia or other factors under the control of the anaesthetist
Category 2	Where there is some doubt whether death was entirely attributable to the anaesthesia, or other factors under the control of the anaesthetist
Category 3	Where both surgical and anaesthetic factors were thought to have attributed to the death
Note: The above classification is applied regardless of the patient's condition before the procedure. However, if it is considered that the medical condition makes a substantial contribution to the anaesthesia-related death, subcategory **H** should also be applied. If no factor under the control of the anaesthetist is identified which could or should have been done better, subcategory **G** should also be applied.	

Group B has three categories of death where anaesthesia is thought to have played no part:

Category 4	Surgical death where the administration of the anaesthesia is not contributory and surgical or other factors are implicated
Category 5	Inevitable death (with or without surgery), which would have occurred irrespective of anaesthesia or surgical procedure
Category 6	Incidental death, which could not reasonably be expected to have been foreseen by those looking after the patient, was not related to the indication for surgery and was not due to factors under the control of anaesthetist or surgeon

Group C identifies deaths where the factors involved in the patient's death are not fully assessable. There are two categories:

Category 7	Those that cannot be assessed, despite considerable data, but where the information is conflicting or key data is missing. The committee uses this category when it is unable to find out the actual cause of death
Category 8	For cases which cannot be assessed as the available data is inadequate to make a final determination

Underpinning the case classification for Group A deaths are sub-categories for a causal or contributory factors (**Appendix D**). There is often more than one factor to be identified in anaesthesia-related deaths.

The committee understands that this classification system has its limitations; however, it is a universal system used by all states of Australia. There are some instances when the patient's disease or condition is the main contributing factor to the patient's death, particularly as proceduralists now operate on older, sicker patients.

On occasion surgical intervention may be the precipitating factor that leads to the death, but it is often difficult to dissociate the effects of the anaesthetic and the anaesthetist's response to the critical incident, as contributing factors.

In these situations, cases are often classified as Category 3GH (the anaesthetic, surgery and significantly the patient's own serious medical condition, were factors that contributed to the death), yet the committee was satisfied with the anaesthetic and surgical management.

1.12 Communication and Reporting

SCIDUA communicates with its key stakeholders in the following manner:

- Each individual anaesthetist who provides information to the committee receives a letter from the Chairperson explaining the reasons behind the committee's views on their case
- A special report for the preceding calendar year is provided to the Minister for Health
- This year the committee provided data to the ANZCA Mortality Sub-committee, which produces the triennial report on the 'Safety of Anaesthesia: A review of anaesthesia-related mortality reporting in Australia and New Zealand (2015-2017).

The ANZCA Mortality Sub-committee report into the "Safety of Anaesthesia in Australia" now reports urgency, based on whether the patient was admitted for scheduled (elective) surgery or as an emergency admission.

The Chairperson and members provide presentations at various forums throughout the year. This encourages candid conversations concerning clinical management and communication that enables SCIDUA to consider these points of view with a patient safety focus.

In addition, the committee periodically submits reports to peer-reviewed journals, in which trends in anaesthesia-related mortality are described. These reach a wide range of anaesthetists in Australia, New Zealand and internationally.

1.7 Committee Activity in 2020

The committee met four times in 2020 and, together with the triage sub-committee who met six times in 2020, reviewed 312 cases. As in previous reports, not all deaths reviewed occurred in the reporting year. Cases are reviewed as soon as possible after the information is made available to the committee.

Table 2 below shows the 2020 SCIDUA summary of activity for cases reviewed.

Activity	No. of cases
Reviewed by triage	266
Reviewed by the committee	46
Total cases reviewed	**312**
Classified by triage	215
Classified by the committee	45
Total cases classified	**260**

Table 1: Summary of cases reviewed (n=312) and classified (n=260) by SCIDUA in 2020.

Each year there are some cases that are notified to SCIDUA but do not fall within the terms of reference – usually because the patient died more than 24 hours after the operation **and** anaesthesia was not thought to be implicated in any way. This may be because the doses of drugs used were trivial or given during resuscitation efforts.

We remind all medical practitioners that once an anaesthetic or sedation drug is given (regardless of the amount given) that patient is deemed to have had a procedure under anaesthesia / sedation and should a death occur, that death is reportable.

1.7 Categorisation of Deaths Reviewed

During the 2020 reporting period a total of 260 cases were reviewed by the committee using this system of classification. Distribution of deaths by classification category is shown in Table 1 below.

Death Type	Category	No. of cases
Deaths attributable to anaesthesia	1	10
	2	5
	3	34
Sub Total		**49**
Deaths in which anaesthesia played no part	4	11
	5	190
	6	6
Sub Total		**207**
Un-assessable deaths	7	1
	8	3
Sub Total		**4**
Grand Total		**260**

Table 2: Distribution of classified deaths in 2020 by category (n=260).

1.8 Notifications by Year of Death

Of the deaths reviewed, 163 occurred in 2020; 94 in 2019; and 3 in 2018, as shown in Figure 1 below.

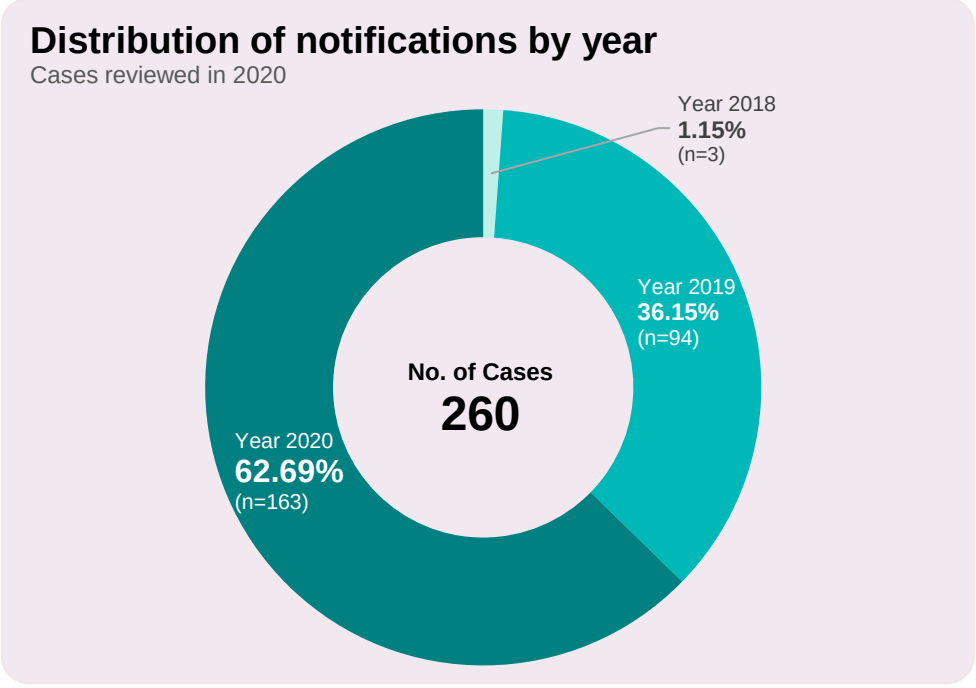


Figure 1: Distribution of notifications received in 2020 by year of death (n=260).

1.9 Surgery and Urgency

The committee classifies the timing of surgery into the four categories listed below:

Emergency	Immediate surgery for a life-threatening condition (less than 30 minutes), e.g., ruptured abdominal aortic aneurysm, intracranial extra-dural haematoma, prolapsed umbilical cord.
Urgent	At the earliest available time to prevent physiological deterioration (30 minutes - 4 hours), e.g., ruptured viscus, appendicitis, open wound, blocked ventriculo-peritoneal shunt.
Urgent non-emergency	The patient has a condition that requires emergency surgery, but there is time to allow medical optimisation and appropriate organisation of operating time and surgeons or surgical teams (4 hours to days), e.g., fractured neck of femur, pacemaker insertion, laparotomy for bowel obstruction.
Scheduled	Where the patient presents for elective surgery.

The committee found the *urgent non-emergency* category accounted for 65% (n=32) of anaesthesia-related deaths, with the majority of cases continuing to be orthopaedic, as in previous years. *Scheduled* surgery had 13 (27%) deaths, and *emergency* surgery had 4 (8%) deaths, as shown in Figure 2 below.

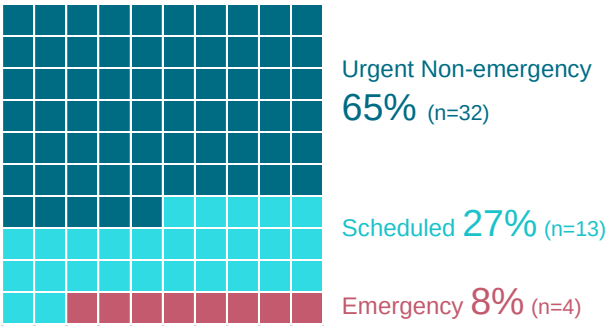


Figure 2: Waffle chart visualizing the distribution of urgency for anaesthesia-related deaths (n=49).

Note: Each coloured cell represents one percentage point.

1.8 Distribution of Specialty

Figure 3 below shows over half of all anaesthesia-related deaths were for orthopaedic surgery (57%, n=28).

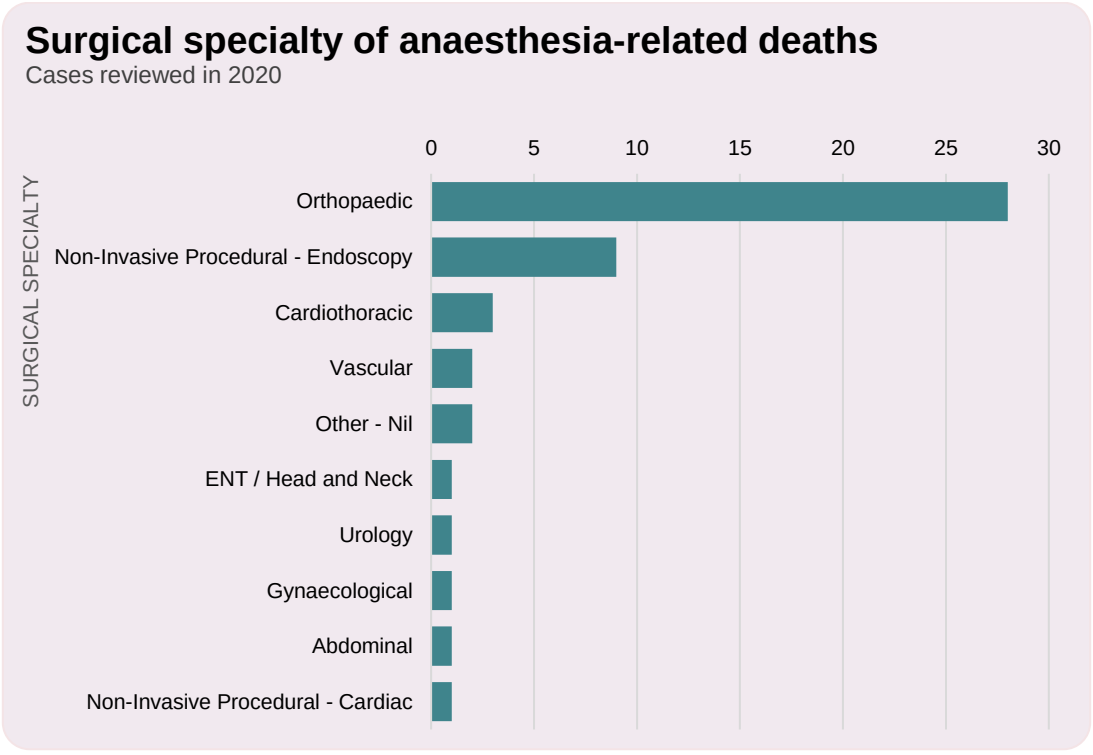


Figure 3: Distribution of surgical specialty for anaesthesia-related deaths (n=49).

SECTION 2: CASE EXAMPLES

CATEGORY 1 DEATHS

The following section provides case examples reviewed by the SCIDUA committee and contain a short clinical scenario and learning points identified.

The first section highlights Category 1 deaths, where it is reasonably certain that death was caused by the anaesthesia or other factors under the control of the anaesthetist.

CASE 1: Summary

A patient in their mid-eighties was admitted for a gastroscopy for investigation of dysphagia. They had a dilated oesophagus on CT and presumed food bolus obstruction.

Background Medical History

- Leiomyosarcoma with lung and bone metastasis
- Ischaemic heart disease with bypass grafts and stents
- Atrial Fibrillation
- Ulcerative colitis with total colectomy
- The patient had an Advance Care Directive in place

Anaesthetic Details

High flow nasal prong oxygen was placed and the patient was sedated with propofol in 50mg bolus increments.

The initial endoscopy revealed a dilated oesophagus with some food matter but the scope was able to be passed into the stomach.

Events

5 minutes into the procedure the patient began to desaturate rapidly. The procedure was terminated and the scope was withdrawn. The desaturation persisted and to the point where death seemed inevitable without ventilation. The patient had an Advance Care Directive in place and the family were called into the recovery room, where the patient passed away 40 minutes later.

Reflection Points from the Committee

- Endoscopies should not be treated as “quick” procedures. The same level of thought, planning and execution should go into the anaesthetic as any other procedure.
- This was an elderly frail patient with a known obstruction in his gastrointestinal tract. This should have necessitated a secure airway for a procedure to be carried out safely.
- Having an Advance Care Directive in place should not be confused with not giving the same level of treatment as any other patient. Once a decision to perform a procedure has been made, this should be carried out to the highest standards. Being “gentle” and using a different technique is understandable but may not be in the patient’s bests interests.
- High flow nasal prong oxygenation will often give you a false sense of security that the patient is ventilating adequately. The oxygen saturations will remain high even if the patient is apnoeic or partially obstructed. You must be vigilant to ensure an unobstructed airway is present when using this method of oxygenation.

CASE 2: Summary

A patient in their late-seventies was admitted for a gastroscopy. They had abdominal pain in the last two weeks with loss of appetite. A single vomit occurred on the morning of the procedure.

Background Medical History

- Previous Cholangitis
- Hypertension
- Hypercholesterolemia

Anaesthetic Details

Nasal prong oxygen (5L/min) was applied and the patient was sedated with propofol 150mg + 50mg. Gastroscopy revealed particulate matter in mid oesophagus and the stomach was filled with fluid. A decision was made to abandon the procedure.

Events

The patient gagged at this point and rapid desaturation occurred to 80%.

An arrest was called and oxygenation via bag mask was attempted. Saturations were now 50%. Poor pulses were noted so CPR was commenced.

Intubation was attempted. There was no view due to amount the of gastric fluid. Blind intubation unsuccessful.

An emergency front of neck access with 14g cannula was performed but became filled with gastric fluid. A laryngeal mask airway was inserted with some improvement in saturation to 80%. A second intubation attempt was successful. An NG tube was inserted and 3L aspirate noted.

The patient was commenced on inotropes and was transferred to ICU.

The patient passed away 3 weeks later due to septicaemia and ARDS.

Reflection Points from the Committee

- A patient vomiting on the day of a procedure should be a red flag for an aspiration risk. A thorough history around such events should be sought.
- Anaesthetists are often reassured by gastroenterologists that they can evacuate the stomach should anything be there. This is NOT true. The suction channels on a gastroscope only allow for fluid to be removed. Any large particulate or solid matter cannot be removed.
- An emergency in an endoscopy unit may not be run as effectively as in the operating theatres. The staff, equipment and skill set of those around you are different to the operating theatres.
- Before embarking on an endoscopy list, it is worth checking the available equipment in the immediate vicinity (this is an ANZCA requirement).

CASE 3: Summary

A patient in their mid-eighties was admitted for gastroscopy and gastrostomy tube insertion. They had metastatic prostate cancer with retrosternal lymphadenopathy causing gastric outlet obstruction. The patient presented with nausea and vomiting and an NG tube was placed. A CT scan of the abdomen was performed as part of the admission.

Background Medical History

- Cardiomyopathy
- Atrial Fibrillation
- Chronic Obstructive Pulmonary Disease
- Pacemaker
- Advanced Care Directive in place.

Anaesthetic Details

Nasal prong oxygen was used, and the patient was sedated with midazolam 1mg, fentanyl 50 micrograms and propofol TCI commenced.

Events

During the procedure the patient coughed, gastric fluid noted in the mouth, and oxygen saturation fell to 50%. The gastroscope was withdrawn, the patient was suctioned and 100mg suxamethonium was given.

The patient was intubated and saturations slowly improved to 90%.

Dark brown liquid was suctioned from the ETT. The procedure was recommenced and completed.

Due to the Advance Care Directive / Not For Resuscitation orders the patient was extubated and the family contacted. A decision was made to palliate the patient and they died the next day.

Reflection Points from the Committee

- This patient had a known gastric outlet obstruction prior to the procedure. An aspiration event was highly likely during the procedure. A secure airway should have been used.
- Careful analysis of all information available is always important. A review of the CT scan here would have given a different picture to the patient's story on the day of feeling well, no nausea and no NG output.
- We often justify sedation in certain cases citing ‘it is more gentle’ or ‘it saves time’, but these views should be questioned continuously.
- We need to be clear about what anaesthetic method we are delivering. Sedation is a term we often use when in actual fact it is a general anaesthetic without a secured airway we are providing.

CASE 4: Summary

A patient in their early-eighties had an elective gastroscopy for investigation of abdominal pain.

Background Medical History

- Ischaemic Heart Disease
- Atrial Fibrillation
- Hypertension
- Chronic Kidney Disease

Anaesthetic Details

Nasal prong oxygen was applied and the patient was sedated with alfentanil and propofol 50mg.

Events

During the gastroscopy, reflux of green fluid was noted. The scope was withdrawn and the patient intubated.

A bronchoscopy was performed to clear the airway as much as possible and the patient was transferred to ICU. A subsequent abdominal CT revealed an obstructing cecal tumour.

The patient died a few days later from ARDS and sepsis.

Reflection Points from the Committee

- Any patient presenting for an endoscopy should have the reason for the procedure explored.
- Abdominal pain is a particularly vague symptom - more information is needed.
- How is the pain being managed? Simple analgesia or oral opioids? The use of opioids will delay gastric emptying.
- Has the patient lost their appetite? This may well indicate delayed gastric emptying.
- Was the abdominal pain accompanied by nausea and vomiting? What is the patient's fasting status? This is an aspiration risk.
- This information will help you decide if the patient is a likely or unlikely aspiration risk. Even a small volume aspiration event can be fatal.

CASE 5: Summary

A patient in their late-seventies with a perforated diverticulum and acute renal failure required a Hartmann's Procedure.

Background Medical History

- Atrial Flutter
- Hypertension
- Asthma

Anaesthetic Details

Rapid sequence induction was undertaken with propofol 50mg and rocuronium 50mg.

Events

A massive aspiration occurred at the time of induction. The initial blood gas post-event showed PaO_2 89, on FiO_2 0.9.

The case was commenced but there was increasing vasopressor requirement and deteriorating gas exchange. At the end of the case the patient was on noradrenaline, adrenaline and dobutamine infusions, with PaO_2 47 on FiO_2 1.0.

Consideration was given for retrieval to another institution, but the patient was deemed too unstable for transfer and they were palliated in the operating theatre.

Reflection Points from the Committee

- Preoperative optimisation in terms of fluid resuscitation and placement of a nasogastric tube should have been part of initial care of this patient.
- The choice of muscle relaxant in cases which require a rapid sequence induction is anaesthetist dependant, however, if using rocuronium a dose of 1.2mg/kg is recommended.
- Consider reverse Trendelenburg positioning during induction to decrease passive regurgitation.

CASE 6: Summary

A patient in their mid-eighties was admitted for a bladder mass biopsy.

Background Medical History

- Ischaemic Heart Disease- NSTEMI / Stent
- Transient Ischaemic Attack
- Peripheral Vascular Disease
- Type 2 Diabetes
- End Stage Renal Failure
- Chronic Pulmonary Obstructive Disease – Lobectomy.

Anaesthetic Details

There was some difficulty in obtaining a reliable pulse oximetry trace pre-operatively but this was ultimately achieved. The patient was induced with fentanyl 50 micrograms and propofol 50mg + 50mg.

Events

A laryngeal mask airway 4 was inserted but the seal was poor. This was removed and the patient was returned to bag mask ventilation. The pulse oximetry was reading inconsistently and the heart rate dropped to 40. Blood pressure dropped to 100 systolic and the patient was treated with ephedrine 6mg x 3.

Given the patient's instability, a decision was made not to proceed with the case. Pulse oximetry was then lost completely with no palpable pulses present, along with pulseless electrical activity. CPR was commenced and 1mg adrenaline was given and the patient was intubated.

There was a brief return of cardiac output then ventricular fibrillation. Resuscitation continued, but a decision was made to cease resuscitation efforts after 20 minutes.

Reflection Points from the Committee

- It is important to always question the need for a procedure. It is especially important when the patient is frail and is at a high anaesthetic risk.
- When a patient is booked for a diagnostic procedure (as opposed to a therapeutic procedure), a conversation should always take place between the proceduralist, anaesthetist and patient. This is so everyone has a clear understanding of what is trying to be achieved and the risks involved. Ask how this diagnostic procedure changes the treatment plan and would the patient be fit for a subsequent definitive procedure?
- Difficulty obtaining a reliable oxygen saturation trace preoperatively should make you think very hard about how unwell the patient is.

CASE 7: Summary

A patient in their early-nineties with a fractured neck of femur had a hemiarthroplasty after a mechanical fall at home.

Background Medical History

- Atrial Fibrillation, on warfarin
- Bioprosthetic Aortic Valve Replacement

Anaesthetic Details

The patient was given Vitamin K 5mg and a fascia iliaca block in the emergency department.

In the operating theatre the patient was induced with fentanyl 50 micrograms and propofol 70mg. A laryngeal mask airway (LMA) 4 classic was inserted and a fascia iliaca block and arterial line was placed.

The patient was placed in the right lateral position.

Events

Post positioning it was noticed that brown fluid was present in the LMA lumen and the patient's mouth. They were suctioned, given suxamethonium 100mg and intubated.

Oxygen saturation post intubation was 80%. Recruitment manoeuvre was performed and the saturations returned to 95% (on FiO_2 of 1.0). The patient was paralysed with rocuronium 30mg and the case was commenced. Multiple recruitments were needed during the case to maintain oxygen saturations. The case was completed, and the patient was transferred to bed and sat upright. Oxygen saturations were 70-80%.

The patient was transferred to ICU, where a discussion with family and ICU resulted in limits being placed on support. The patient had continuing hypoxia and haemodynamic compromise and they died four hours post-surgery.

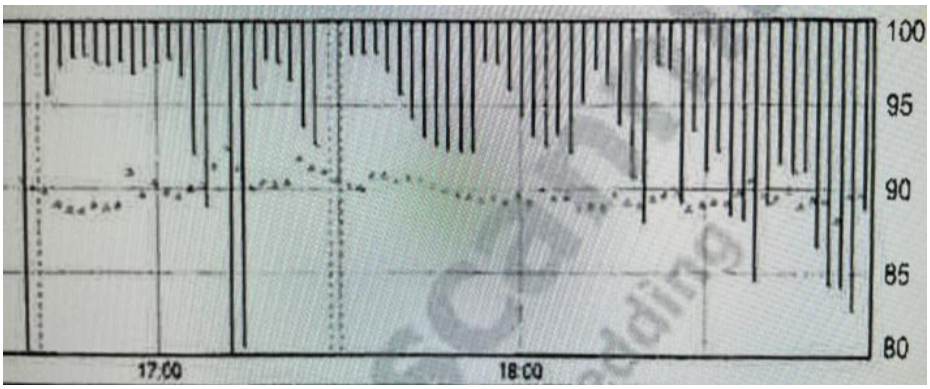


Image 1: Oxygen saturations trends during the case.

Reflection Points from the Committee

- Aspiration is a risk in any patient having surgery even if they are technically fasted. The risk of aspiration increases with emergency surgery.
- Clinical judgement ultimately decides the risk of aspiration in the individual patient in any given circumstance.
- A plan for how to deal with aspiration should it occur should always be made prior to undertaking any anaesthetic.
- Any surgery taking place where the patient is not supine adds complexity and difficulty. Thought should be given to various issues surrounding this, especially to loss of airway and intravascular access.

CASE 8: Summary

A patient in their late-seventies was admitted for gastroscopy, +/- stent for gastric outlet obstruction.

Background Medical History

- Recent diagnosis of metastatic bowel cancer. Palliative care involved; patient for ward-based care.
- NG tube was removed two days prior as there was minimal drainage.

Anaesthetic Details

The patient was induced with fentanyl 100 micrograms, propofol 60mg and paralysed with rocuronium 30mg.

Events

Difficult bag mask ventilation – two-person technique and Guedel airway (oropharyngeal airway) used. Faeculent smell was noted and laryngoscopy revealed a soiled oropharynx. It was a challenging intubation as the view was obscured by ongoing reflux of gastric contents. Intubation was successful; however, the trachea was heavily soiled. An NG tube was inserted and 500mls was suctioned.

It was difficult to oxygenate and ventilate the patient. Oxygen saturations were 90% on FiO_2 0.8. High airway pressures were noted, but the patient was haemodynamically stable.

The patient was given sugammadex 200mg and the anaesthesia was stopped. The patient remained non-responsive.

A discussion followed between all teams involved and family members. A decision was made to transfer the patient to ICU for palliation, where they died two hours later.

Reflection Points from the Committee

- Patients who have bowel obstruction require a rapid sequence induction with an appropriate dose of muscle relaxant. If using rocuronium the recommended dose is 1.2mg/kg
- Preoxygenation is a critical component of rapid sequence inductions. Achieving an end tidal oxygen of 0.8 or greater prior to induction should be sought.
- Modified rapid sequence induction is a term used to describe the technique of bag mask ventilation while applying cricoid pressure. This can increase the chance of aspiration because of accidental insufflation of the stomach.
- While modified rapid sequence inductions have their place in clinical practice, it is not advisable to use them in patients with known full stomachs.

CASE 9: Summary

A patient in their early-sixties presented with post-tonsillectomy bleeding. The tonsillectomy was performed four weeks prior. Blood loss was estimated to be greater than 1 Litre. The patient's observations: HR 100; BP 140/110.

Background Medical History

- Previously well.

Anaesthetic Details

The patient was assessed in the anaesthetic bay as Mallampati Score 1[4]. They had good mouth opening and neck extension.

Rapid sequence induction was performed. Midazolam 2mg, fentanyl 100 micrograms, propofol and rocuronium 60mg were administered.

Events

The patient had a grade 1 view on laryngoscopy. They were intubated but had no end tidal CO_2. The ETT was removed and oxygen saturations were 95%. Help was summoned and the patient was reintubated. Oxygen had reduced to saturations 63%. Once again, a grade 1 was on view. This time high airway pressures were noted with oxygen saturations at 40-50%.

Severe bronchospasm was suspected, and intravenous adrenaline was given. Sinus bradycardia was developing and atropine 600 micrograms was given. The patient proceeded to have a cardiac arrest. Pulseless electrical activity occurred and CPR was commenced.

Emergency cricothyroidotomy was performed (30 minutes post induction). Saturations improved to 78%, along with return of spontaneous cardiac output a few minutes later.

Arterial and central venous access was obtained and surgery commenced. The bleeding point was identified and controlled. The patient was reintubated orally and the cricothyroidotomy wound closed.

The patient was transferred to ICU. In ICU myoclonic seizures were noted with non-reactive pupils. EEG confirmed status epilepticus.

Global hypoxic injury was suspected and the patient died 4 days later. Mast Cell tryptases taken post-surgery, and 4 hours later were 4.7 and 5.5.

Reflection Points from the Committee

- End tidal CO_2 is the gold standard for confirming intubation of the trachea. Until proven otherwise **No Trace = Wrong Place**.
- The old saying "if in doubt, take it out" holds true even today. Bag mask ventilation is a safer alternative than ventilating an oesophagus.
- If you are convinced that the endotracheal tube is in the correct position but there is no carbon dioxide trace, consider using a bronchoscope to confirm position.
- In a case such as this, where there is bleeding in the airway which might obstruct a clear view, consider using a video laryngoscope to maximise chances of a successful intubation on the first attempt.

[4] The modified Mallampati classification is a scoring system for the amount of mouth opening to the size of the tongue and provides an estimate of space available for oral intubation by direct laryngoscopy.

CASE 10: Summary

A patient in their mid-seventies was admitted for removal of lingual exostosis. A similar procedure was performed three months earlier, uneventfully, with the patient discharged home on oral amoxicillin.

Background Medical History

- Rheumatoid Arthritis
- Asthma

Anaesthetic Details

The patient was induced with midazolam 1mg, fentanyl 75 micrograms and propofol 80mg. A laryngeal mask airway was placed and amoxycillin 2g administered.

The patient was draped and local anaesthetic (LA) administered (0.5% Marcaine with adrenaline).

Events

During LA administration the patient was noted to cough and move his hand. BP at that time showed 130mmHg systolic, sevoflurane was increased and the airway was checked.

Next blood pressure reading was 60mmHg systolic. Drapes were removed and the patient appeared poorly perfused. Pulses could not be felt and BP 40mmHg systolic. An arrest was called; CPR commenced and adrenaline given. Suxamethonium 100mg was given and the patient was intubated. Initially high peak airway pressures were noted. CPR continued for 35 minutes before return of cardiac output.

There was no meaningful neurological recovery post-event and the patient was palliated 10 days later. Mast cell tryptase was 161 micrograms/L, and 4 hours later 106 micrograms/L.

Reflection Points from the Committee

- Anaphylaxis can occur with any drug, or with drugs which have been used uneventfully previously. Anaphylaxis can be fatal even with immediate recognition and management.
- In clinical practice you are more likely to see an antibiotic associated anaphylaxis (rather than muscle relaxants) purely because nearly every patient we anaesthetise gets given antibiotics.
- Anecdotally antibiotic anaphylaxis tends to have more cardiovascular manifestations and be more severe than muscle relaxant anaphylaxis where respiratory manifestations predominate.

CATEGORY 2 DEATHS

Category 2 deaths are classified as: Where there is some doubt whether death was entirely attributable to the anaesthesia, or other factors under the control of the anaesthetist

CASE 11: Summary

A patient in their mid-seventies fell sustaining a fractured neck of femur and they presented for a hemiarthroplasty. They also had concurrent bronchopneumonia.

Background Medical History

- Ischaemic heart disease
- Left ventricular ejection fraction 15-20%

Anaesthetic Details

The patient was induced with fentanyl 50 micrograms, propofol 30mg, and paralysed with rocuronium 30mg.

Induction and intubation were tolerated well.

Events

The patient was positioned laterally for the operation. They sustained progressive hypotension leading to a Pulseless Electrical Activity (PEA) arrest 20 minutes post induction. The anaesthetic was ceased.

CPR was commenced and there was return of cardiac output in 40 seconds. No adrenalin was given.

A decision was made not to proceed with surgery and the patient was transferred to ICU.

The patient died 5 hours later.

Reflection Points from the Committee

- Patients with significant ventricular dysfunction are very sensitive to anaesthetic agents
- Invasive arterial blood pressure monitoring should be instituted prior to induction in order to detect deviation from normal parameters and institute immediate treatment. Hypotension in these patients is poorly tolerated and leads to a declining spiral of ischemia and further hypotension.
- Intraoperative TOE (if available) will help guide fluid loading and monitor cardiovascular function.
- Consideration of central venous access either prior to induction or immediately after to allow for anticipated inotrope administration is also sensible.
- Manipulation of the fracture site and cementing of prosthesis are significant insults to the cardiovascular system due to embolic phenomenon.

CASE 12: Summary

A patient in their early-eighties required insertion of a tunnelled Vascath® for haemodialysis. They had acute renal failure secondary to multiple myeloma.

Background Medical History

- Ischaemic heart disease / CABG
- Recent Echo showing normal LV size and function. Mild reduction in RV function.
- Aortic valve repair
- Atrial fibrillation
- Type 2 Diabetes

Anaesthetic Details

The patient was commenced on a metaraminol infusion prior to induction. They were given fentanyl 100 micrograms, and propofol 100mg + 50mg. A laryngeal mask airway #5 was inserted.

Events

The first BP post induction was 70mmHg systolic, treated with a metaraminol bolus. The patient had progressive bradycardia to 20bpm and atropine 1.2mg was given. A short period of CPR / 1mg adrenaline was given, with the patient's heart rate improving to 150bpm and BP 200/100 afterwards. The patient was intubated.

The BP started to fall again whilst remaining tachycardic. Further adrenaline was given resulting in BP overshoot and further tachycardia. A decision was made to abandon the procedure.

A central line was inserted and noradrenaline was commenced. ABGs pH 7.17 pO_2 216 PCO_2 45. BE -11 Lac 7.2 The patient was transferred to ICU.

An echo cardiogram in ICU showed severe right heart failure. Treatment was withdrawn the next day.

Reflection Points from the Committee

- As with any procedure it is important to ask if the procedure can be done without needing a general anaesthetic. It is safer in the elderly, frail and sick to have procedures carried out with minimal anaesthetic if possible. Sometimes this is not possible, but it is always important to ask the question.
- Patients with renal failure currently receiving dialysis are often intravascularly dry.
- Anaesthetic agents in "normal" doses will have an exaggerated effect in this patient population.
- If treating hypotension/bradycardia with adrenaline, smaller doses (10-20 micrograms increments) will achieve this without a prolonged exaggerated overshoot.

CASE 13: Summary

A patient in their mid-nineties was admitted with a fractured neck of femur and concurrent pneumonia.

Background Medical History

- High level nursing home resident
- Dementia
- Ischaemic heart disease
- Atrial Fibrillation
- Advanced care directive. Not for CPR.

Anaesthetic Details

Spinal anaesthetic was attempted (ketamine 10mg + propofol 10mg sedation given three times) but unable to find the space, so a general anaesthetic was administered.

Propofol 20mg, ketamine 20mg, fentanyl 75 micrograms and rocuronium 50mg was given. The patient was intubated.

Events

The patient was positioned laterally. Desaturation, bradycardia (40bpm) and hypotension (60 systolic) occurred, which was treated with 100% oxygen, IV fluids, and atropine 300 micrograms x 3 doses.

Phenylephrine 200 micrograms x 3 doses was given and then adrenalin 100 + 200 + 200 micrograms. There was no response to treatment. No CPR was commenced as per the advanced care directive. The patient died 30 minutes post induction.

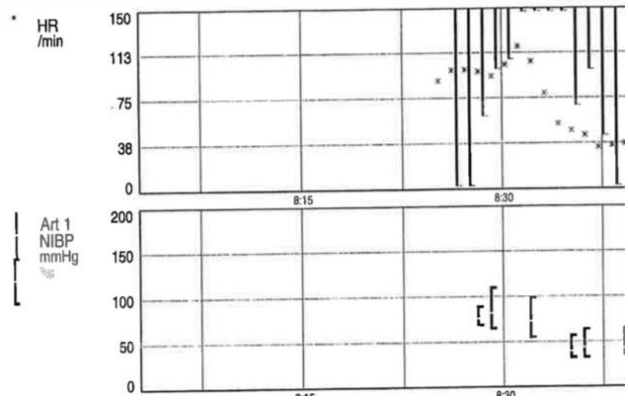


Image 2: Anaesthetic trend printout.

Reflection Points from the Committee

- Elderly patients are often dehydrated. They have concealed blood loss in their fracture site and, in this case, suffering from a concurrent infection makes the patient prone to sepsis. All these factors increase the chance of major decompensation post induction.
- Arterial line monitoring prior to induction will be of use in such a patient.
- These are high risk patients having surgeries that are deemed necessary. It is reasonable to provide these patients with the highest standards of care but being aware of their (and their families) wishes should things not go according to plan.

CASE 14: Summary

A patient in their mid-eighties had a fractured neck of femur following a fall.

Background Medical History

- High level nursing home resident
- Epilepsy
- Cerebellar cerebrovascular accident
- Breast Cancer
- Previous pulmonary embolus

Anaesthetic Details

The patient was induced with propofol 40mg and paralysed with rocuronium 25mg. The patient was intubated.

Events

The patient had post induction hypotension with no pulse palpable and was treated with metaraminol 0.5mg x 2 doses. A palpable pulse returned and the heart rate was 60-80 bpm. The patient then had runs of tachyarrhythmia which were self-reverting.

Image 3: Tachyarrhythmia captured on ECG.

A decision was made not to proceed with the surgery. Sugammadex was given and the patient extubated.

An ECG showed sinus rhythm with ST depression. The patient died in the recovery room.

Reflection Points from the Committee

- Even with “gentle” induction, cardiovascular compromise can occur.
- It is appropriate not to proceed with surgery when the patient showed signs of decompensation prior to surgery beginning.

CASE 15: Summary

A patient in their late-forties with obstructive oesophageal cancer required oesophageal re-stenting. They had chronic aspiration pneumonitis and poor respiratory function. Oxygen saturations were 88% on supplemental oxygen.

Background Medical History

- Metastatic cancer to lungs, liver and peritoneum
- Intellectual impairment / Nonverbal
- Advanced care directive

Anaesthetic Details

The patient had rapid sequence induction with fentanyl 100 micrograms, propofol 150mg and suxamethonium 100mg.

Events

Laryngoscopy revealed a soiled oropharynx. The patient was intubated, however, it was very difficult to oxygenate following and the patient had subsequent bradycardia then loss of cardiac output.

Adrenaline was given with no response. In keeping with the Advance Care Directive no CPR was attended. The patient died on the operating table.

Reflection Points from the Committee

- This was a palliative procedure being carried out with a good reason. It was carried out in the safest way possible but unfortunately the outcome was not as intended.
- Even when a rapid sequence induction is used it does not guarantee a significant aspiration event will not occur. But it is still the best technique we have to prevent such events.
- An assistant trained in cricoid pressure application is essential.

CATEGORY 3 DEATHS

These deaths are classified as: Where both surgical and anaesthetic factors were thought to have attributed to the death.

CASE 16: Summary

A patient aged in their late-teens was admitted for a minor procedure prior to commencing chemotherapy for newly diagnosed mediastinal lymphoma. They had a large mass with compression of the heart, aorta, inferior vena cava, both pulmonary arteries and both main bronchi. The patient became short of breath on lying flat and had intermittent difficulty in swallowing.

Background Medical History

- Previously well before diagnosis

Anaesthetic Details

The procedure was planned under local anaesthetic (sitting up) and sedation only if needed. An ECMO team was consulted prior to the procedure. Full monitoring and defibrillation pads were applied.

Oxygen was administered via a Hudson mask, and two specialist anaesthetists (cardiac and general) were present in the room.

Events

The patient was given 1mg midazolam and an arterial line was inserted. The procedure commenced; local anaesthetic was given and the patient's blood pressure was 180mmHg systolic. Fentanyl 25 micrograms was given and the patient was conscious but showing signs of distress. They then complained of shortness of breath before falling unconscious with rapid desaturation.

A laryngeal mask airway was inserted. Oxygen saturations returned to 95%, but the patient was not able to be ventilated adequately (CO_2 climbing). The ECMO consultants and cardiothoracic consultant were now in attendance. A decision was made to insert a double lumen tube prior to commencing Veno Venous ECMO.

A DLT was inserted without any further medication being given. Haemodynamic collapse then ensued. CPR was commenced while ECMO cannulation insertion took place. The patient was placed on ECMO and transferred to ICU.

Over the following days the patient did not respond to chemotherapy and had worsening mass effects. A repeat MRI Brain showed unsalvageable brain injury.

Reflection Points from the Committee

- Mediastinal masses represent life threatening disease and should be treated as such. Both respiratory and cardiovascular systems are at risk.
- Any change in the patient's condition preoperatively that wasn't present during the prior assessment, when surgery was being planned, should prompt a re-evaluation of the suitability of performing a procedure on the day.
- Thought should be given to where procedures are performed. For major life-threatening pathology, it should be carried out where the greatest number of resources are present.
- The anaesthetists involved took a great deal of time preparing for this case and planning for possible eventualities and ensuring all teams were present, but even this was not enough to rescue the situation.

CASE 17: Summary

A patient in their early-seventies required a gastroscopy and colonoscopy for positive faecal occult blood.

Background Medical History

- Motor Neurone Disease
- Respiratory failure on BiPAP. Oxygen saturations 90% on room air. Hypercapnic.
- Obstructive Sleep apnoea
- Atrial fibrillation
- Congestive cardiac failure – Left ventricular ejection fraction of 35%
- Ischaemic heart disease with 10 stents
- Advance Care Directive

Anaesthetic Details

A decision was made to offer sedation during the procedure to avoid tachycardia.

Oxygen was administered via a Hudson mask and sedation was given with midazolam 1.5mg, fentanyl 20 micrograms and ketamine 60mg incrementally during the procedure. During the 40-minute procedure oxygen saturations ranged 90-97%.

Events

At the end of the procedure the patient was noted to be sweaty, tachypnoeic and hypoxaemic (oxygen saturations were 79%). The patient was thought to be in pulmonary oedema. This was treated with bag mask ventilation, frusemide and GTN spray. Flumazenil 400 micrograms and Naloxone 400 micrograms was also given.

An arterial line was placed and blood gas analysis showed pH 6.98, $PaCO_2$ 168, PaO_2 136.

The patient was transferred to ICU where they suffered a VF arrest and could not be resuscitated.

Reflection Points from the Committee

- This patient was at the end of their natural life, and it is important for anaesthetists to carefully consider whether booked procedures need to be performed. Perhaps a diagnostic procedure should not have been carried out in this case.

CASE 18: Summary

A patient aged in their late-eighties with a fractured neck of femur presented for a hemiarthroplasty. They presented with thigh pain and a pelvic CT showed the fracture with faecal loading in the colon as an aside. A chest x-ray showed post cardiac consolidation. Oxygen saturations were 95%.

Background Medical History

- Mild dementia
- Type 2 diabetes
- Hypertension

Anaesthetic Details

The patient was given a gas induction with oxygen, nitrous and sevoflurane.

Events

The patient regurgitated coffee ground vomitus. They were immediately turned to the lateral position and suctioned. The patient was coughing vigorously and allowed to wake up when it was then noticed how distended the abdomen was.

An abdominal x-ray taken after the event revealed a small bowel obstruction and the patient was moved to the ward. They developed respiratory distress later on that day and were seen by ICU, and after discussion with the family comfort measures were undertaken.

The patient died 6 hours post-induction.

Reflection Points from the Committee

- Concurrent disease is often present in patients presenting for emergency surgery. Having these patients assessed by medical and anaesthetic teams prior to surgery can help diagnose these conditions and optimise them prior to surgery.

CATEGORY 4

These deaths are classified as: Surgical death where the administration of the anaesthesia is not contributory and surgical or other factors are implicated.

CASE 19: Summary

A patient in their mid-fifties had excision of SCC of the tongue, neck dissection and free radial forearm flap.

Background Medical History

- Previously well

Anaesthetic Details

The patient was administered total intravenous anaesthesia with nasal intubation.

Events

The usual practice of the ENT surgeon in these cases was to perform an elective tracheostomy for airway management in the post-operative period. This surgery occurred during COVID-19 precautions when tracheostomies were avoided and so the nasal tube was left insitu and the patient sent to ICU.

On day 4 the nasal tube was accidentally dislodged during routine care. The patient was taken back to theatre where an oral endotracheal tube was placed with some difficulty.

On day 6 the patient returned to theatre for a formal tracheostomy. Postoperatively there was intermittent air leak from the tracheostomy site and some bleeding.

The patient was now becoming febrile and a decision was made to decannulate the patient within 24 hours of insertion.

The patient continued to deteriorate post decannulation, becoming more hypoxemic and unresponsive to non-invasive ventilation.

A decision was made to reintubate the patient. Initial attempts by ICU staff were unsuccessful. The ENT surgeon arrived but the stoma could not be recannulated. The anaesthetist was able to intubate the patient over a bougie. The patient arrested a short time later but was able to be resuscitated. However, they remained unresponsive following that event and died 3 days later.

The post-mortem showed a right sided pneumothorax and bronchopneumonia.

Reflection Points from the Committee

- The onset of COVID-19 saw a widespread change in all our practices. Since then, there has been a period of enormous change with improved knowledge of COVID-19, change in variants, availability of vaccines and skill with PPE.

CATEGORY 5 - Inevitable Deaths

This year there is not a specific case example for this category. Inevitable deaths are cases where the patient's disease or injury made recovery impossible, despite competent anaesthesia and surgery, and as such, death was considered inevitable.

The majority of cases (79.62%; n=207) reviewed by the committee were identified as having no anaesthetic or surgical factors involved, with 190 classified as inevitable deaths.

Of the 190 deaths reviewed, 93.16% of patients were assessed as ASA grade 4 or 5 - being critically unwell or not expected to survive for 24 hours - with 73.16% (n=139) aged 65 years or over.

Further analysis on inevitable deaths identified that cases were distributed across several surgical specialties and non-invasive procedural areas, with abdominal surgery and non-invasive surgery (cardiac, endoscopy, radiological) the most frequent, as shown in Figure 4 below.

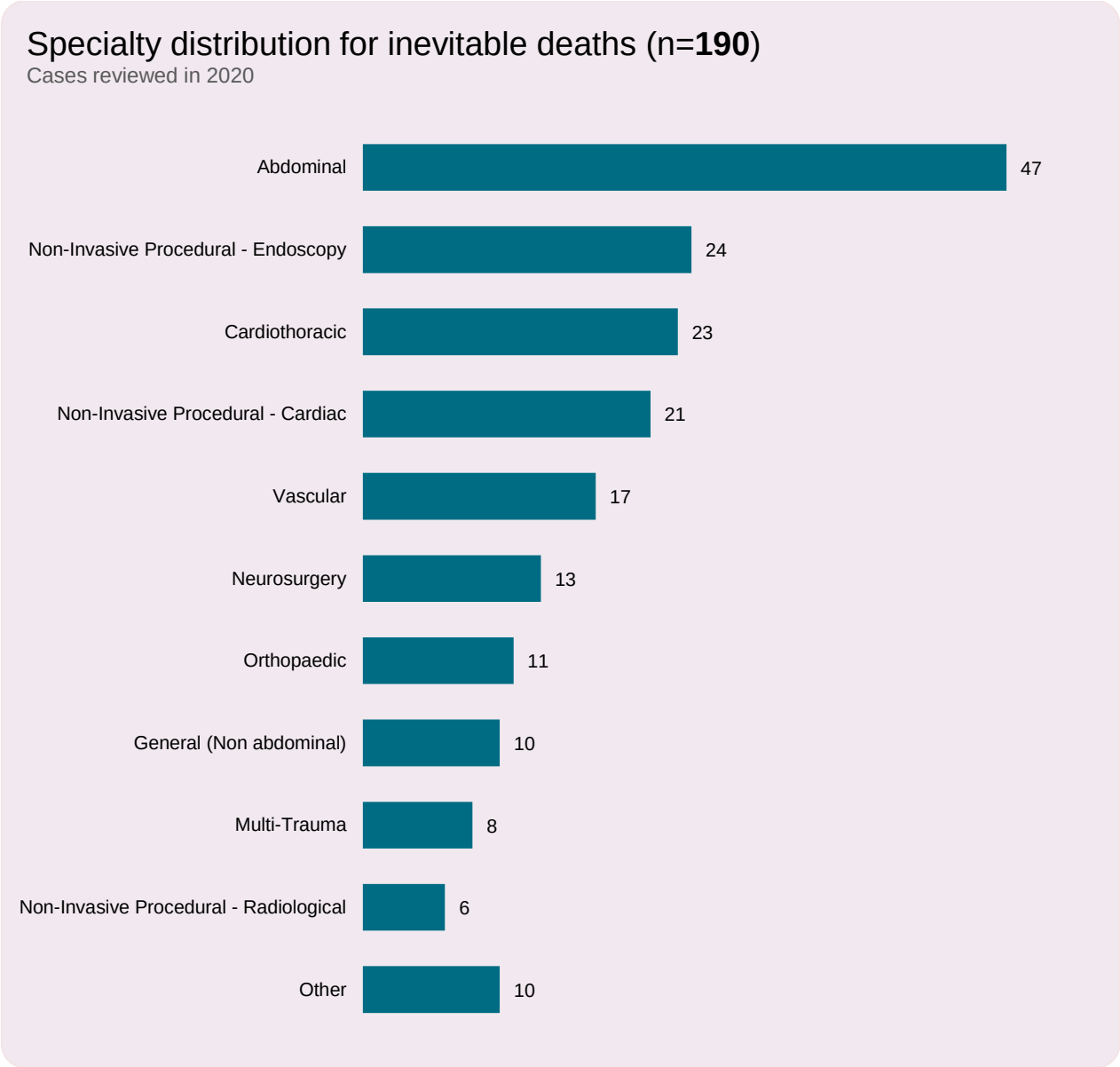


Figure 4: Specialty distribution for inevitable deaths determined by SCIDUA in 2020 (n=190).

Note: The grouping 'Other' includes: ENT / Head and Neck, Other - Nil, Other - Resuscitation, Urology.

2.1 Causal or Contributory Factors

The committee determined that correctable factors were present in 14 anaesthesia-related deaths in 2020. The causal or contributary factors related to these deaths are varied (n=20), with the majority being associated with anaesthetic technique (n=11), of which *airway maintenance* (Bii) was the major factor (n=10), as shown in Table 3 below.

Of the 14 anaesthesia-related deaths with correctable factors, 71.43% (n=10) were classified as Category 1 deaths; and 78.57% (n=11) of patients were 70 years of age or older; the median age is 76.5 years.

Causal or contributory factors	Frequency count
A Pre-Operative	**4**
Ai Assessment	4
Aii Management	0
B Anaesthetic technique	**11**
Bi Choice or application	1
Bii Airway maintenance	10
Biii Ventilation	0
Biv Circulatory support	0
C Anaesthesia drugs	**2**
Ci Selection	0
Cii Dosage	0
Ciii Adverse event	2
Civ Inadequate reversal	0
Cv Incomplete recovery	0
D Anaesthetic management	**1**
Di Crisis management	0
Dii Inadequate monitoring	1
Diii Equipment failure	0
Div Inadequate resuscitation	0
Dv Hypothermia	0
E Post-Operative	**0**
Ei Management	0
Eii Supervision	0
Eiii Inadequate resuscitation	0
F Organisational	**2**
Fi Inadequate supervision or assistance	0
Fii Poor organisation	1
Fiii Poor planning	1
G No correctable factor	**35**
H Medical condition of patient a significant factor	**41**

Table 3: Factors identified in anaesthesia-related deaths, 2020 (n=49).

Note: The frequency count adds up to more than 14, because some anaesthesia-related deaths have more than one causal or contributing factor identified.

2.2 Anaesthetists and Anaesthesia

Patient outcomes are also influenced by the grade of the anaesthetist and the type of anaesthesia used. Figure 5 below shows the distribution of anaesthetist grade and type of anaesthesia used for the 49 anaesthetic-related deaths reviewed in 2020.

Anaesthesia-related deaths where general anaesthesia was administered accounted for 73.47% (n=36) of cases reviewed by the committee in 2020. In 97.22% (n=35) of these deaths the general anaesthetic was administered by a specialist anaesthetist.

Regional anaesthesia administered by a specialist anaesthetist in 34.69% (n=17) of deaths, with one episode of regional anaesthesia administered by a trainee.

Sedation was administered by a specialist in 10 of the 12 deaths reported. The majority of patients were aged 63 years or older. Four patients were also administered a regional anaesthetic during their admission for orthopaedic surgery; whilst another was administered a local anaesthetic for gynaecological surgery.

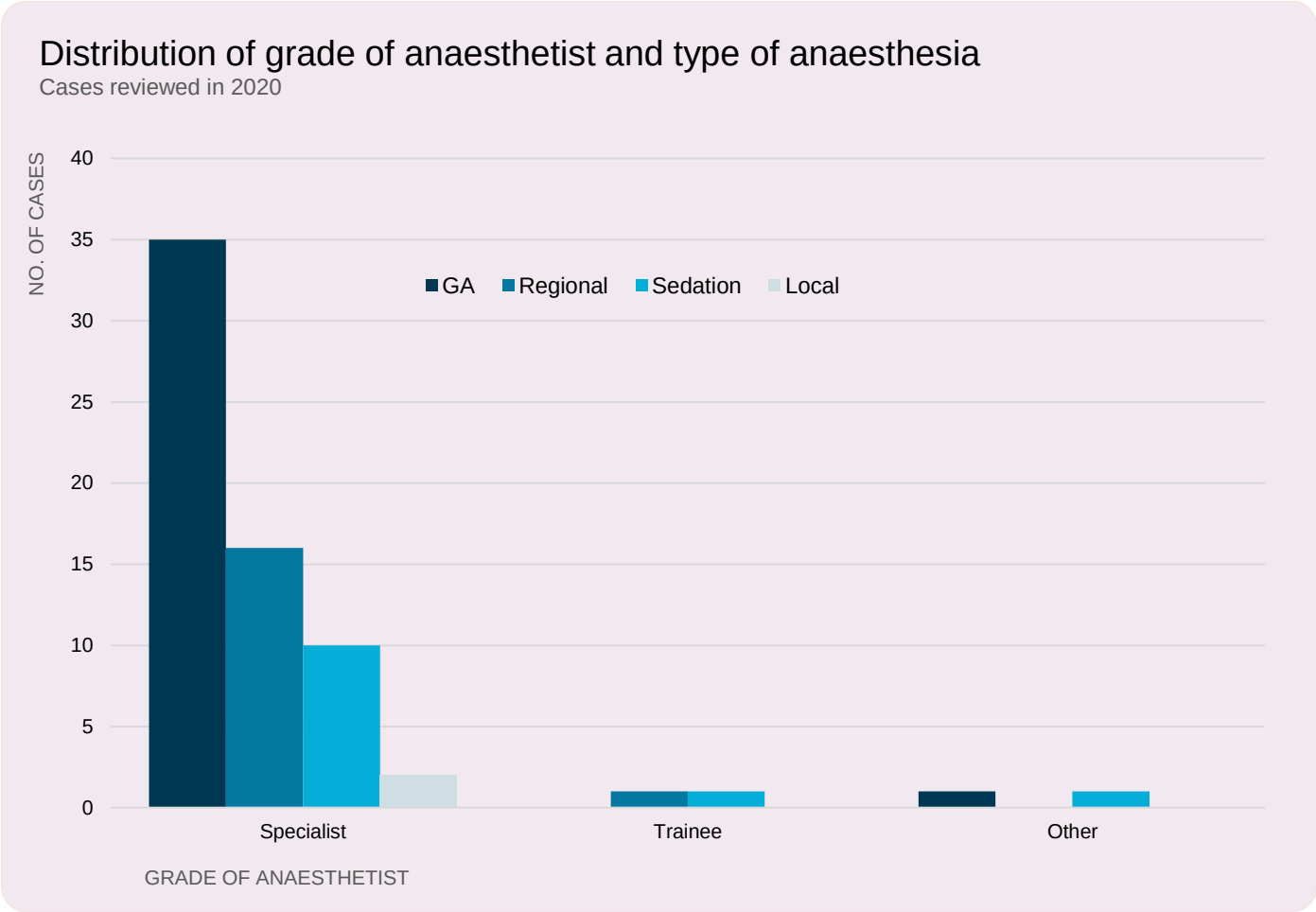


Figure 5: Frequency distribution of anaesthesia-related deaths (n=49) for 2020 by grade of anaesthetist and type of anaesthesia administered.

Note: The frequency count adds up to 67 as some anaesthesia-related deaths had more than one type of anaesthesia administered to the patient.

2.3 Deaths in the Operating Theatre or Procedure Room

Deaths that occur under the anaesthetist's direct care, either on the operating table or shortly after in the recovery room, are of specific importance to the committee. 20.38% (n=53) of cases reviewed by the committee occurred in operating theatre or procedural room, as highlighted in Figure 6 below.

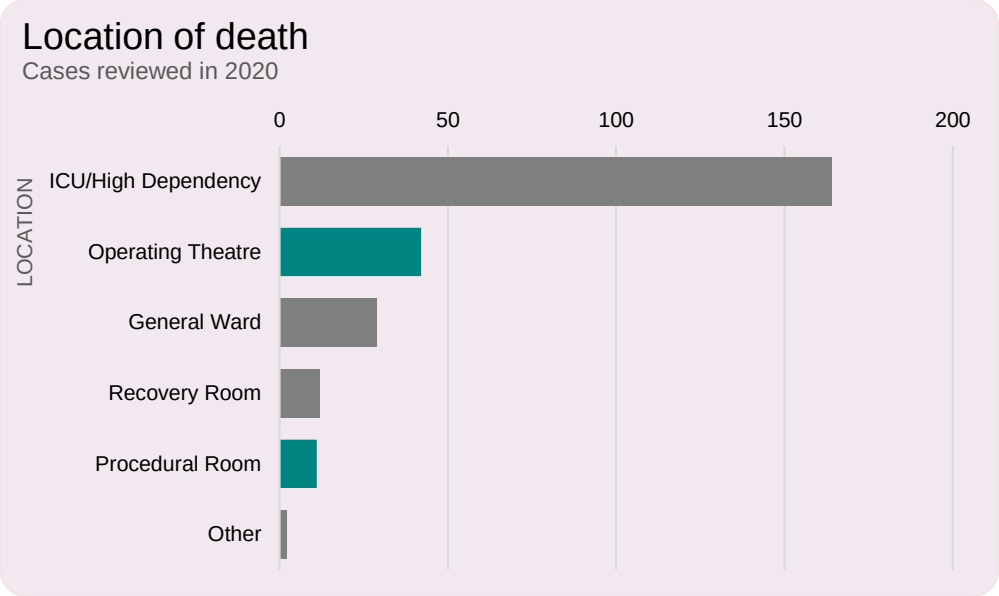


Figure 6: Distribution of death location (n=260) as determined by SCIDUA in 2020.

Of the 53 deaths that occurred in the operating theatre or procedural room, 11 were attributed to anaesthesia-related factors and one was deemed as un-assessable. Anaesthesia played no part in the remaining deaths (n=41).

There were 11 trauma related cases included in this cohort. Figure 7 below shows the number of deaths in the operating or procedural rooms and whether anaesthesia played a part.

Of the 11 deaths attributable to anaesthesia within the operating room, three were 'scheduled', three were 'emergency', and the remaining five were 'urgent non-emergency' surgeries.

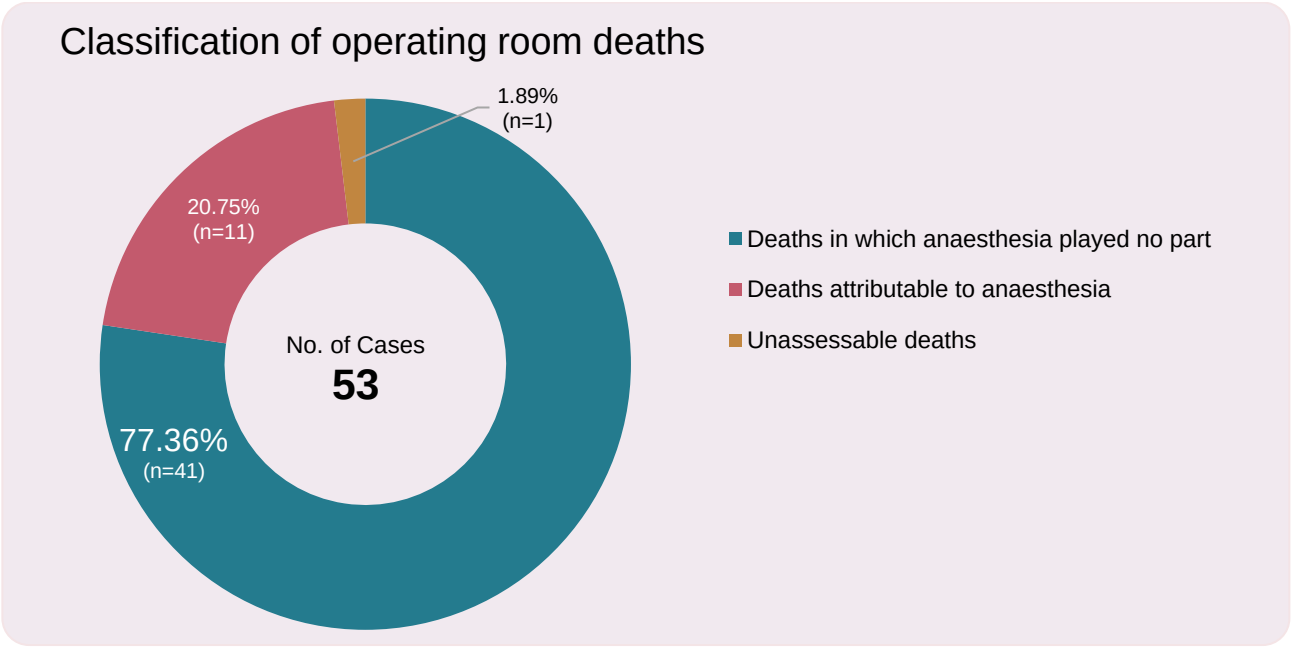


Figure 7: Deaths occurring in the operating theatre or procedural room and whether anaesthesia played a part, as determined by SCIDUA in 2020 (n=53).

2.4 Surgical Specialty and Gender

Figure 8 below shows the gender distribution for deaths by surgical specialty occurring in the operating theatre or procedural room, where *anaesthesia played no part*. Of the 41 deaths, 68.29% (n=28) were male and 31.71% (n=13) female.

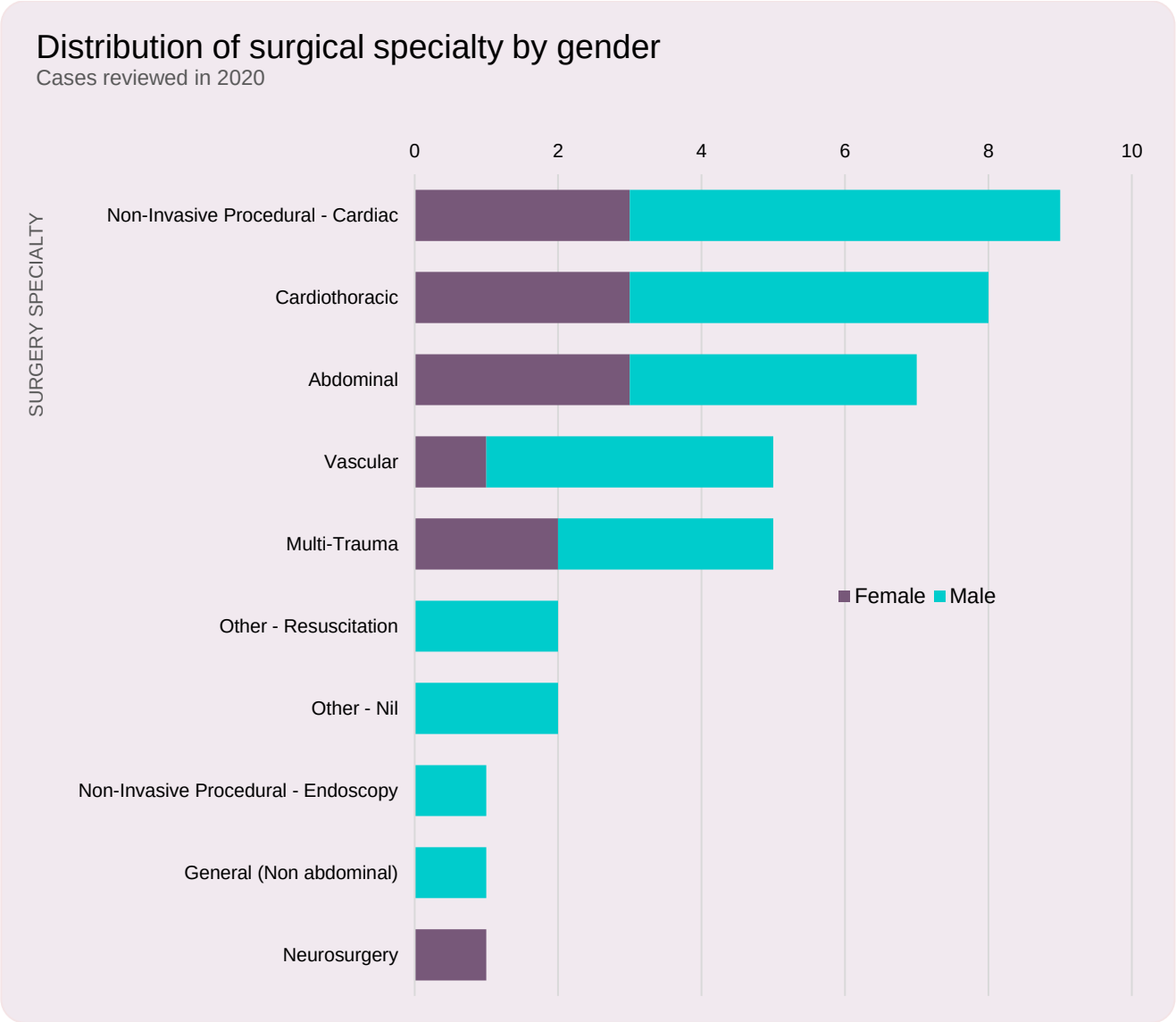


Figure 8: Distribution of gender across surgical specialty for deaths in which anaesthesia played no part that occurred in the operating theatre or procedural room (n=41) for cases reviewed in 2020.

2.5 Age and Gender

Figure 9 below shows that anaesthesia-related deaths in 2020 occurred more often in males (53.06%; n=26) than females (46.94%; n=23). The age range spanned 101 years, with deaths from patients aged 16 years up to 101 years.

The majority of these deaths occurred in patients aged 72 years or older (87.76%; n=43). The median age for male patients is 81 years and female 85.5 years.

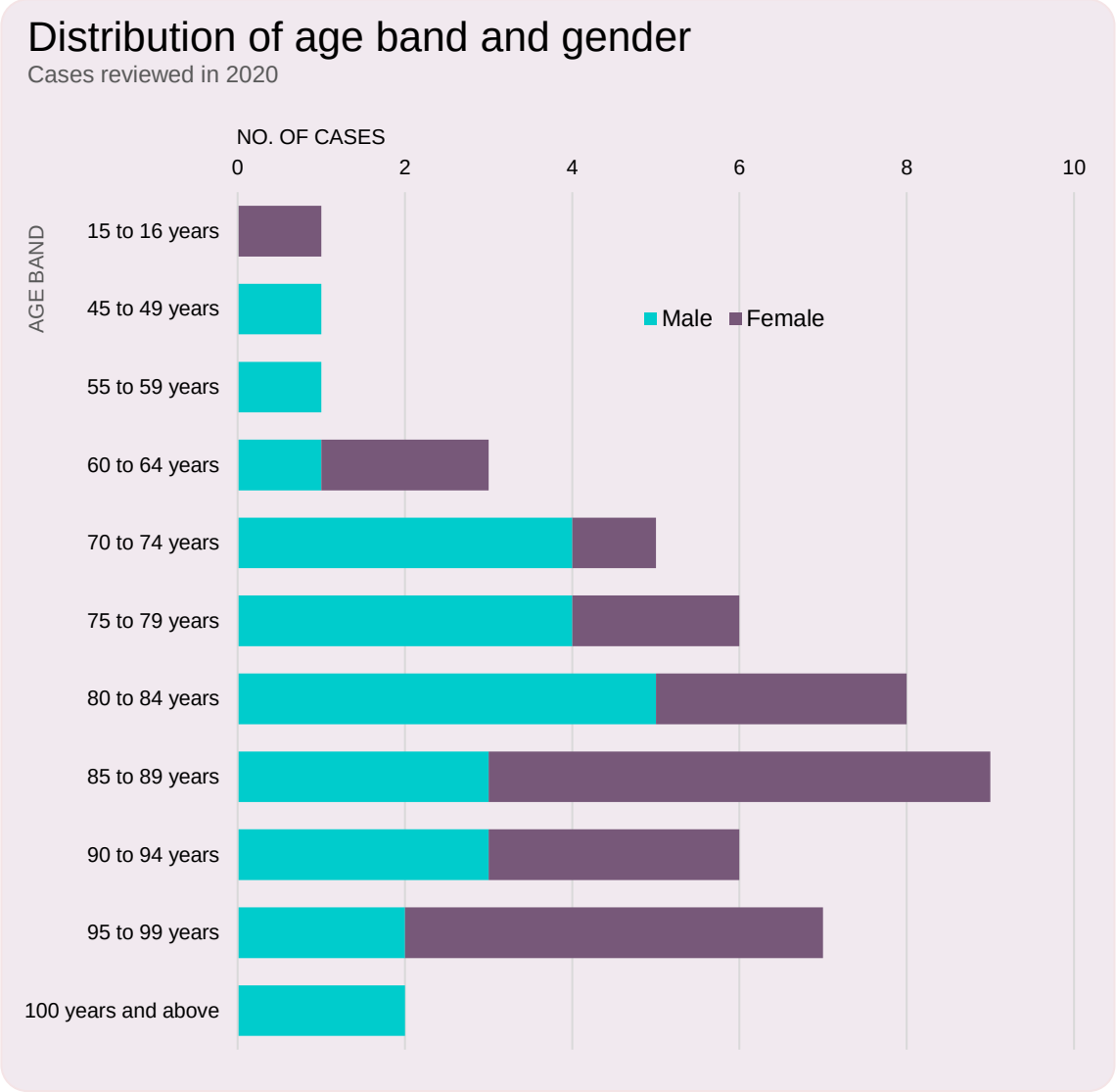


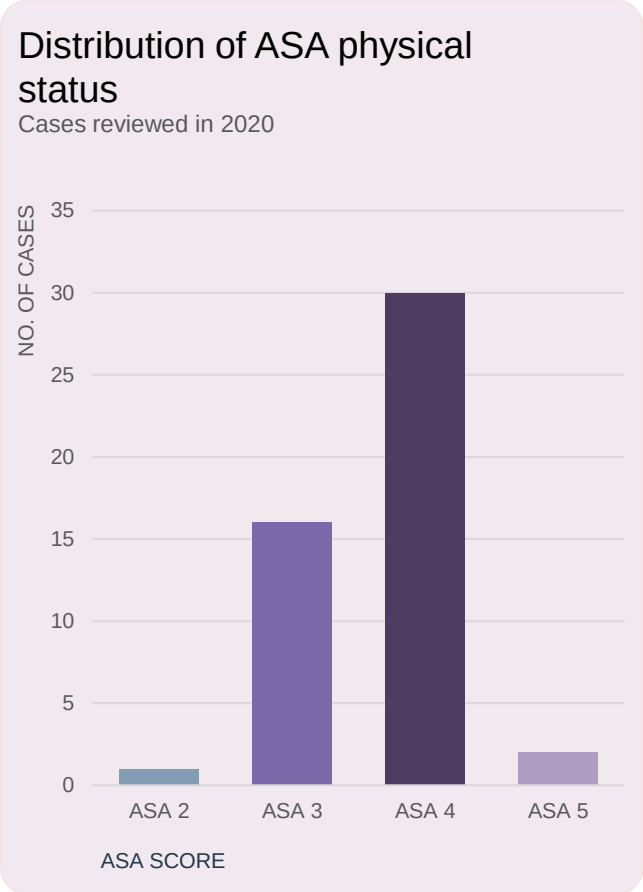
Figure 9: Distribution of gender across age bands for deaths attributable to anaesthesia (n=49) for cases reviewed in 2020.

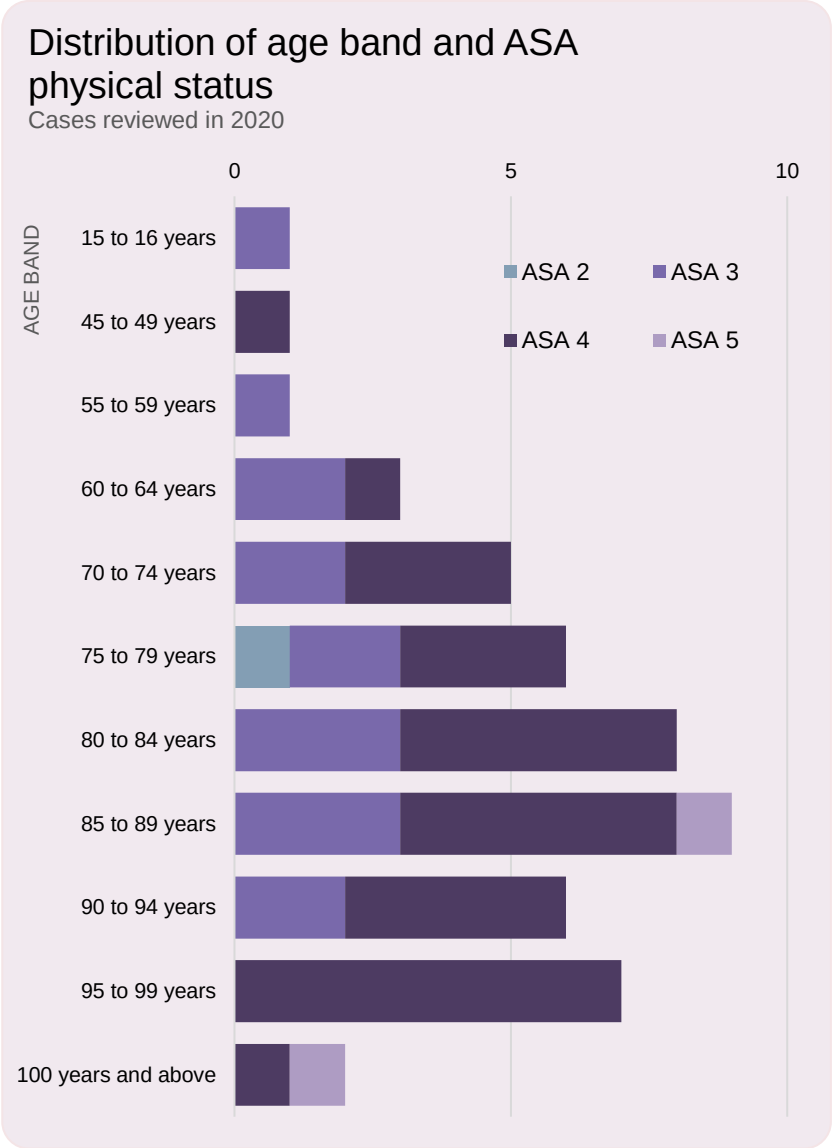
2.6 ASA Physical Status

The American Society of Anaesthesiologists (ASA) Physical Status Classification System (**Appendix A**) has been used for over 60 years to assess and grade patients according to their pre-anaesthesia health to assist with predicting peri-operative risk factors.

Figure 10 below shows the majority of anaesthesia-related deaths were patients assessed as ASA grade 3 or 4 (93.88%; n=46). When compared to section 4.3 Age and gender; this outcome demonstrates that majority of anaesthesia-related deaths in the age group 80 - 89 were assessed as ASA grade 3 or 4, as seen in Figure 11 below. This outcome supports the view that higher anaesthetic risks exist for elderly patients, who typically have more co-morbidities.

Two anaesthesia-related deaths were assessed as ASA grade 5; i.e., a moribund patient who is not expected to survive without the operation.





Figures 10 and 11: Distribution of ASA score and age bands for deaths attributable to anaesthesia (n=49) for cases reviewed 2020.

2.7 Hospital Level Classifications

SCIDUA classifies hospitals into six levels, using a numerical system based on, but not identical to, the NSW Guide to Role Delineation of Health Services[5], as follows in Table 4:

Level 6	A multi-disciplinary hospital, which provides facilities for most or all surgical sub-specialties and the intensive care environment to support them. Specialist and sub-specialist anaesthetic staff are on site during the day and anaesthetic registrar cover is on site 24 hours a day. This classification also applies to where a hospital is designated as a trauma centre.
Level 5 **Level 5 P**	A hospital which is multi-disciplinary, but only provides some sub-specialty surgery and anaesthesia, with an appropriate post-operative environment. Specialist and sub-specialist anaesthetic staff are on site during the day and anaesthetic registrar cover is on site 24 hours a day, or available within 10 minutes.
Level 4	A multi-disciplinary hospital, which does not cater for all surgical specialities, but accepts some trauma and provides a lower level of intensive care, referring any patients in need of specialised life support to a higher-level facility. Specialist anaesthetic staff are on site during the day and provide an on-call service after hours.
Level 3	A hospital or day centre which undertakes a limited range of procedures but does not have the capability to care for high-risk patients or surgery which necessitates high-level post-operative care. Specialist anaesthetic staff are on site during the day.
Level 2	A facility at which anaesthesia or sedation is provided to enable a single procedure to be undertaken on good-risk patients (such as stand-alone ECT or dentistry).
Level 1	Any other location at which anaesthesia or sedation is administered, such as a dental office.

Table 4: Description of hospital level classifications.

*Note: For institution, hospital or facility that is in regional NSW, the suffix **R** is added.*

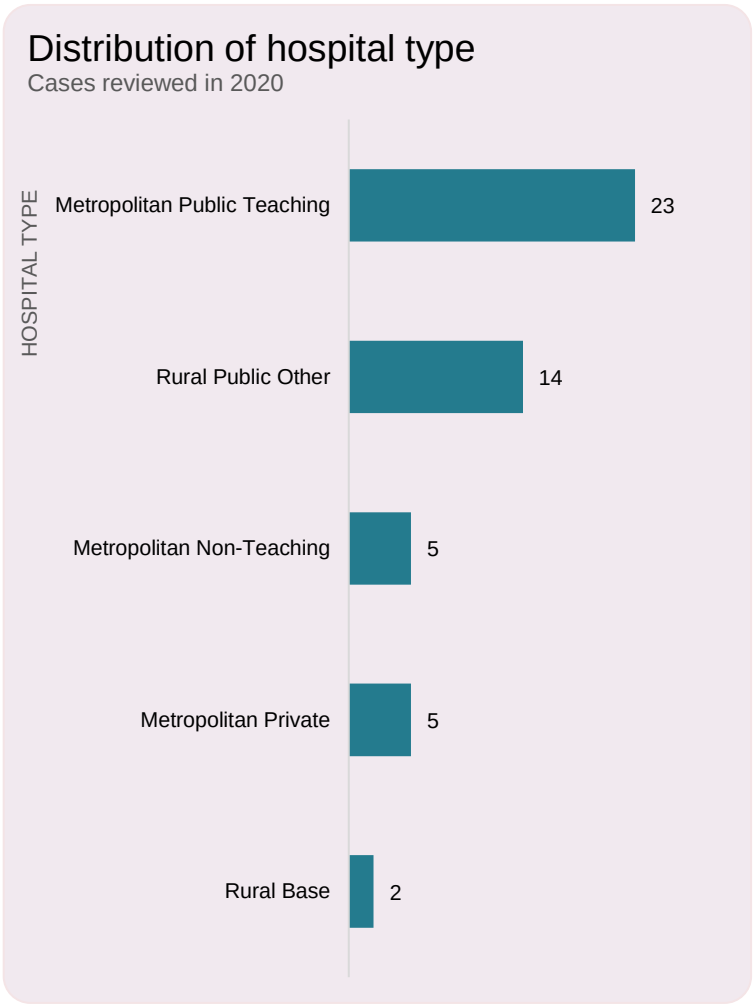
*For private institutions, hospitals or facilities, the suffix **P** is added.*

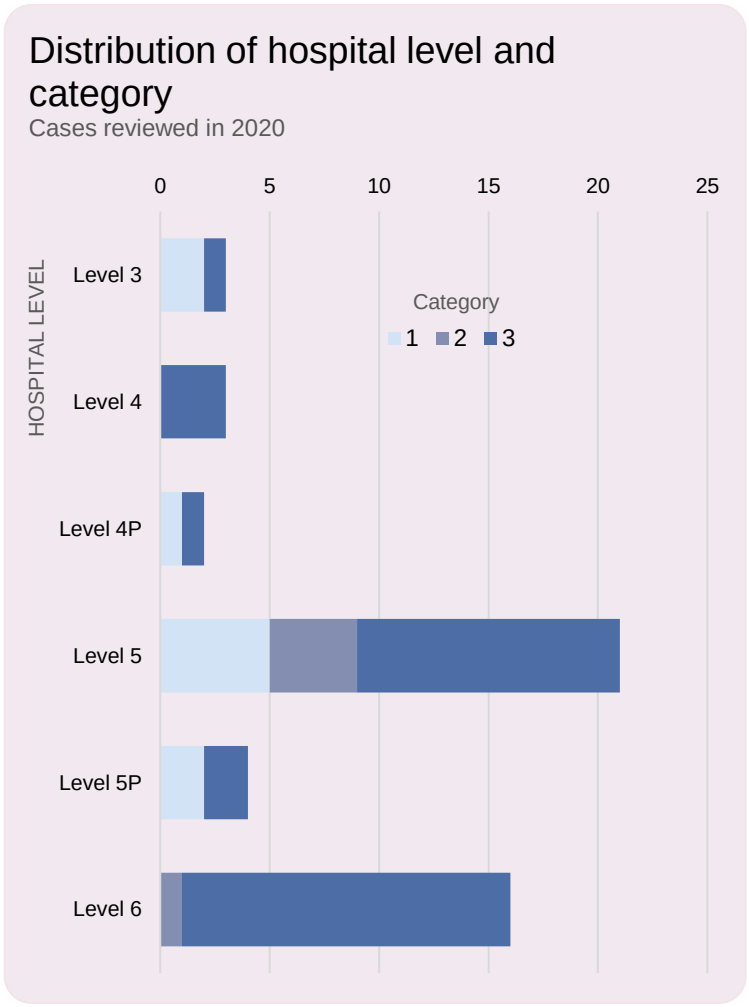
[5] NSW Ministry of Health, 2016, Guide to the Role Delineation of Health Services
http://www.health.nsw.gov.au/services/Publications/role-delineation-of-clinical-services.PDF

2.8 Hospital Level Distribution

Figures 12 and 13 below show the distribution of hospital type, and the hospital levels and classification categories.

- 46.94% of anaesthesia-related deaths (n=23) occurred in Metropolitan Public Teaching hospitals, with 83.67% of anaesthesia-related deaths occurring in Hospital Levels 5 (n=21), 5P (n=4) and 6 (n=16). However, these hospital types and levels typically perform higher volumes of complicated and emergency surgeries.
- 57.14% (n=12) of deaths in Level 5 hospitals were classified as Category 3 deaths; having both surgical and anaesthetic factors involved. The Category 1 deaths generally concerned events associated with pulmonary aspiration on induction of anaesthesia. There was one other death following a cardiac arrest after administration of anaesthesia.





Figures 12 and 13: Distribution of hospital type, hospital level and category for deaths attributable to anaesthesia (n=49) for cases reviewed 2020.

SECTION 3: TREND DATA

3.1. Date of Death Data over 11 years (2010-2020)

This section of the report reviews SCIDUA deaths for each calendar year over the eleven-year period (2010-2020) to identify any trends in the data. The SCIDUA Program has had very few changes in its structure over its long-established history. This translates to consistent quality in the questions asked of participating anaesthetists and in the data set.

This section of the report continues from the data sets provided in the 2019 report, with a refresh of the data occurring on 16 June 2022. Trends are reported over the 11-year period (2010-2020) from the notifications reported to SCIDUA by participating hospitals and medical practitioners for the deaths that occurred in each calendar year.

Typically, there is a 5-10% roll-over of notified deaths for the calendar year which are classified by the committee in the following calendar year.

3.2. Notifications of Death

Figure 15 below shows the number notifications submitted to SCIDUA between 2010–2020. The highest number of deaths occurred in 2017, with August and October 2017 reporting the highest number of deaths (n=42) which is above the upper control limit of 39 and the lowest in December 2014 (n=8).

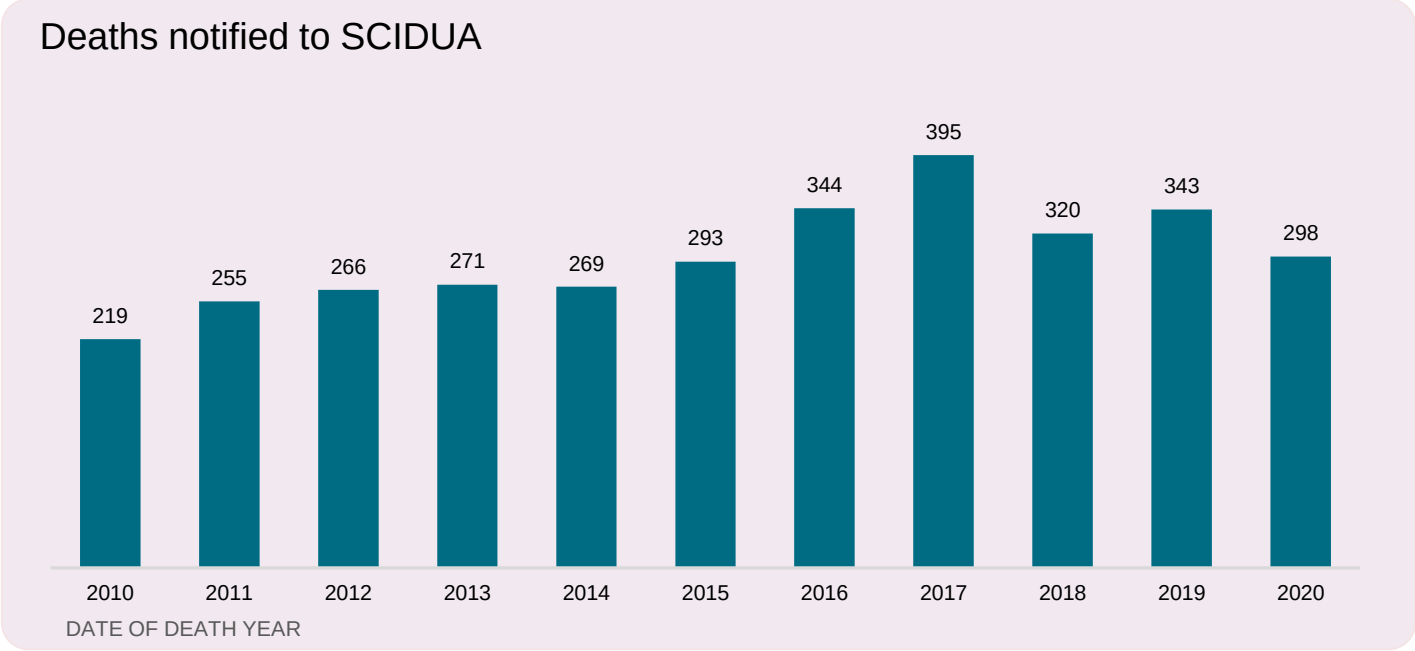


Figure 14: Deaths (n=3,273) notified to SCIDUA by year of death 2010-2020.

3.3. Notifications by Year and Month

Figure 16 below further shows deaths notified per month over the 2010-2020 period. In 2017, the monthly deaths notified were above the 11-year average of 24, resulting in 2017 being the year with highest number of deaths notified to SCIDUA.

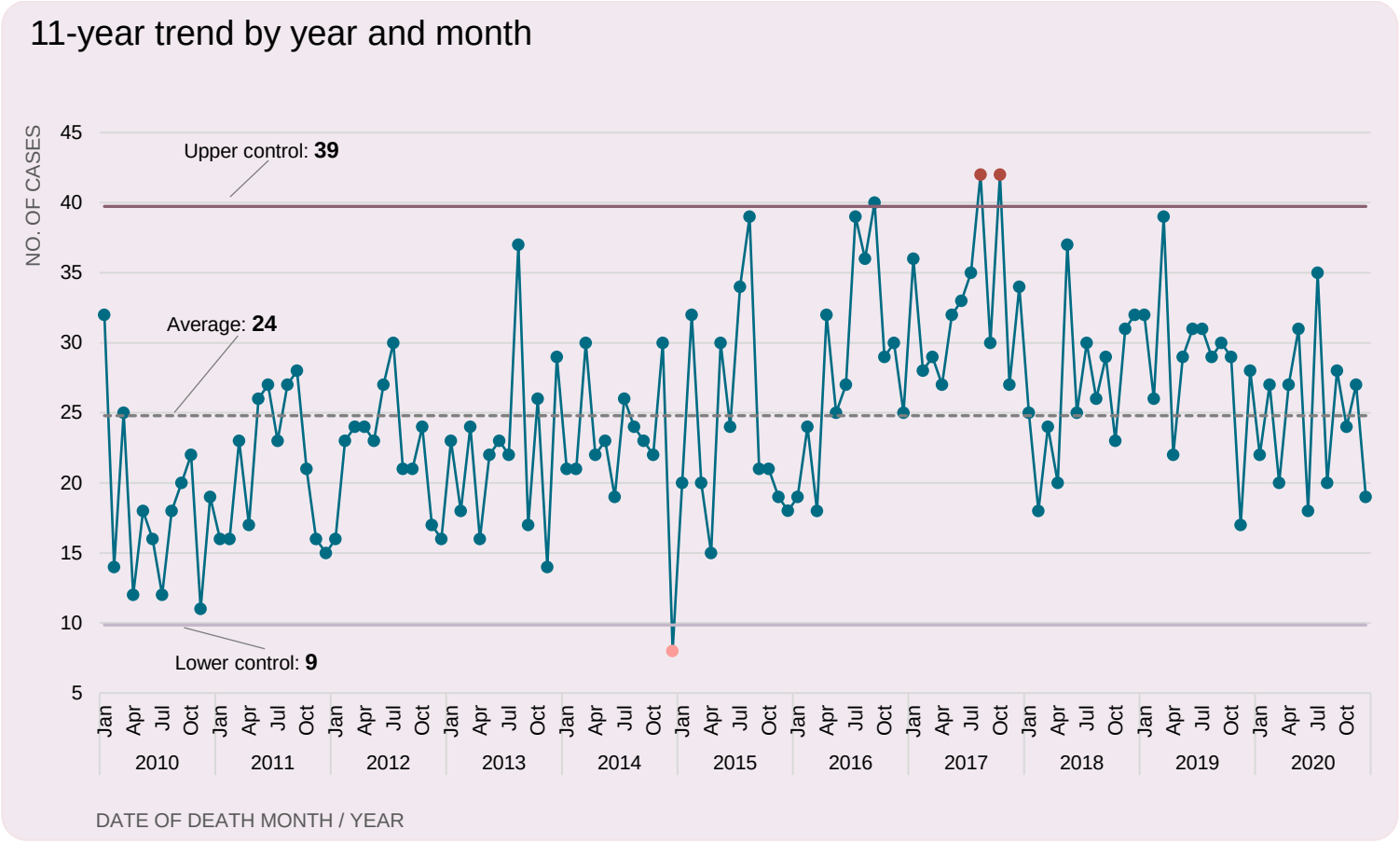


Figure 15: Deaths (n=3,273) notified to SCIDUA occurring by date of death month and year, 2010-2020.

3.4. Classification of Deaths

Data analysis on the 3,273 notifications of death submitted over the 11-year period indicates that 76% (n=2,485) were classified as deaths in which anaesthesia played no part, 16% (n=533) as anaesthesia-related deaths. Deaths that could not be assessed constituted 3% (n=93), and 5% (n=162) of forms did not complete the review process as they did not meet the criteria for review. The waffle chart in figure 14 below shows the percentage of classifications assigned to these deaths.

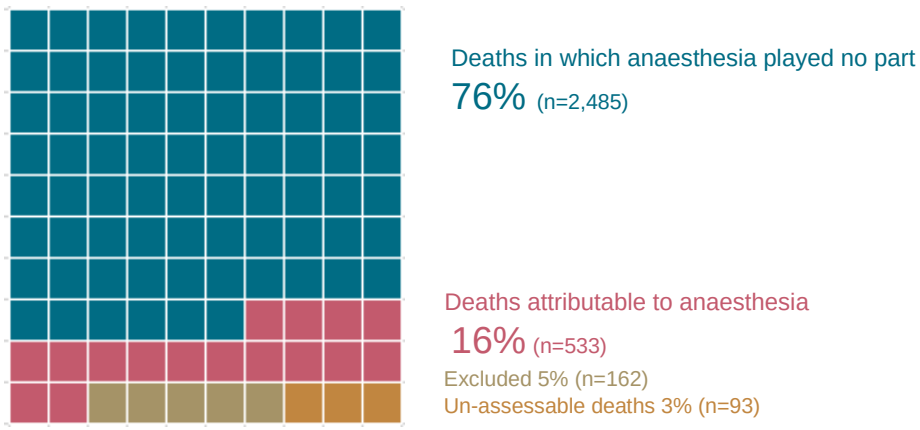


Figure 16: Percentage of classifications over the 11-year period (date of death: Jan 2010 – Dec 2020).

During the period of 2016 to 2019 there was an above the average (n=225) increase of notifications for deaths in which anaesthesia played no part while notifications in 2020 (n=223) were slightly below the 11-year average (n=225), as included in Figure 17 below.

The highest number of anaesthesia-related deaths that were notified to SCIDUA occurred in 2011 (n=57) and the lowest occurred in 2018 (n=28).

In 2020, there was a 6% (n=56) increase in anaesthesia-related deaths compared to 2019 (n=53).

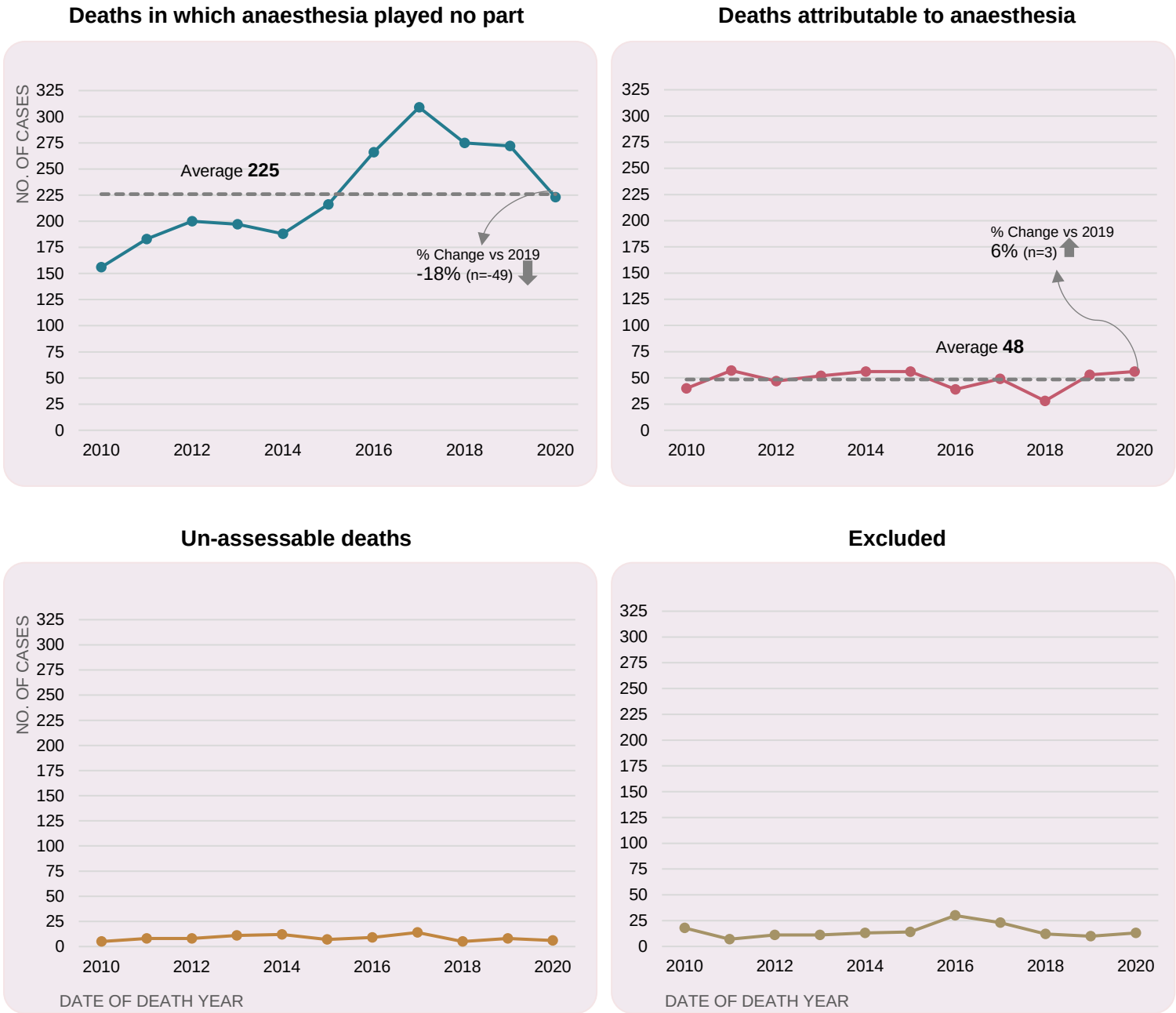
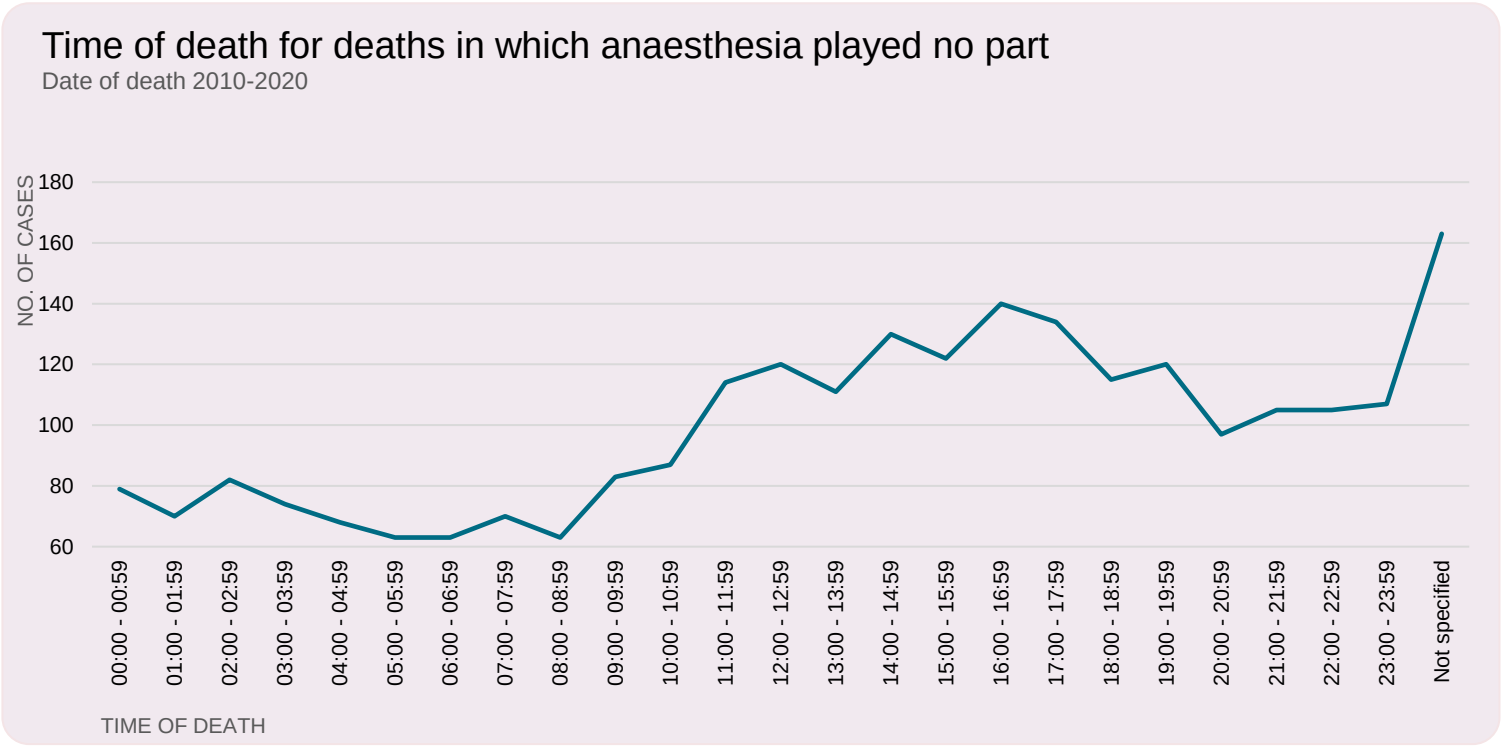


Figure 17: Classification of deaths (n=3,273) by category and date of death year, 2010-2020.

3.5. Time of Death

Review over the 11-year period shows that overall, 93.34% (n=3,055) of deaths notified to SCIDUA have the time of death specified, as represented in Figures 18 and 19 below. Further analysis of time band for deaths attributable to anaesthesia shows 8.06% (n=41) occurred between 7:00 to 7:59 pm, of which 53% (n=22) were urgent non-emergency orthopaedic surgeries. Time of death was not specified in 24 anaesthesia-related death notifications.

6.03% (n=140) of deaths not related to anaesthesia occurred between 4:00 to 4:59 pm of which 79.29% (n=111) were emergency surgeries. There were 163 notifications in which anaesthesia played no part and did not specify time of death. Distribution of time of death for anaesthesia-related deaths and where death is not associated with anaesthesia is shown in Figures 18 and 19 below.

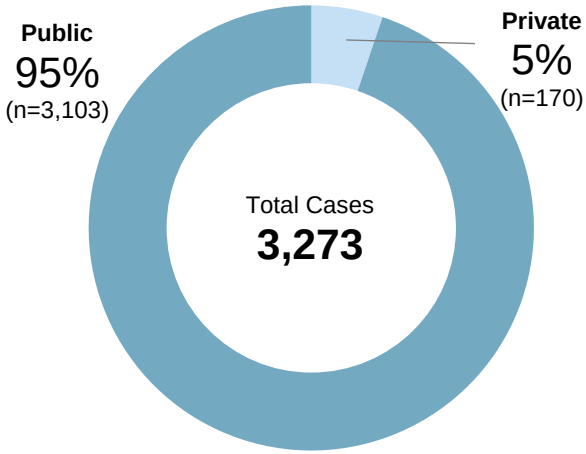


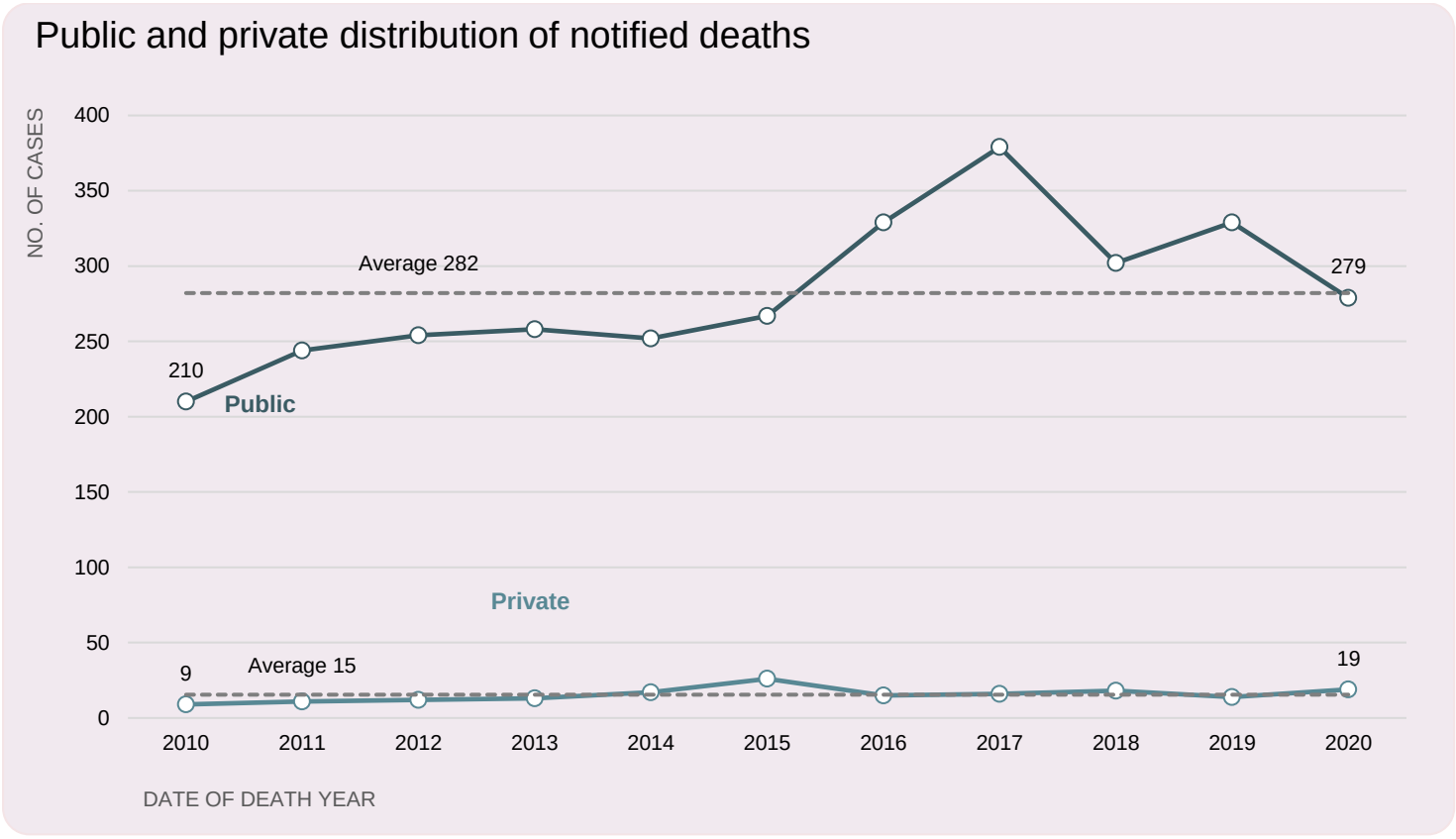
Figures 18 and 19: Distribution of time of death for anaesthesia-related deaths (n=533) and deaths in which anaesthesia played no part (n=2,485) over the 11-year period 2010-2020.

3.6. Distribution by Public and Private Deaths

Over the 11-year reporting period there was a small increase in the number of private hospital notifications, from 9 in 2010 to 19 in 2020. In 2018, of the 18 notifications submitted to SCIDUA by private hospitals, none were attributable to anaesthesia as determined by the committee. The majority of notifications were from the public health system at 95% (n=3,103), with a yearly average 282. The variances in high-low represent the reporting backlog some hospitals experience, with a trending decline towards the end of the calendar year when the two-week closure comes into effect and staffing numbers are reduced.

Over the 11-year period, 2017 had the highest number of deaths (n=379) notified from the public health system, while the highest number of notified deaths from the private sector occurred in 2015 (n=26). Figures 20 and 21 below compare public and private facility notifications, 2010-2020.





Figures 20 and 21: Public and private distribution of deaths (n=3,273) by date of death, 2010-2020.

3.7. Distribution by Hospital Group

The Clinical Excellence Commission encourages Local Health Districts (LHD) and Specialty Health Networks to report notifiable deaths using the admitted patient death screening tool[6]. SCIDUA encourages over-reporting as it helps to foster a positive safety culture for incident reporting. Over-reporting also allows the SCIDUA Chairperson to review deaths that occur outside of the 24-hour period to determine whether there was a catastrophic event that contributed to the patient death following the administration of anaesthesia or sedation.

Data analysis on the days variance for death notifications by LHD/hospital groups shows a range of notifications from 78 to 1 per annum over the 11-year period. Obviously, those groups with a higher number of tertiary facilities and higher rate of surgeries/procedures, are represented with more notifications of death per annum. However, the availability of dedicated staffing resources also helps to facilitate robust identification of cases, resulting in higher quality notifications which meet the criteria of SCIDUA. Figure 22 below shows the distribution of death notifications by local health districts/hospital groups, 2010–2020.

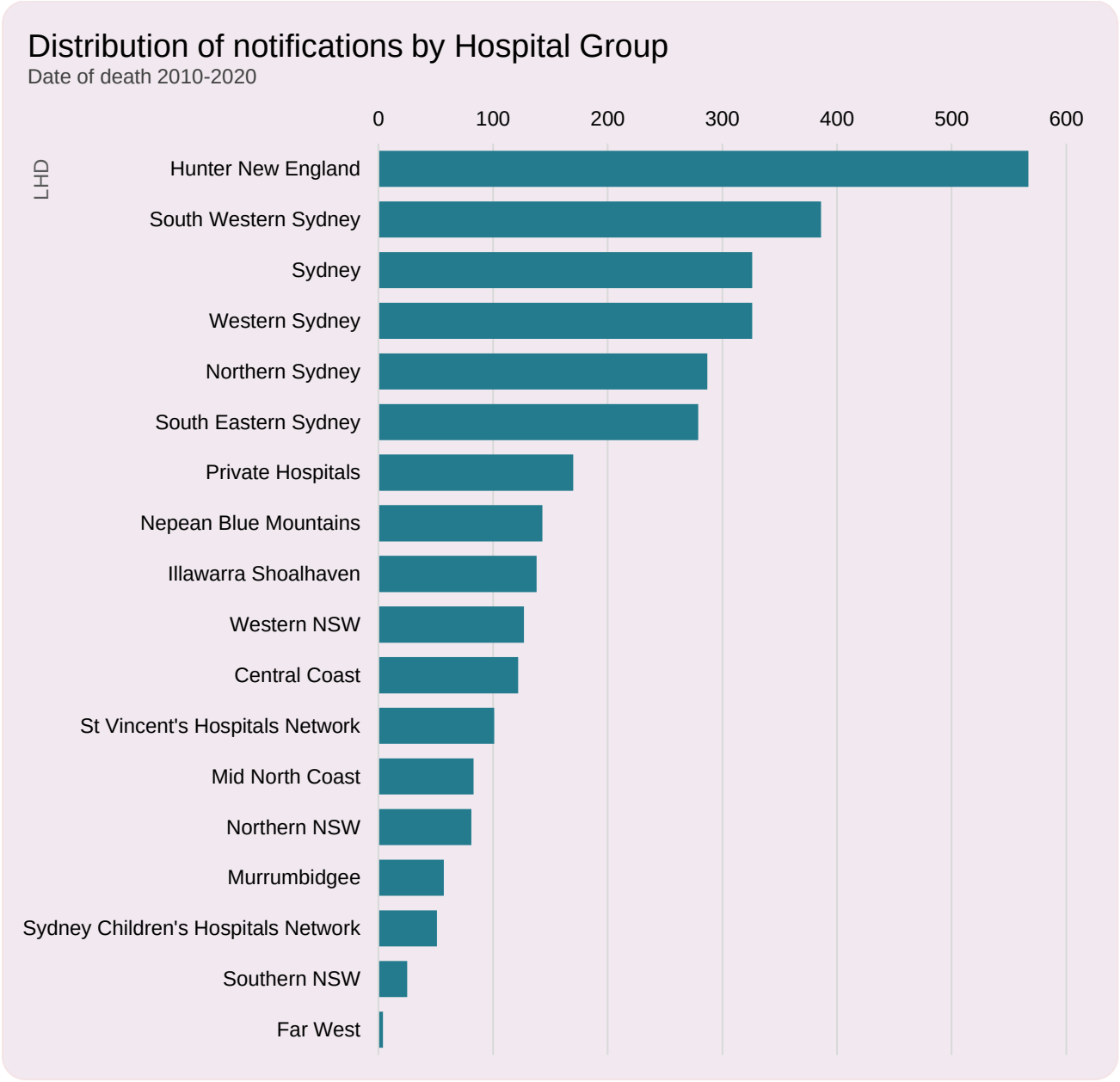


Figure 22: Distribution of deaths (n=3,273) notified to SCIDUA by LHD/hospital groups 2010-2020.

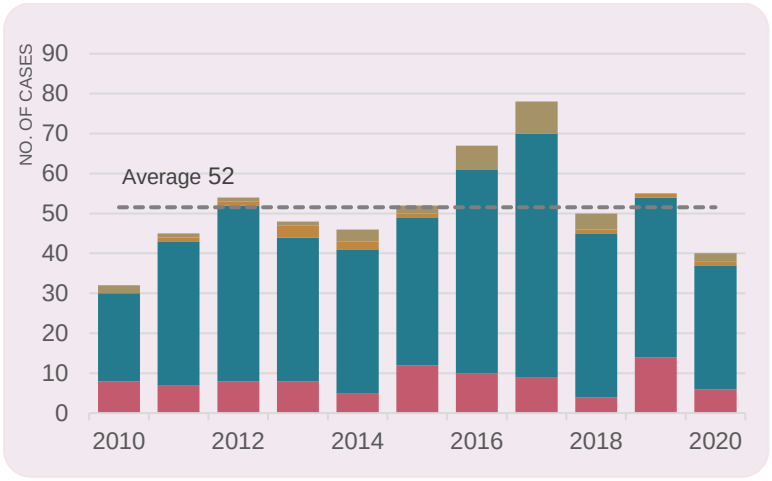
[6] The Admitted Patient Death Screening Tool is available at: https://www.cec.health.nsw.gov.au/__data/assets/pdf_file/0010/290665/Admitted-Patient-Death-Screening-Tool.PDF

Figure 23 below shows the distribution of deaths (n=3,273) notified to SCIDUA by case classification and calendar year for each hospital group over the 11-year period (2010-2020).

Case classification: Deaths attributable to anaesthesia, Deaths in which anaesthesia played no part, Un-assessable deaths, Excluded

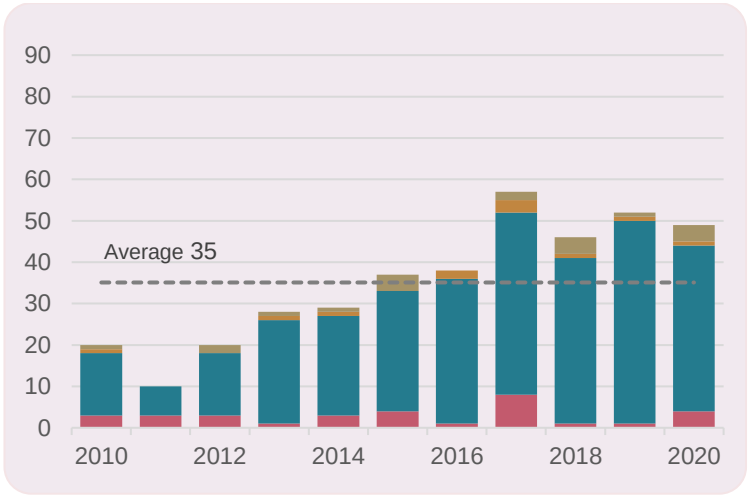
HNELHD

Classified Notifications 567



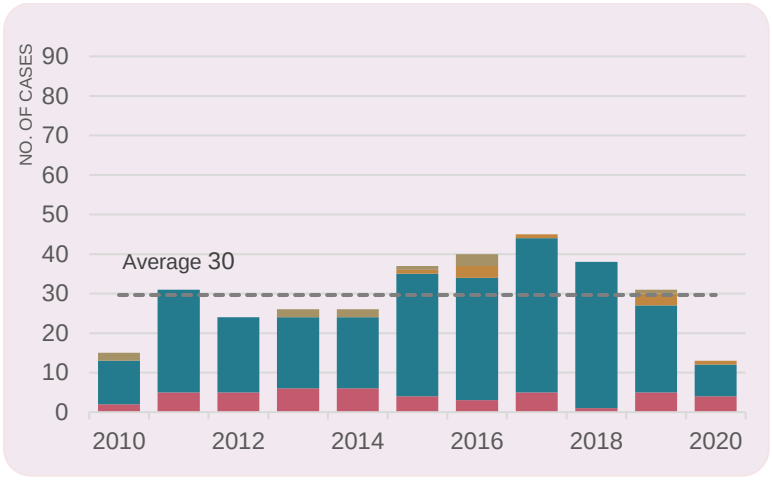
SWSLHD

Classified Notifications 386



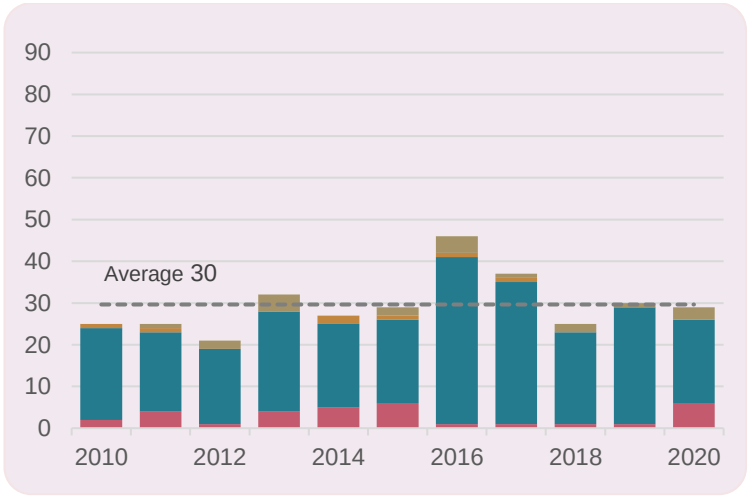
Sydney LHD

Classified Notifications 326



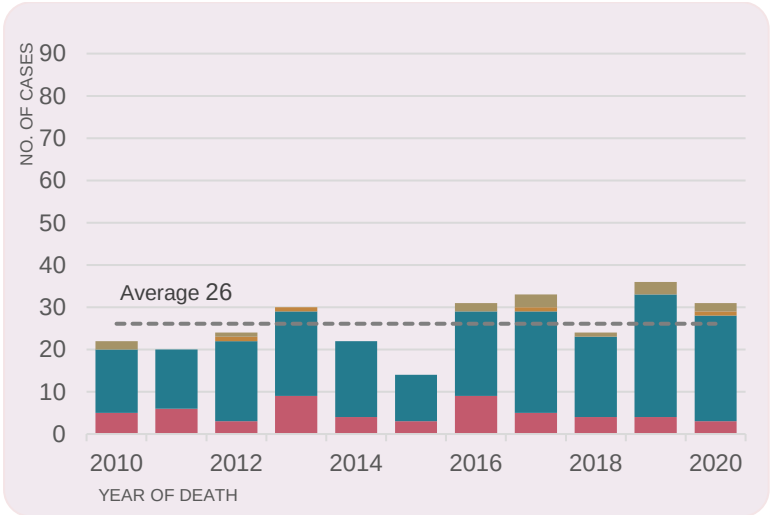
WSLHD

Classified Notifications 326



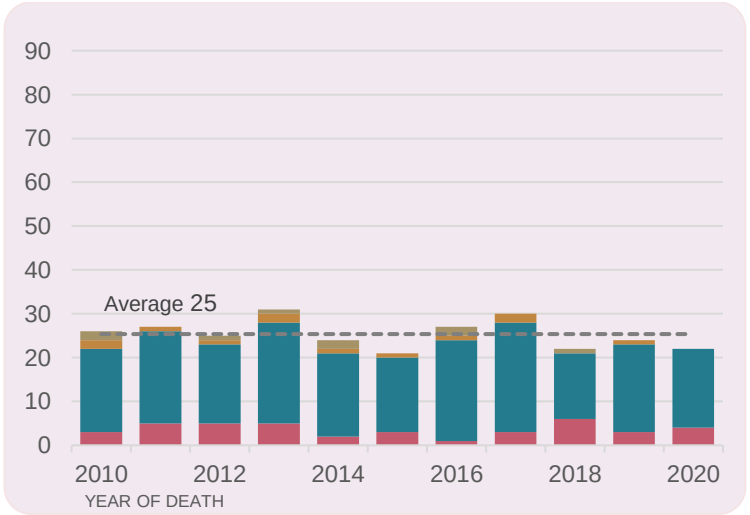
NSLHD

Classified Notifications 287



SESLHD

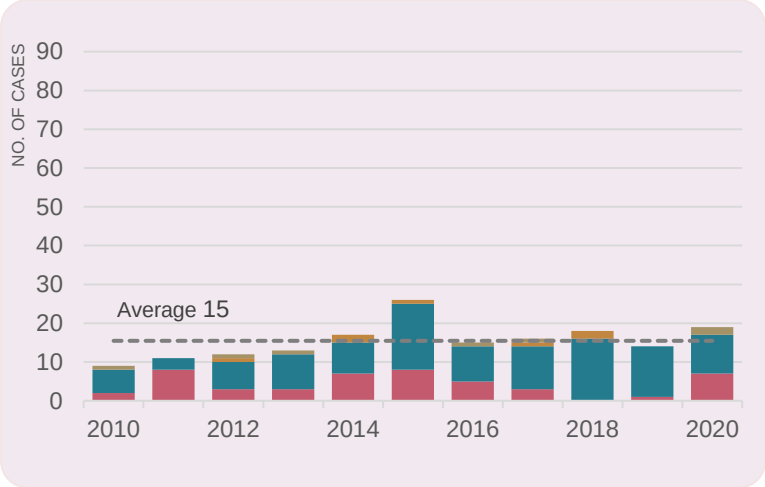
Classified Notifications 279



Case classification: Deaths attributable to anaesthesia, Deaths in which anaesthesia played no part, Un-assessable deaths, Excluded

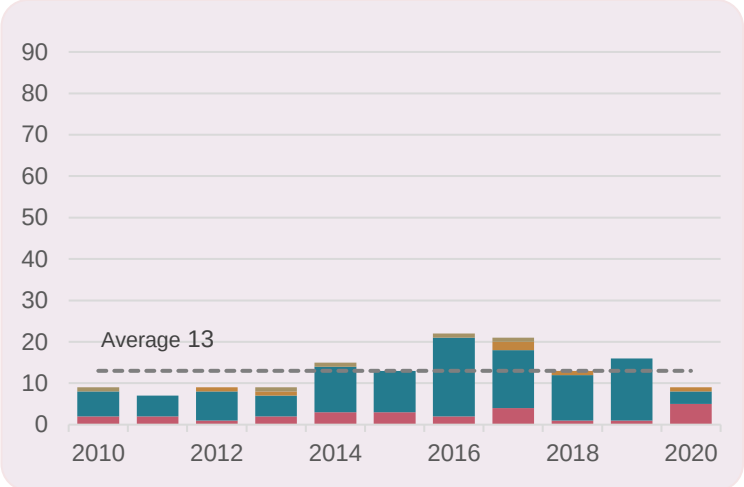
Private Hospitals

Classified Notifications 170



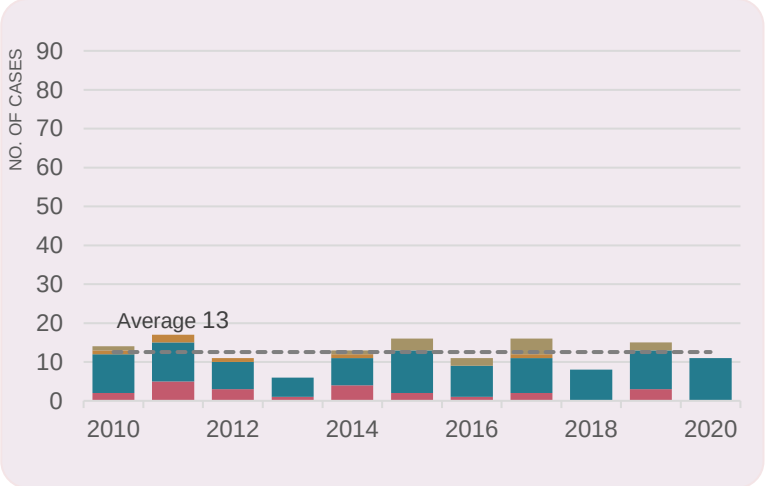
NBMLHD

Classified Notifications 143



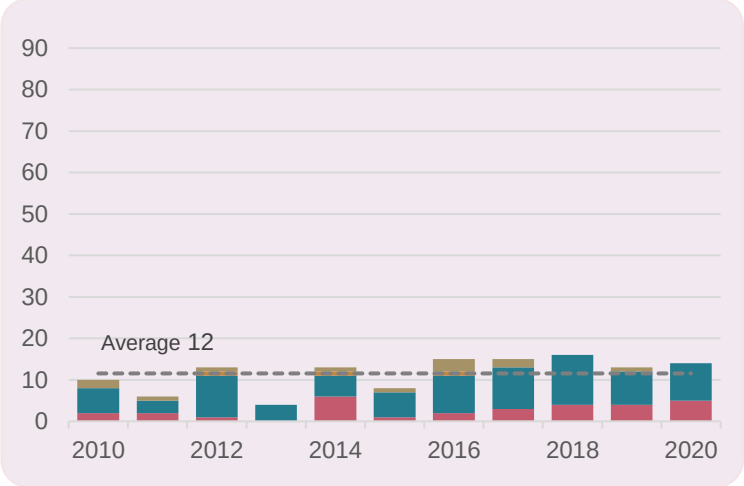
ISLHD

Classified Notifications 138



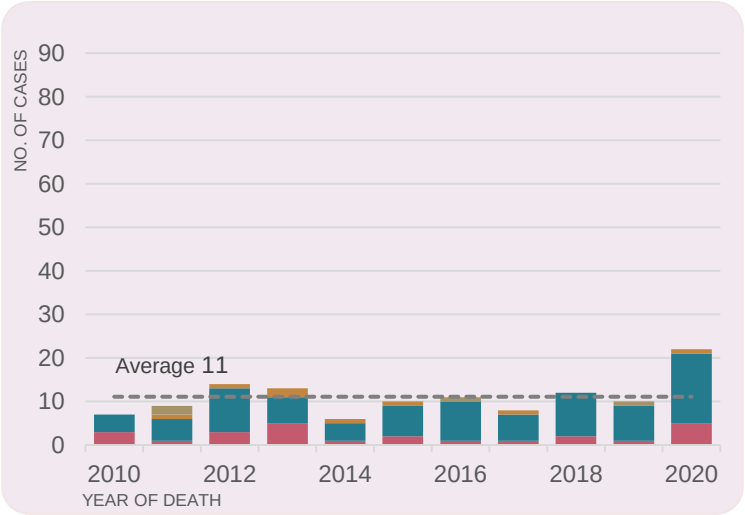
WNSWLHD

Classified Notifications 127



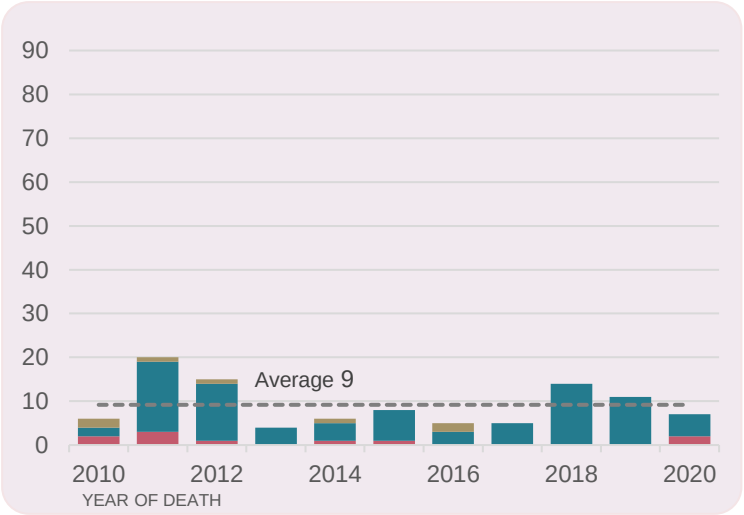
CCLHD

Classified Notifications 122



St Vincent's Network

Classified Notifications 101



Case classification: Deaths attributable to anaesthesia, Deaths in which anaesthesia played no part, Un-assessable deaths, Excluded

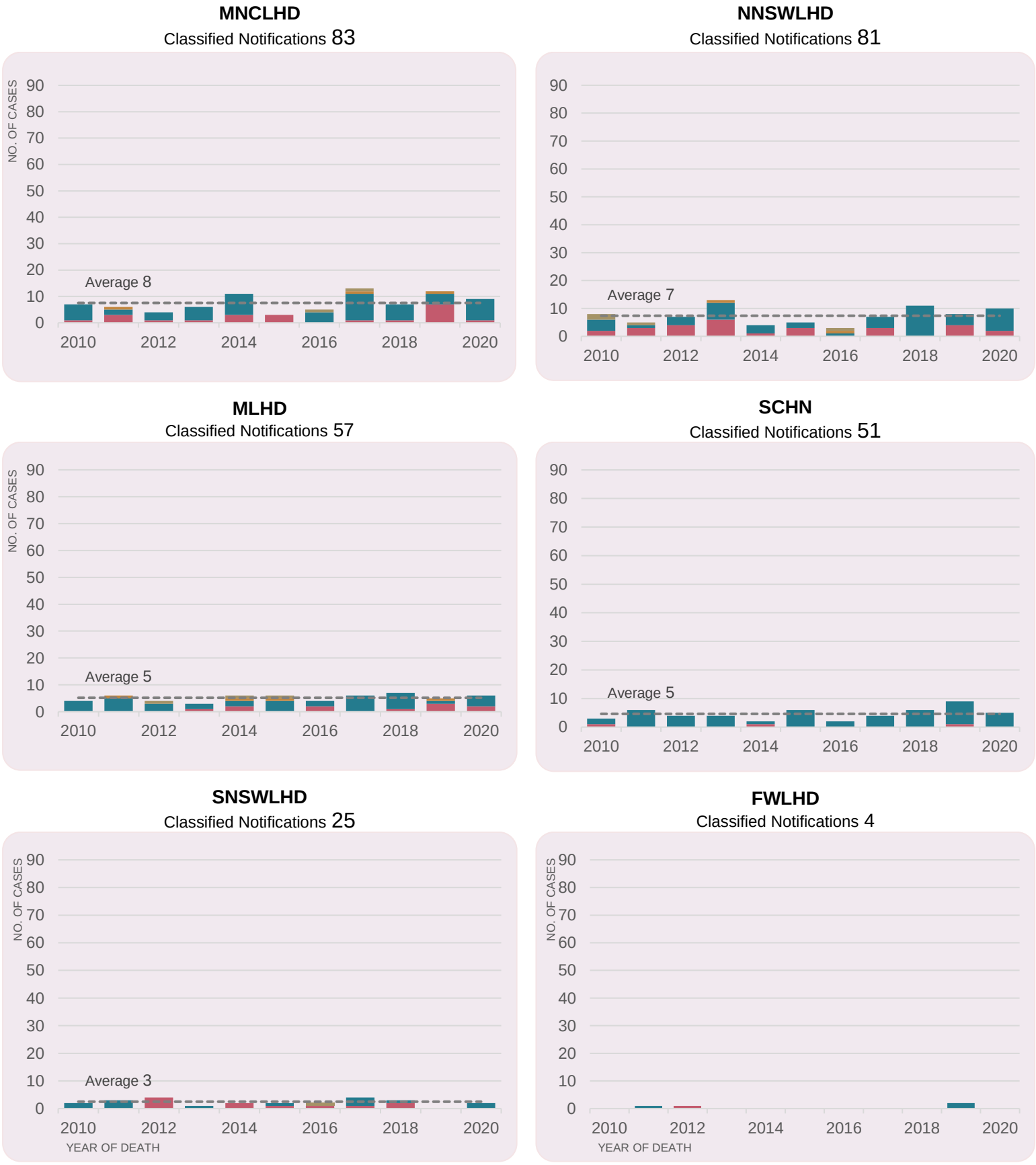


Figure 23: Distribution of deaths (n=3,273) notified to SCIDUA by case classification and calendar year for hospital groups over the 11-year period (2010-2020).

3.8. Notifications of Death by Days Variance

To obtain the most accurate information from medical practitioners involved with the death of a patient that meets the criteria of SCIDUA, it is important to capture a clear recollection of events by submitting a 'Form of Notification' as soon as possible after the patient death.

Members of the SCIDUA committee encourage medical practitioners to adopt a model of early self-notification (1-30 days after the patient death) to SCIDUA, rather than waiting for the notification from the hospital system (45 days after the end of the month in which the death occurred) to generate an email request by SCIDUA. Medical practitioners are also encouraged to contact the SCIDUA Chairperson should they have any queries or concerns about the notification process or whether the death meets the criteria for SCIDUA.

Data analysis over the 11-year period shows that overall, 44.31% (n=1,451) of deaths are self-notified by medical practitioners within 30 days of the patient death. However, there are still 30.05% (n=982) of notifications that are received more than 90 days after the patient death, as shown in Figure 24 below.

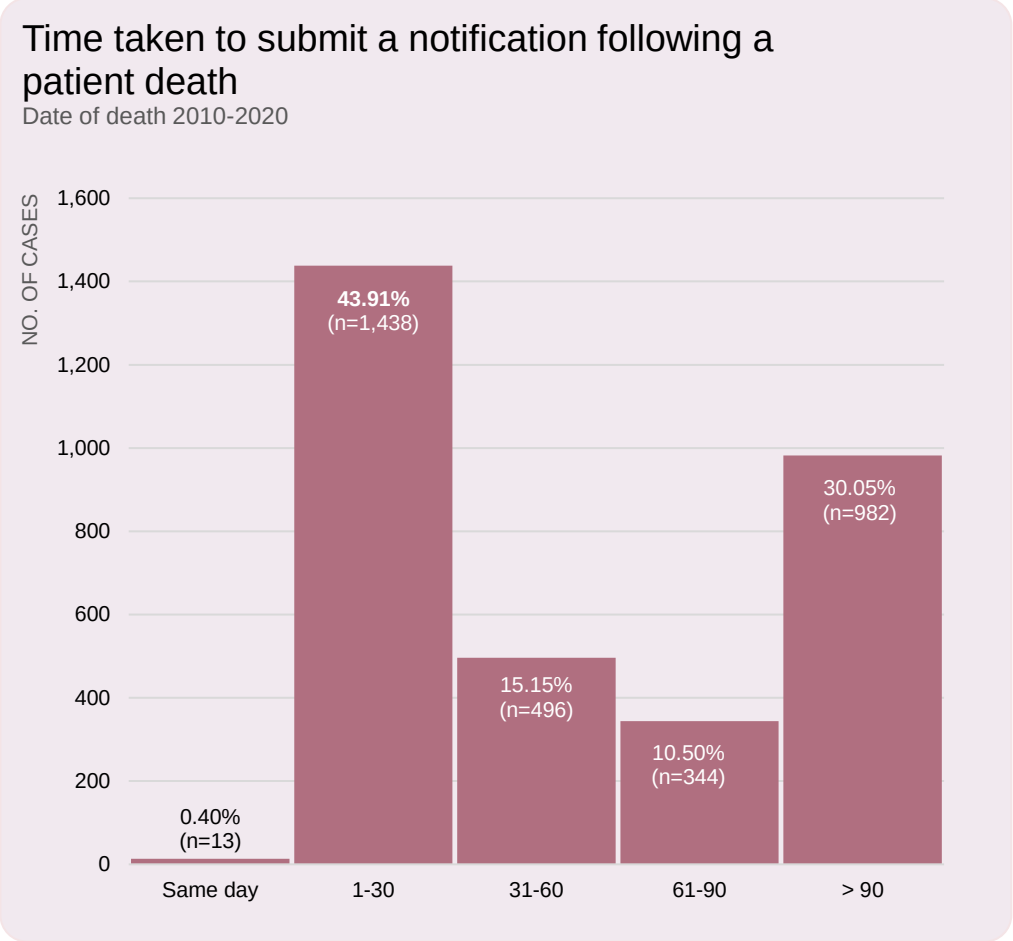


Figure 24: Days variance for submission of notifications for deaths occurring between 2010-2020.

Data analysis for the 11-year period on the days variance for notifications to SCIDUA greater than 90 days of patient death had an average of 89 and there was a steady above-average increase since 2014.

In 2019 (n=166) and 2020 (n=145) 48% of the notifications were submitted within 30 days of the patient death.

In 2020, there are 6 same day notifications which is the highest over the 11-year period, as shown in Figure 25 below.

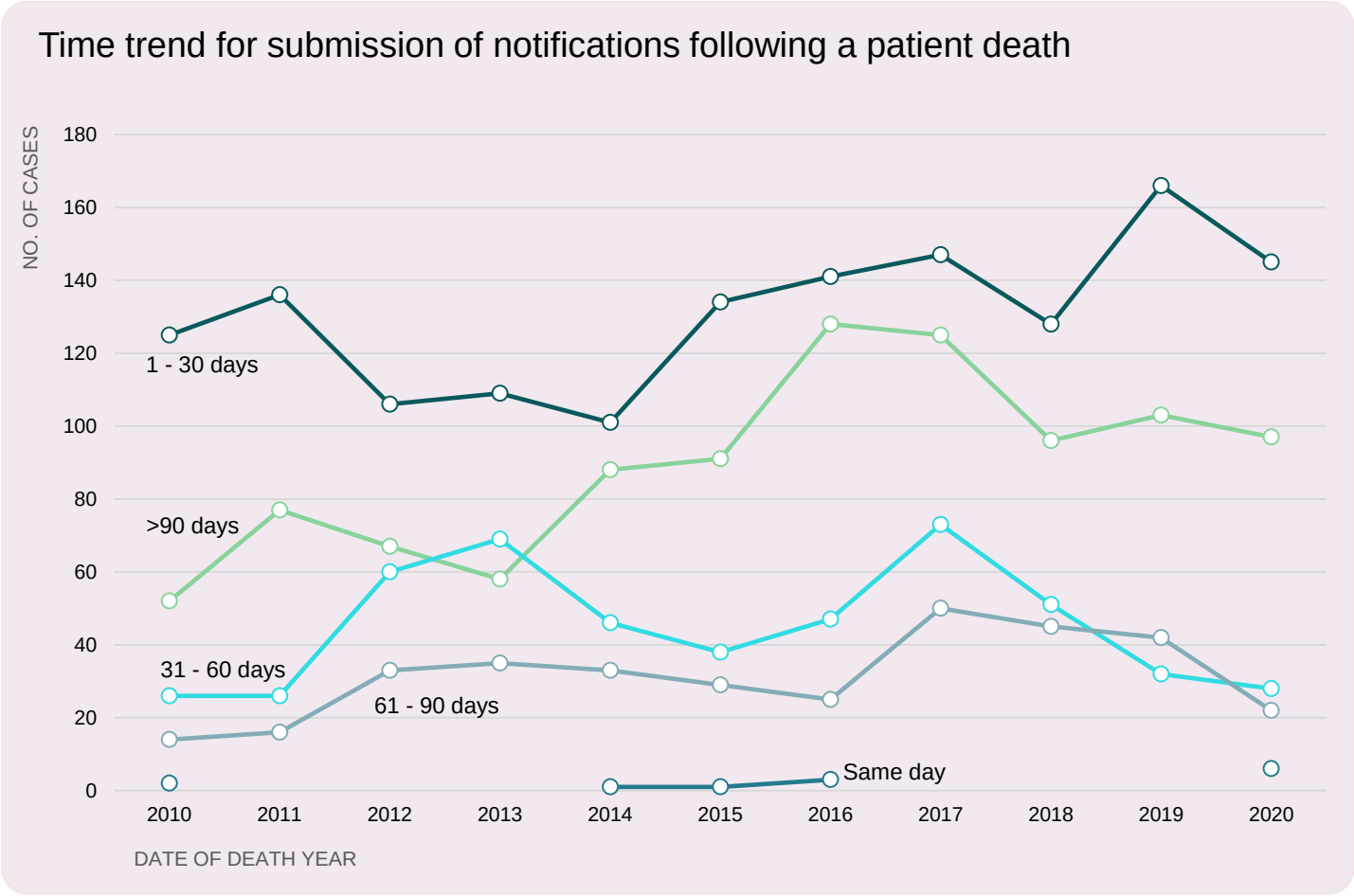


Figure 25: Trend for submission of notifications of death (n=3,273) occurring between 2010-2020.

3.9. Submission Rate by Hospital Group

A closer look at the notifications submitted to SCIDUA for deaths occurring in 2020 identify that 14 out of the 17 hospital groups have more than 50% of their notifications submitted within 90 days of death, as seen in Figure 26 below.

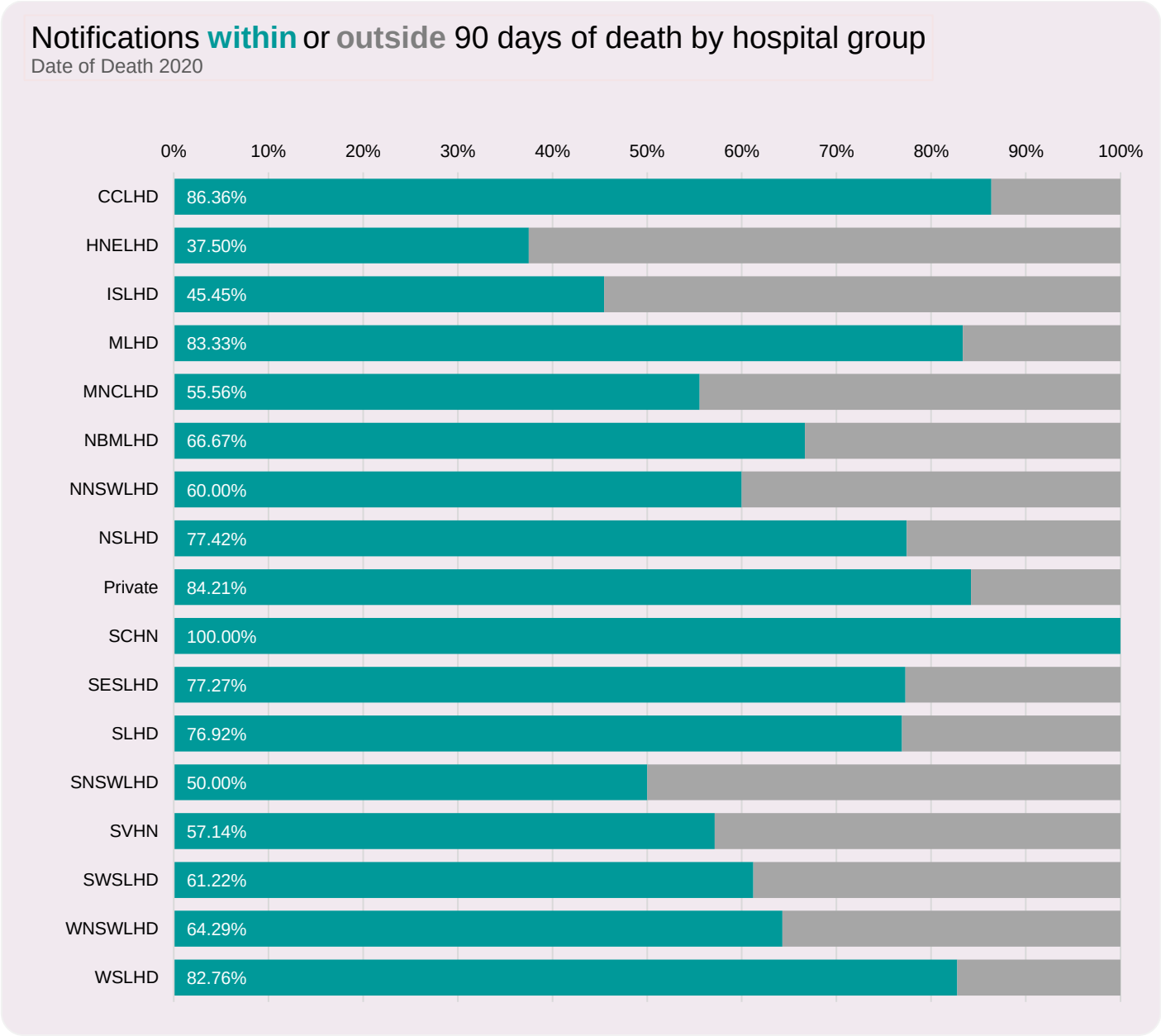


Figure 26: Distribution of percentage of notifications submitted to SCIDUA within 90 days and over 90 days from date of death for the deaths occurring in 2020 (n=298).

3.10. Trauma Deaths

The SCIDUA triage sub-committee classifies trauma deaths (*death due to physical trauma)* prior to review by the full committee. Most trauma deaths have an ASA score of '4' (a patient with severe systemic disease that is a constant threat to life) and are admitted to a Level 6 hospital with a trauma facility.

The definition of *major trauma* applies when patients of any age, are admitted to a designated NSW Trauma Service within 14 days of sustaining an injury, and:

- have an Injury Severity Score (ISS) > 12 (moderate to critically injured); or
- are admitted to an Intensive Care Unit (irrespective of ISS) following injury; or
- die in hospital (irrespective of ISS) following injury, except those with an isolated fractured neck of femur injury sustained from a fall from a standing height (<1 metre) and those aged 65 years or older who die with minor soft tissue injury only[7].

Analysis on the deaths classified by SCIDUA as trauma-related identify that 2014 had the highest number of trauma deaths (n=73) and 2010 had the lowest (n=18). Overall, there were 592 deaths classified as trauma, with 256 deaths classified as inevitable and 31 as un-assessable, as shown in Figure 27 below.

Further analysis shows that females represented 51.52% (n=305) of all trauma deaths and males 48.48% (n=287) in the 11-year period, the median age for female being 67.5 and male 57.5.

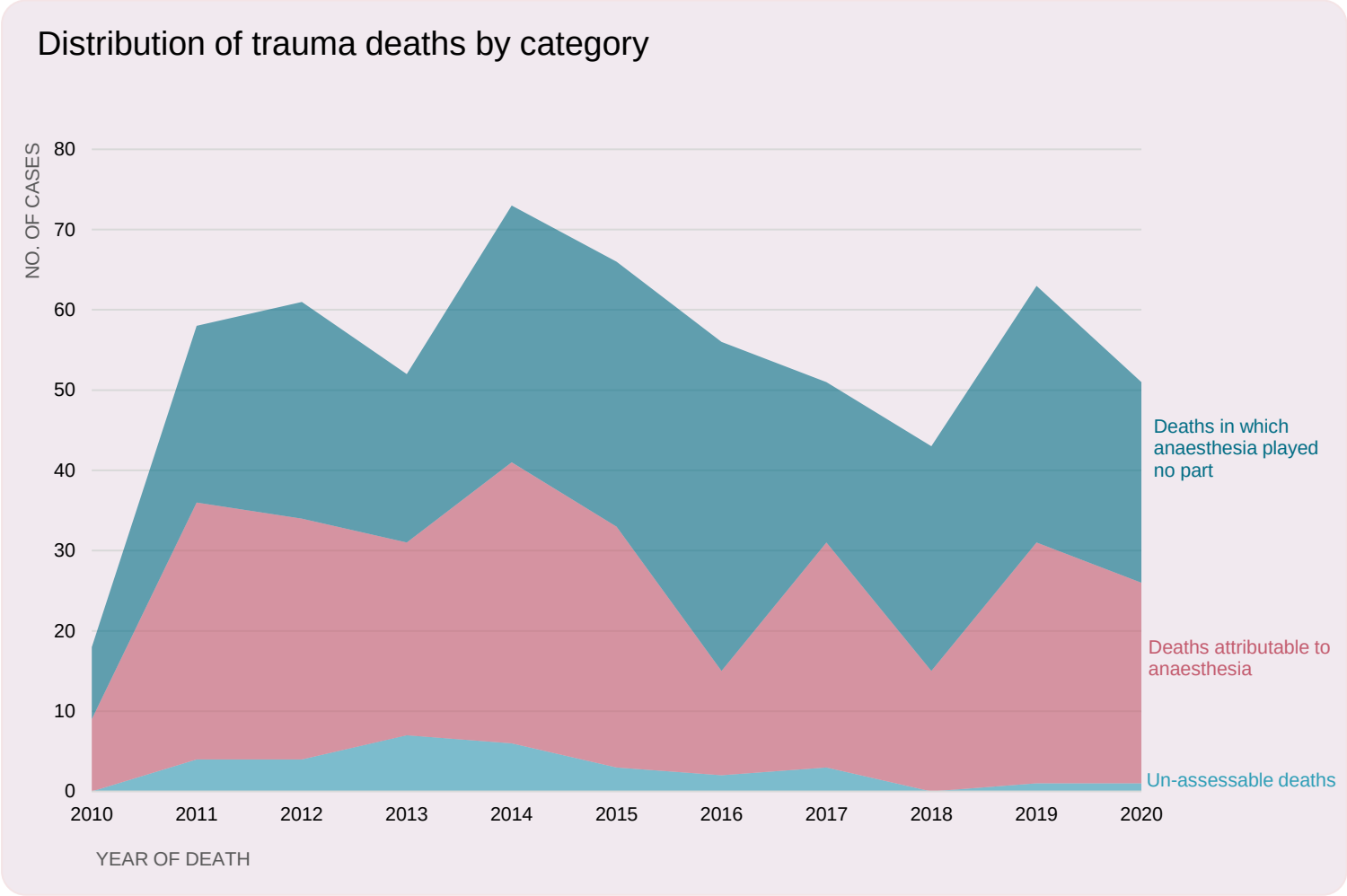


Figure 27: Trauma deaths by category (n=592) over the 11-year period (2010-2020).

Note: Cases classified as excluded (n=162) are not included in this analysis.

[7] https://www.aci.health.nsw.gov.au/__data/assets/pdf_file/0007/341098/Major_Trauma_in_NSW,_2015._A_Report_from_the_NSW_Trauma_Registry_Final.pdf

Figures 28-30, below, show further information on trauma-related deaths.

Data analysis shows that ASA 4 is assigned to 44.76% (n=265) of trauma deaths. The majority of trauma deaths occur within the orthopaedic surgical specialty (n=354). 91.72% of trauma deaths occurred in ICU/High Dependency, operating theatre and general ward locations.

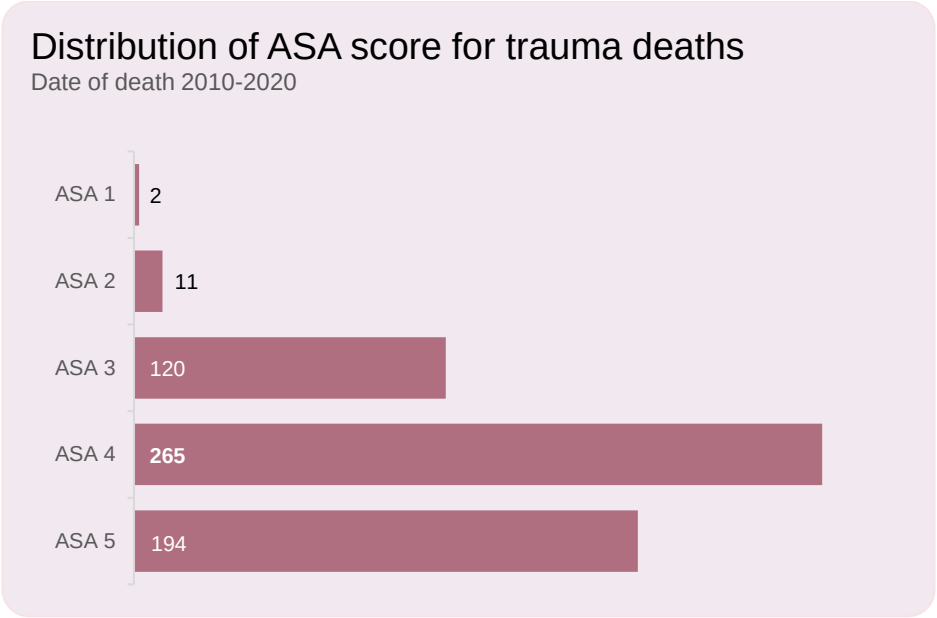
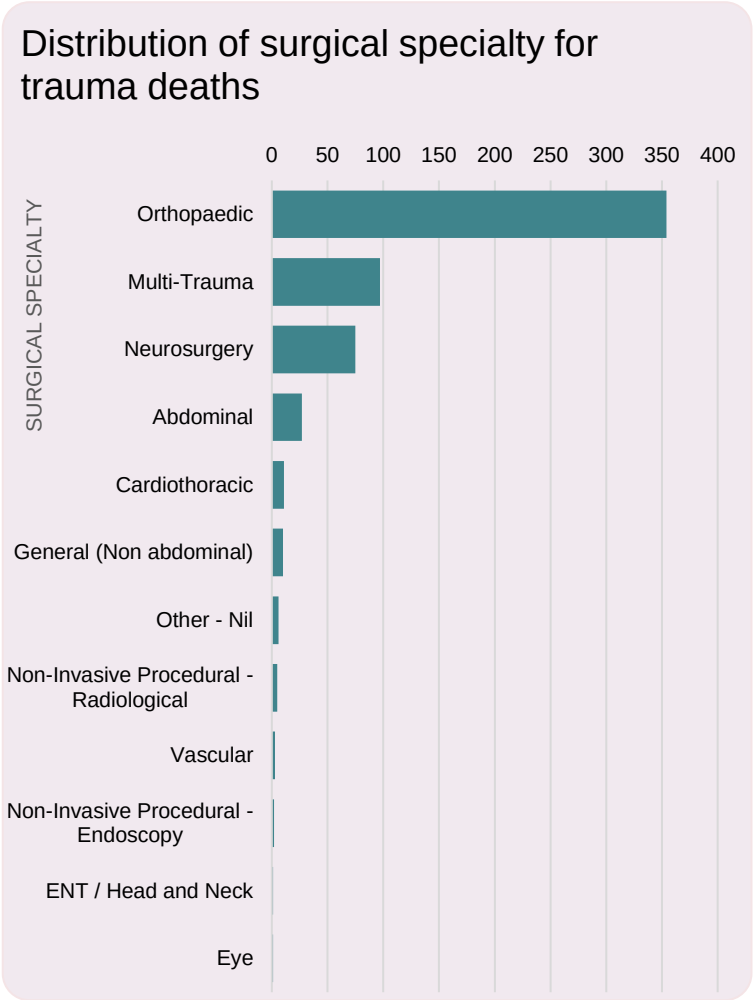
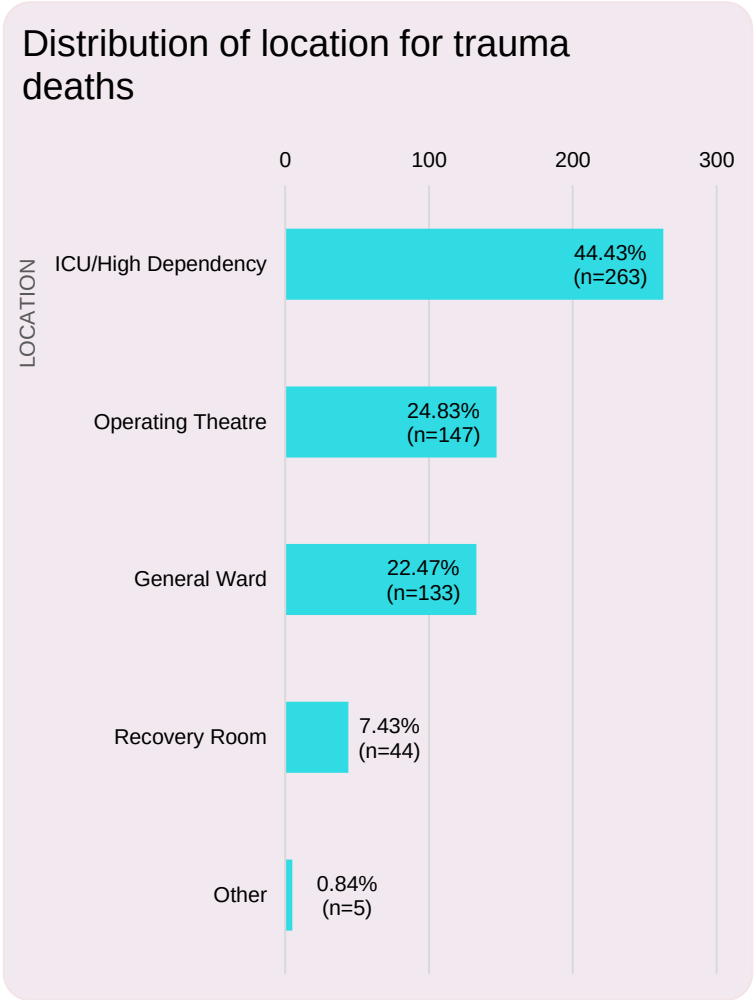


Figure 28: Trauma deaths by ASA score (n=592) over the 11-year period (2010-2020).

Note: Cases classified as excluded (n=162) are not included in this analysis.





Figures 29 and 30: Trauma deaths (n=592) by surgical speciality and location of death.

Note: Cases classified as excluded (n=162) are not included in this analysis

3.11. Non-Beneficial Surgery (Futile Surgery)

Futility is subject to much debate within medical and surgical care. There is no concise definition and an objective understanding is yet to find common ground. For the purpose of reviewing deaths potentially associated with anaesthesia, SCIDUA applies the concept of 'non-beneficial surgery' to help classify deaths which may otherwise be seen as futile.

These are cases where surgery is performed, when it is clear before starting, that no favourable outcome could be expected from the surgical intervention. In 2020, the committee classified 7 such cases having date of death in 2019 (n=1) and 2020 (n=6). 71.43% (n=5) classified as emergency i.e., the patient requires immediate surgery (less than 30 minutes) for a life-threatening condition, such as a ruptured abdominal aortic aneurysm.

These cases may reinforce difficult situations where medical practitioners are presented with challenging circumstances, such as, the desire to proceed with surgery when other end of life or palliative care planning could provide alternative options, or where surgery is performed to provide comfort measures.

SCIDUA encourages all treatment team members to engage the patient and their families in a conversation about realistic outcomes when offering procedures, and giving patients and families the option of palliation, where feasible, or of establishing a ceiling of care.

The cumulative total for cases classified as non-beneficial over the 11-year period is 87 of which 85.06% (n=74) are deaths in which anaesthesia played no part and the remaining 14.94% (n=13) are deaths attributable to anaesthesia, as represented in Figure 31 below.

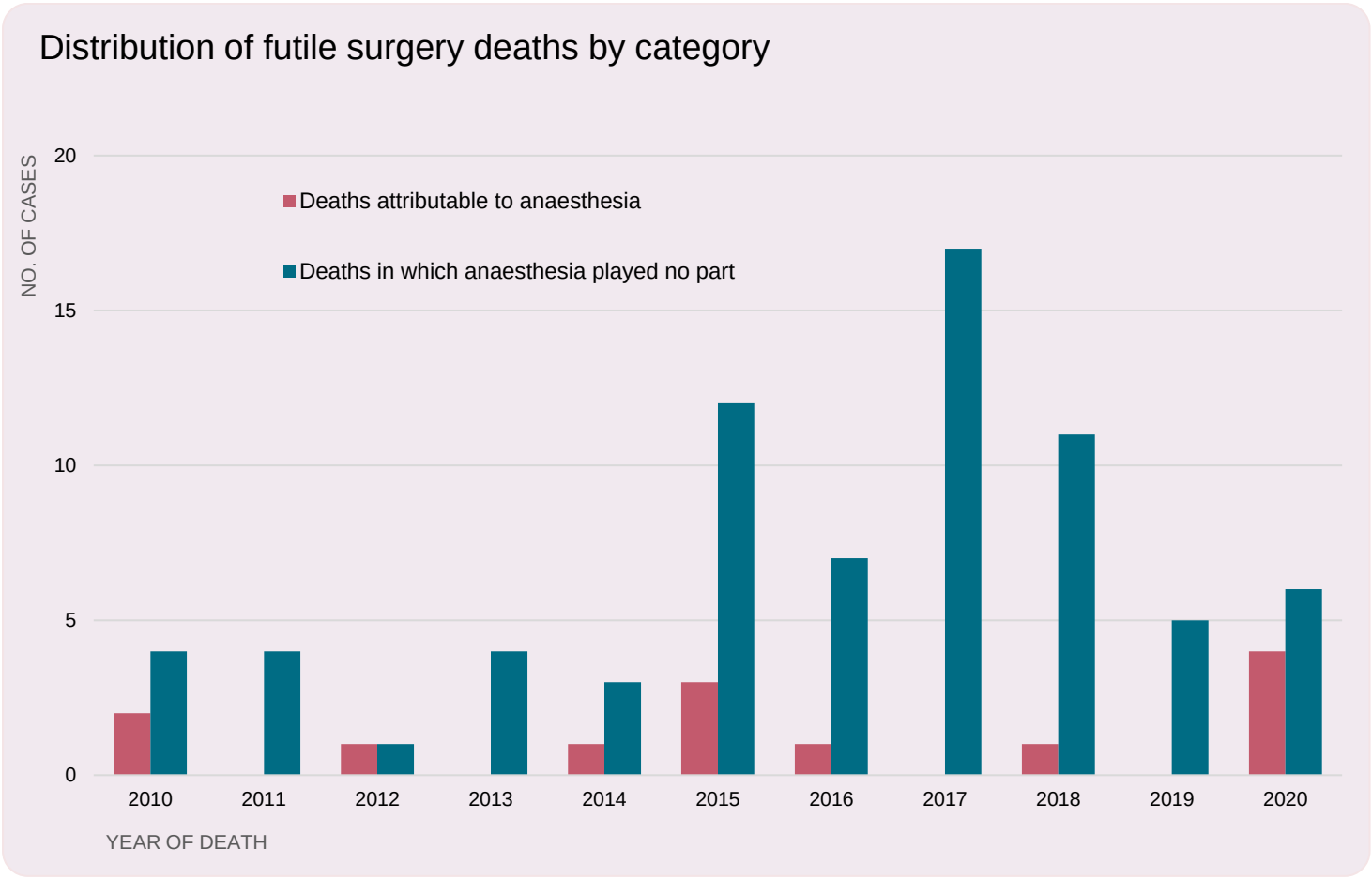
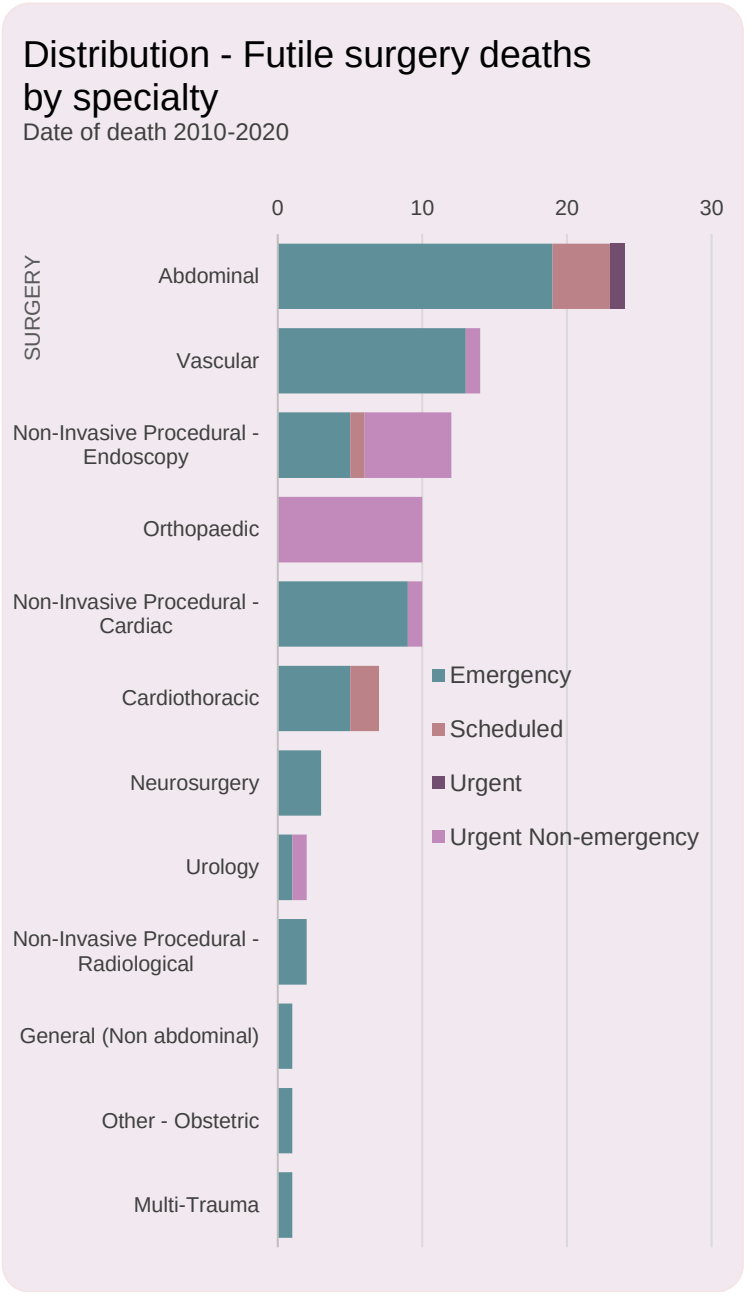
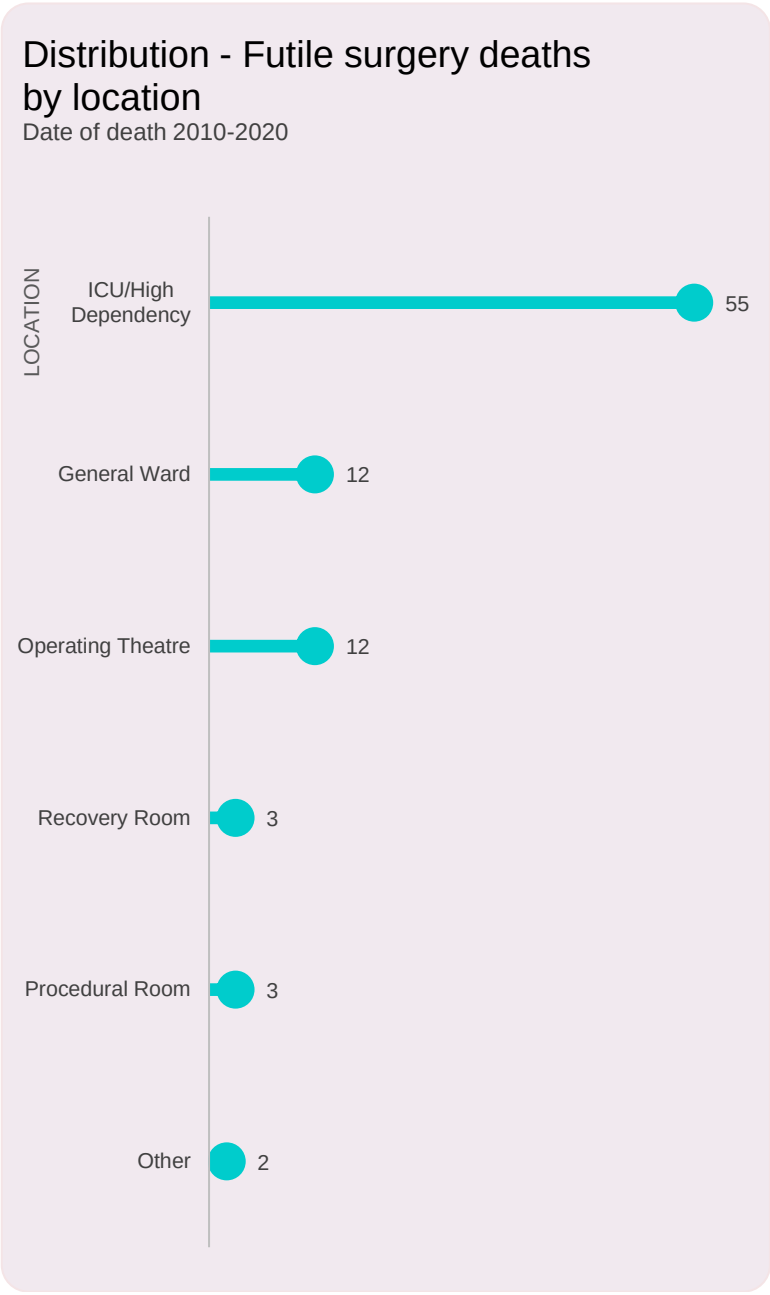


Figure 31: Distribution of non-beneficial surgical cases by category (n=87) over the 11-year period (2010-2020).

Overall, there were 68.97% (n=60) deaths classified as futile surgery for the urgency type ‘Emergency’; 21.84% (n=19) were ‘Urgent Non-emergency’, 7 ‘Scheduled’ (elective surgery) and one as ‘Urgent’.

Most of the futile surgery deaths were for abdominal surgery at 27.59% (n=24) and the majority of the deaths occurred in an ICU/High dependency 63.22% (n=55) location. Figures 32 and 33 below show the distribution of futile-related surgery by speciality and location.





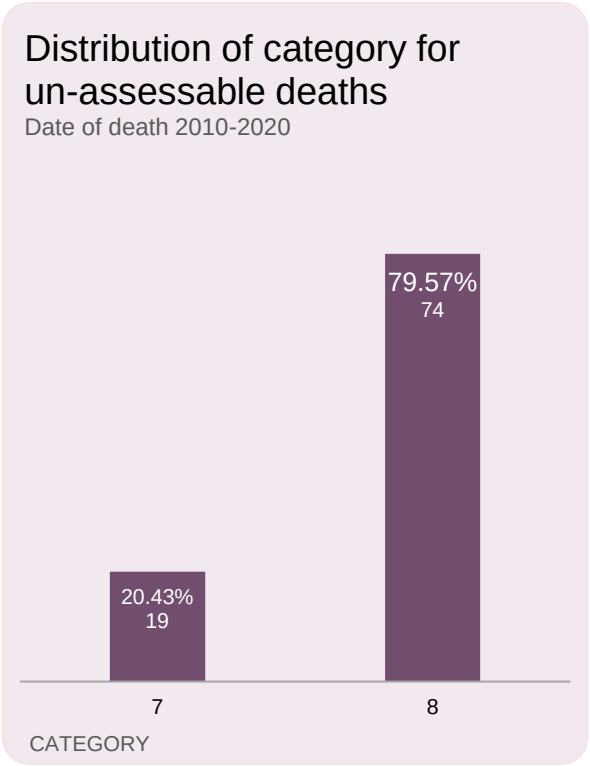
Figures 32 and 33: Distribution of surgery type and location for non-beneficial surgical cases (n=87) over the 11-year period (2010-2020).

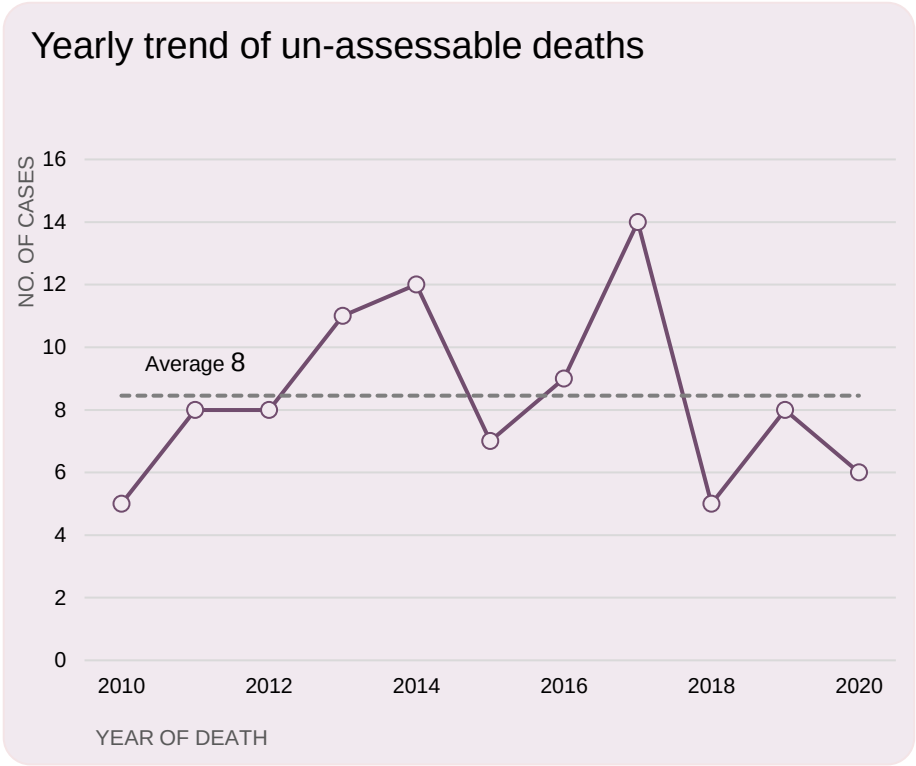
3.12. Un-assessable Deaths

On occasion, some of the “Forms of Notification” (FON) submitted to SCIDUA contain insufficient details. This is either when there is little known about the event, or there is a lack of other clinical information for the committee to adequately assess and classify the death.

Every effort is made to follow-up with the medical practitioner or anaesthetic department to obtain further details on the death, however, there are a small number of deaths each year that remain un-assessable and are classified as a *Category 8* death.

2.84%, a total of 93 cases over the 11-year period, were determined to be un-assessable by the committee, as shown in Figures 34 and 35 below.





Figures 34 and 35: Distribution of un-assessable deaths (n=93) over the 11-year period (2010-2020).

3.13. Bone Cement

The committee classifies deaths where bone cement is used. Figure 36 below shows a total of 101 such deaths, for the 11-year reporting period, of which 97 were related to anaesthesia and four were classified as un-assessable deaths. The highest volume of deaths occurred in 2014 (n=15). Just under 31% of these deaths occurred in the operating theatre, over the 11-year period.

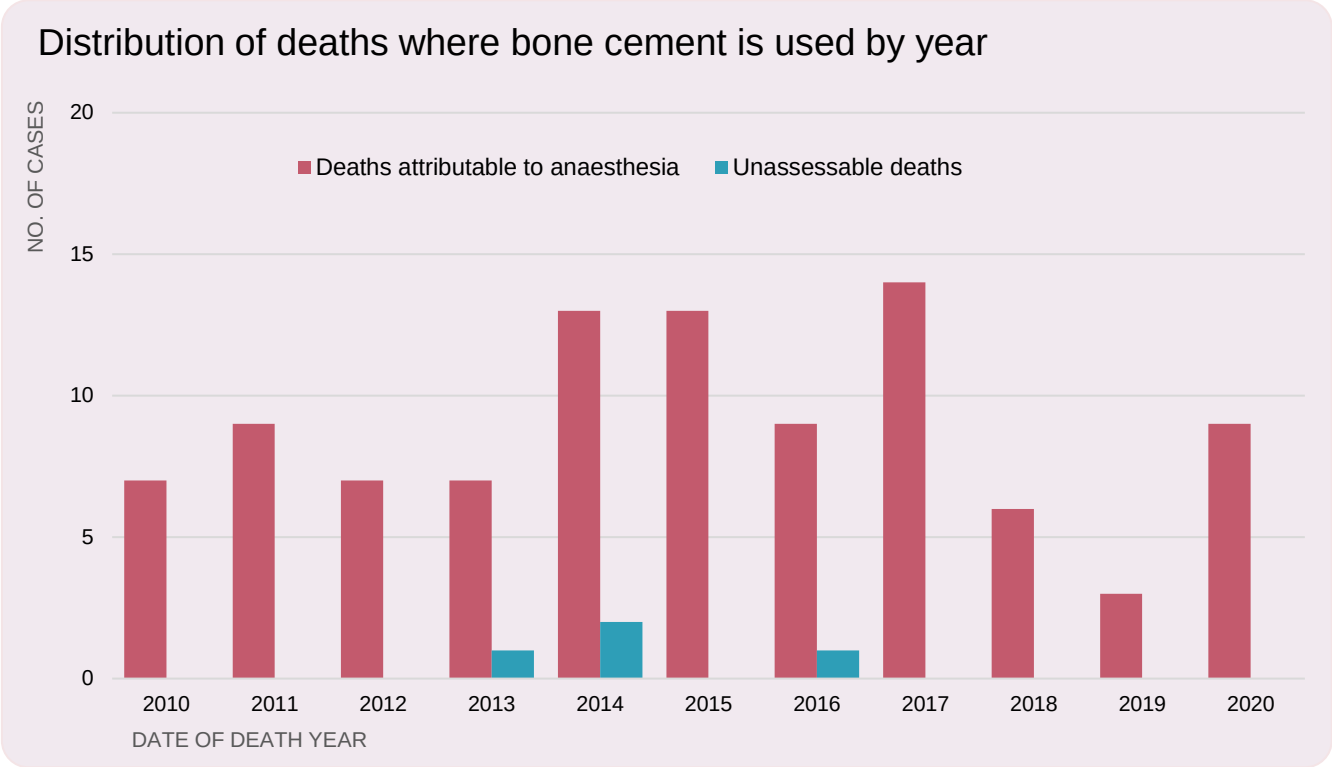


Figure 36: Trend of deaths where bone cement is used (n=101) over the 11-year period (2010-2020).

3.14. Adverse Reaction to Anaesthesia

For the 11-year period where anaesthesia-related deaths were determined to have a causal factor classification of Ciii (adverse reaction to anaesthesia drugs), there were 17 such deaths, 2 of which were trauma-related. 12 of these were males with median age of 68, and 5 females having median age of 64.

3.15. Correctable Factors

Data for the 533 anaesthesia-related deaths concerning causal and contributing factors over the 11-year reporting period is shown below. The committee identified correctable factors in 29.27% (n=156) deaths, as shown in Figure 37.

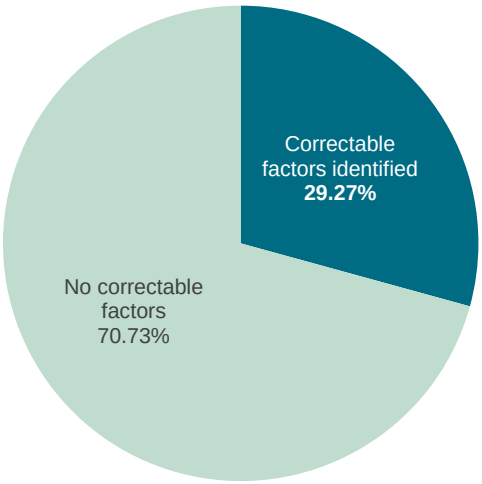


Figure 37: Comparison of correctable and no correctable factors 2010-2020.

3.16. Causal and Contributing Factors

Figure 38 below shows that anaesthetic technique is a causal or contributing factor in 43.59% (n=68, individual case) of anaesthesia-related deaths that had identified correctable factors (n=156*).

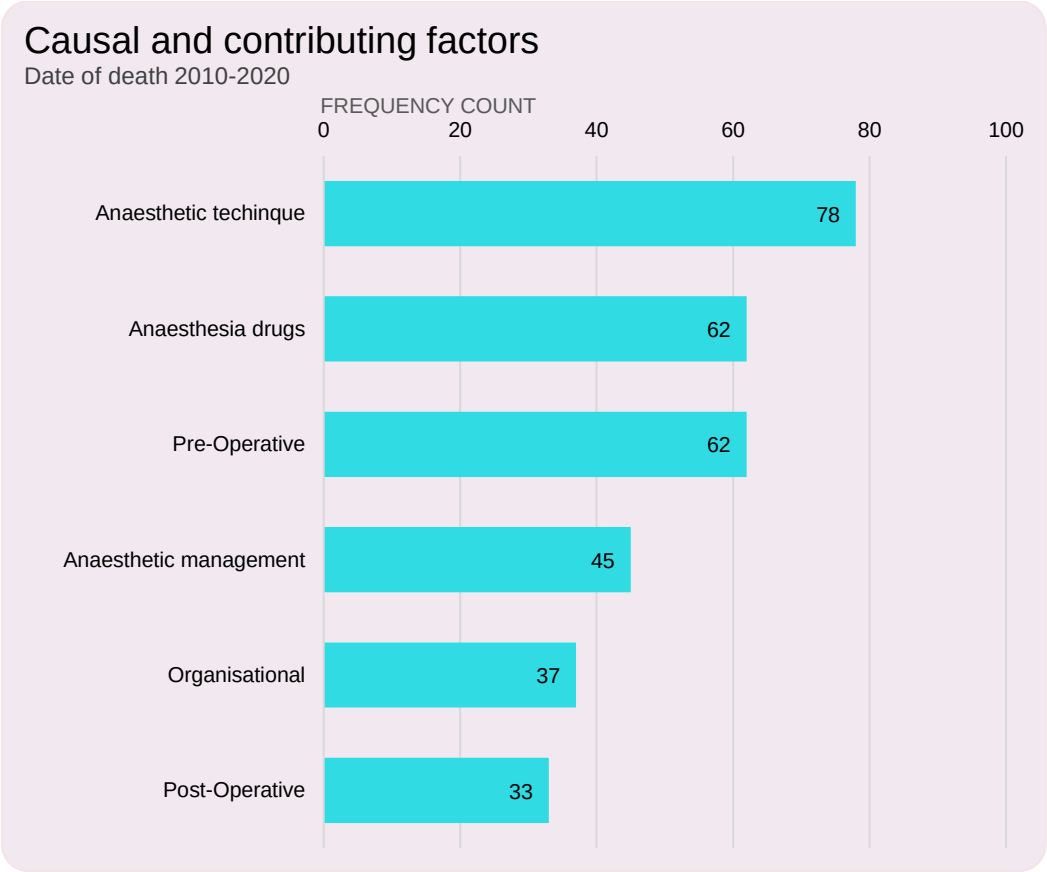


Figure 38: Causal and contributing factors (n=317) identified in anaesthesia-related deaths (n=156) over the 11-year period (2010-2020).

**Note:* The frequency count adds up to more than 156, because anaesthesia-related deaths can have more than one causal or contributing factor identified.*

Figure 39 below further show the causal or contributory factors by category. The top 3 selected individual causal or contributory factors were pre-operative assessment (n=52), anaesthetic technique - airway maintenance (n=48) and anaesthesia drugs dosage (n=34).

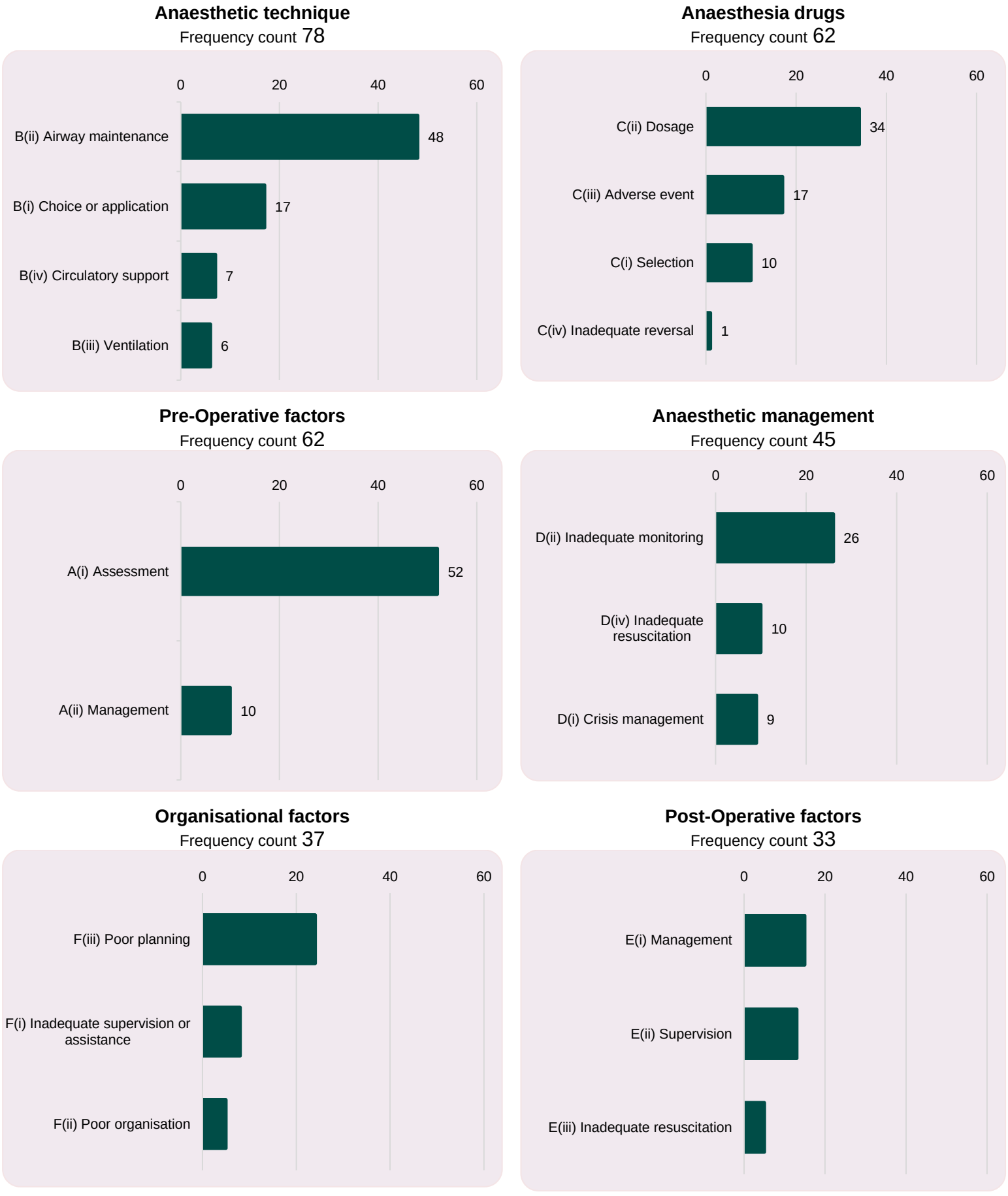


Figure 39: Distribution for causal and contributing factors over the 11-year period (2010-2020).

3.17. Other Significant Factors

The committee identified that the medical condition of the patient – *Where it is considered that the medical condition was a significant factor in the anaesthesia-related death* - as a factor in 90.24% (n=481) of deaths. The majority of these are Category 3 classifications. Figure 40 below shows the distribution of patient medical condition as a factor in anaesthetic-related deaths 2010-2020.

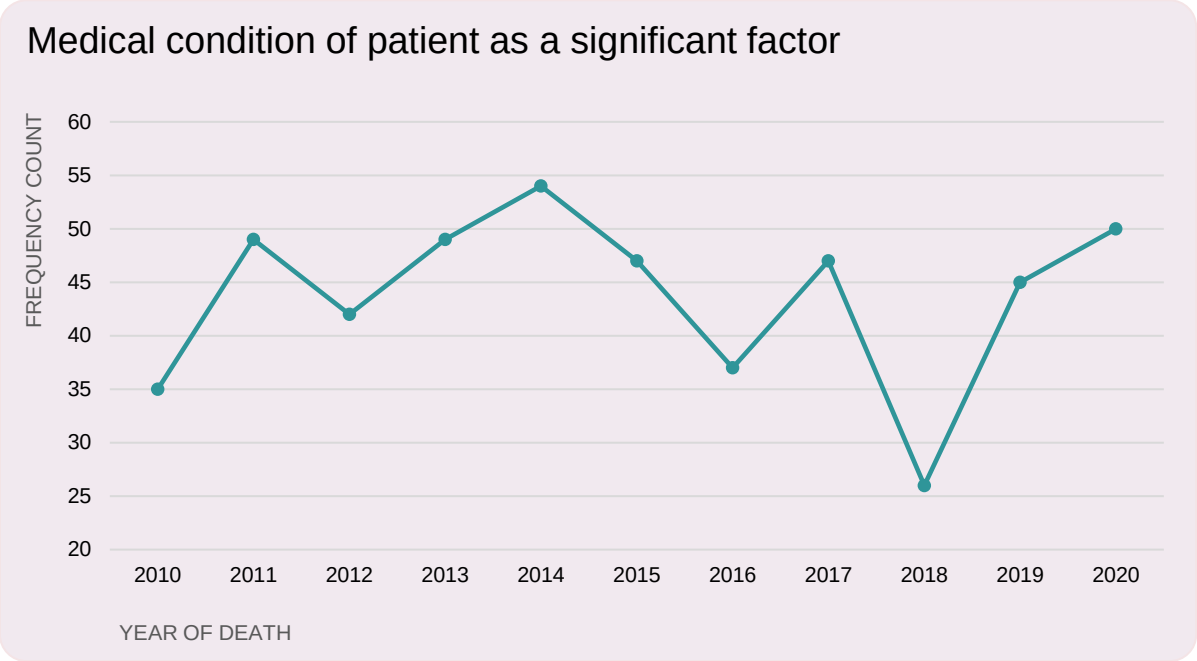


Figure 40: Medical condition of patient as a significant factor in anaesthesia-related deaths, 2010-2020.

3.18. No Correctable Factors

Over the 11-year period, 70.73% (n=377) of the anaesthesia-related deaths (n=533) had no correctable factor identified, as represented in Figure 41 below.

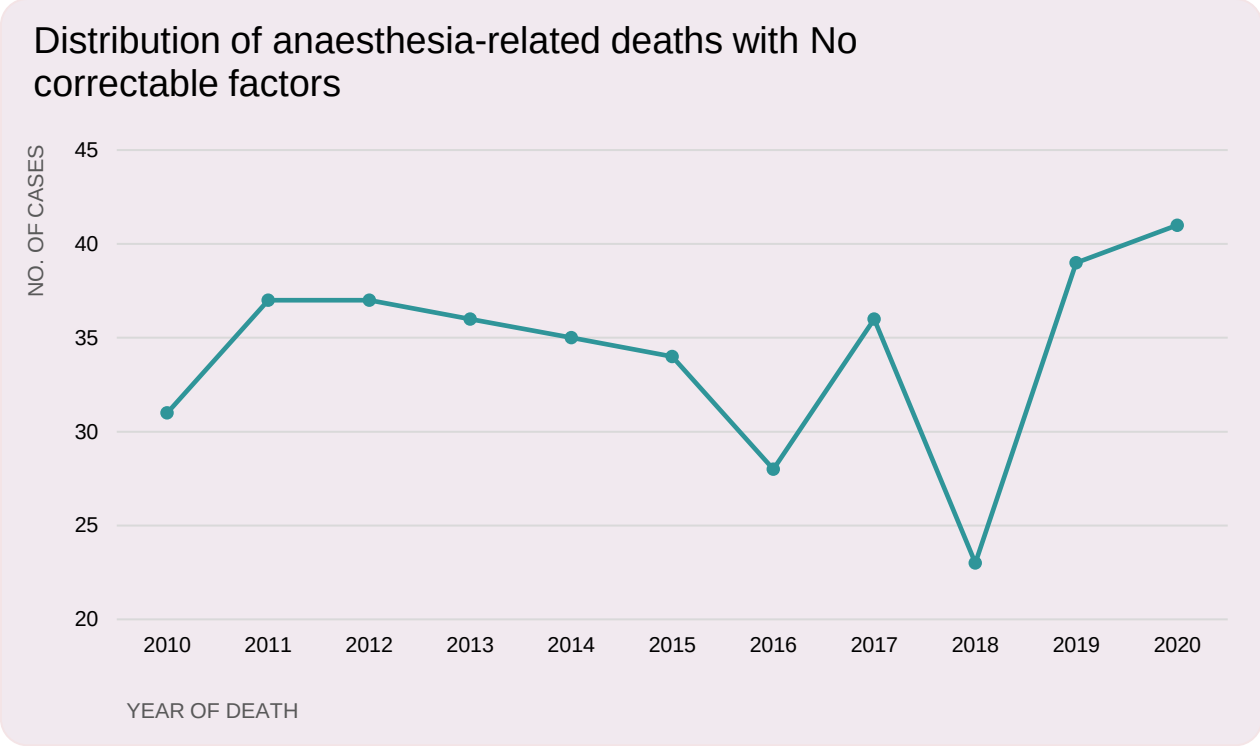


Figure 41: No correctable factor in anaesthesia-related deaths, 2010-2020.

3.19. Age and Gender

Figure 42 below shows 53.10% (n=283) of 533 anaesthesia-related deaths occurring over the 11-year period are female. 81.61% (n=435) of the deaths are assessed as Category 3 – *where death was caused by both surgical and anaesthesia factors* and the remaining are assessed as Category 1 (10.69%; n=57) and Category 2 (7.69%; n=41).

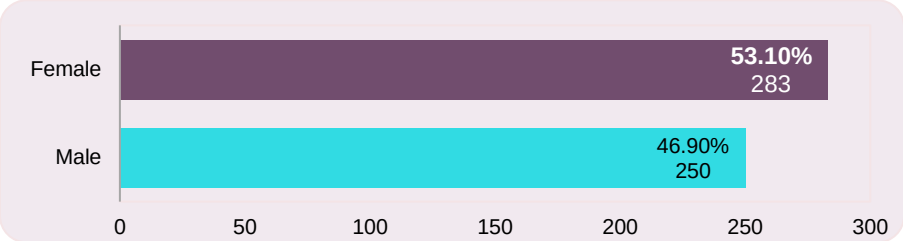


Figure 42: Gender distribution of anaesthesia-related deaths, 2010-2020.

Figure 43 below shows the age band distribution for deaths, with 90.43% (n=482) occurring in the 60 to 99 years range. The majority of deaths occurred in the 85 to 89 years age band (n=103). The median age for females is 74 and males is 71.5 years.

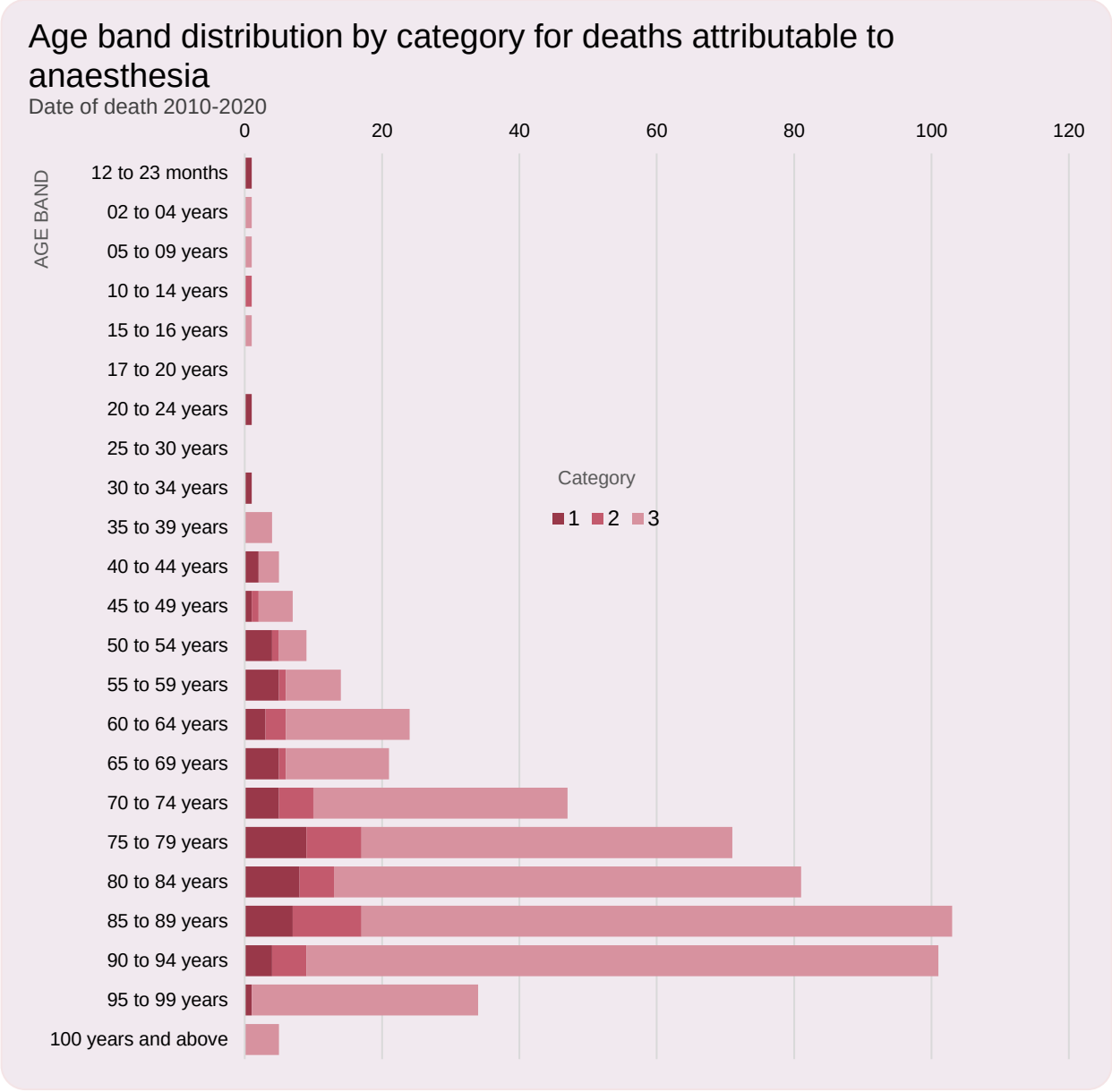
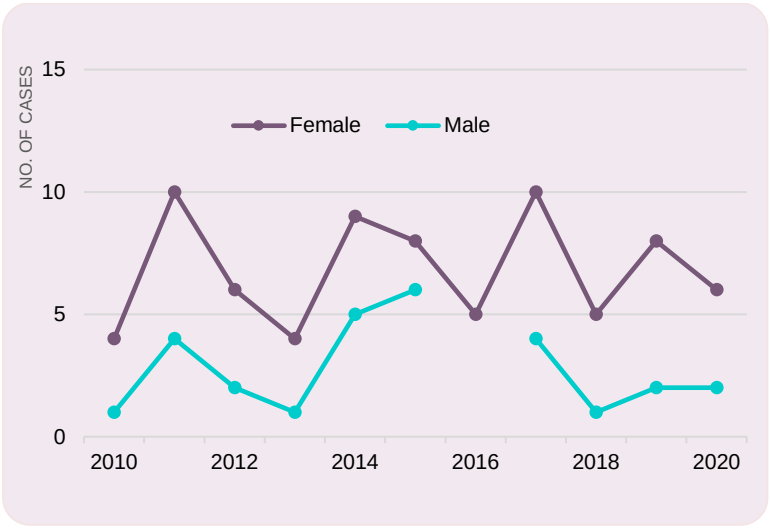


Figure 43: Distribution of age band and category (n=533) for deaths attributable to anaesthesia over the 11-year period (2010-2020).

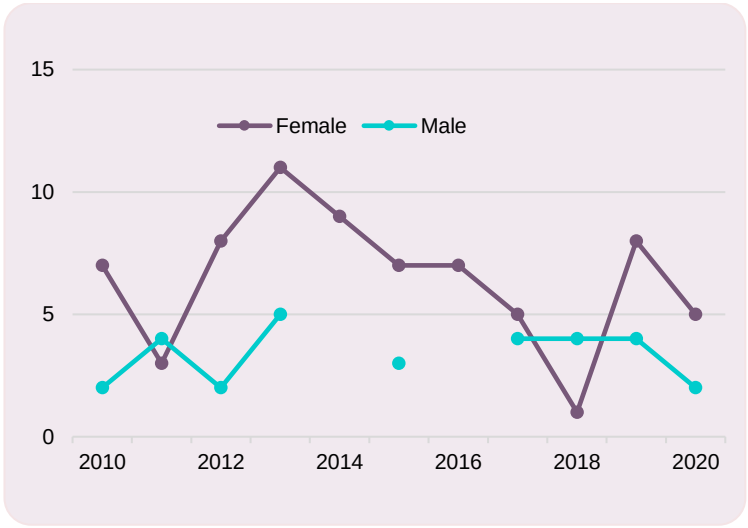
The graphs in Figure 44 below show trends by year of death and gender for the ‘Top 8’ age bands, ranging from 60 to 99 years that contributed to 90.43% of anaesthesia-related deaths 2010-2020.

The percentage of females is higher in anaesthesia-related deaths for ages 85 and over, however, there were no female deaths for the age groups 2 to 14 years and 20 to 24 years. Similarly, there are no male deaths in age groups 12 to 23 months, 15 to 16 years, and 30 to 34 years.

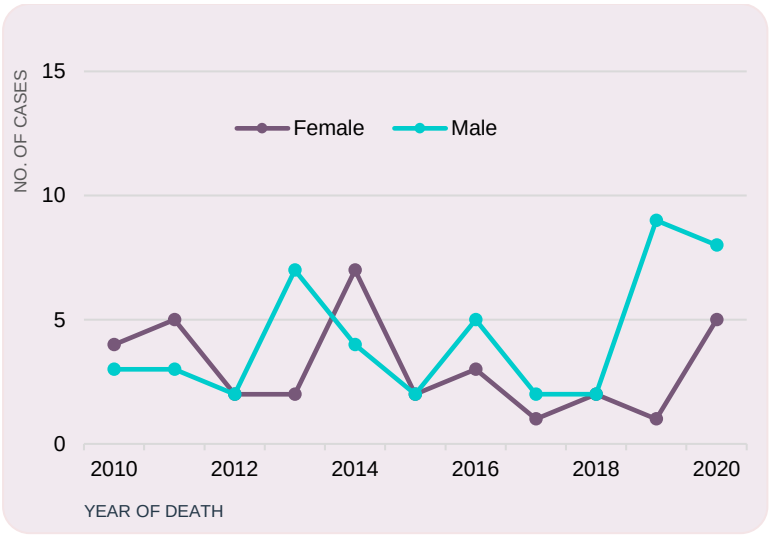
85 to 89 years
Total Notifications 103



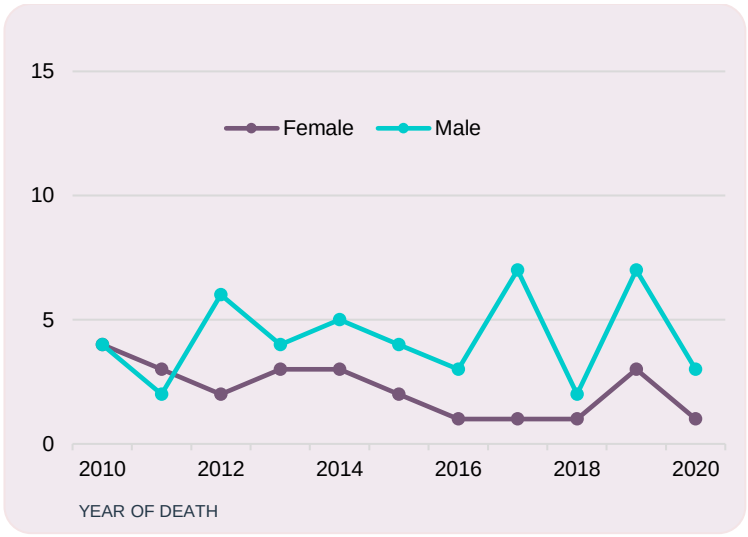
90 to 94 years
Total Notifications 101



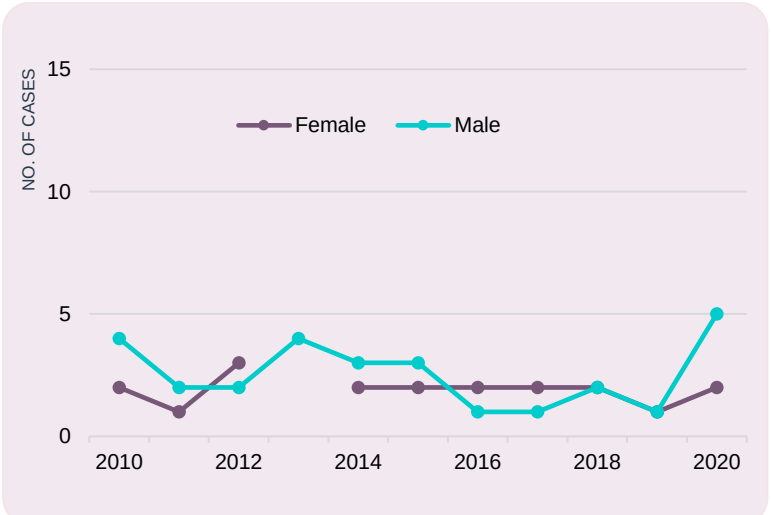
80 to 84 years
Total Notifications 81



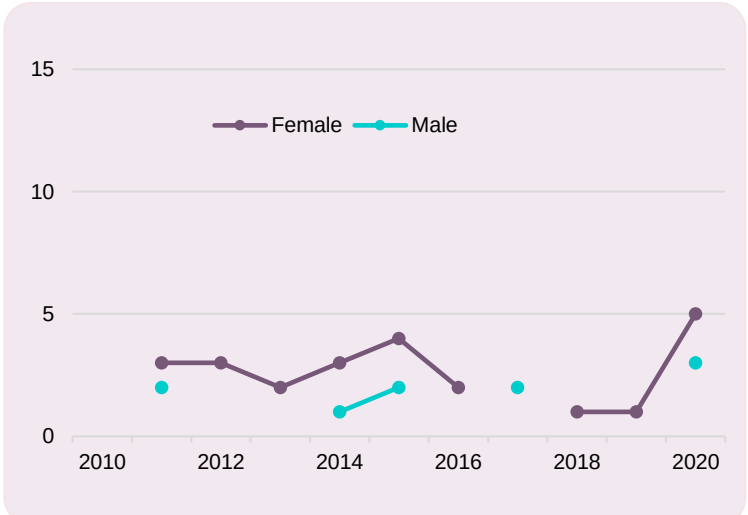
75 to 79 years
Total Notifications 71



70 to 74 years
Total Notifications 47



95 to 99 years
Total Notifications 34



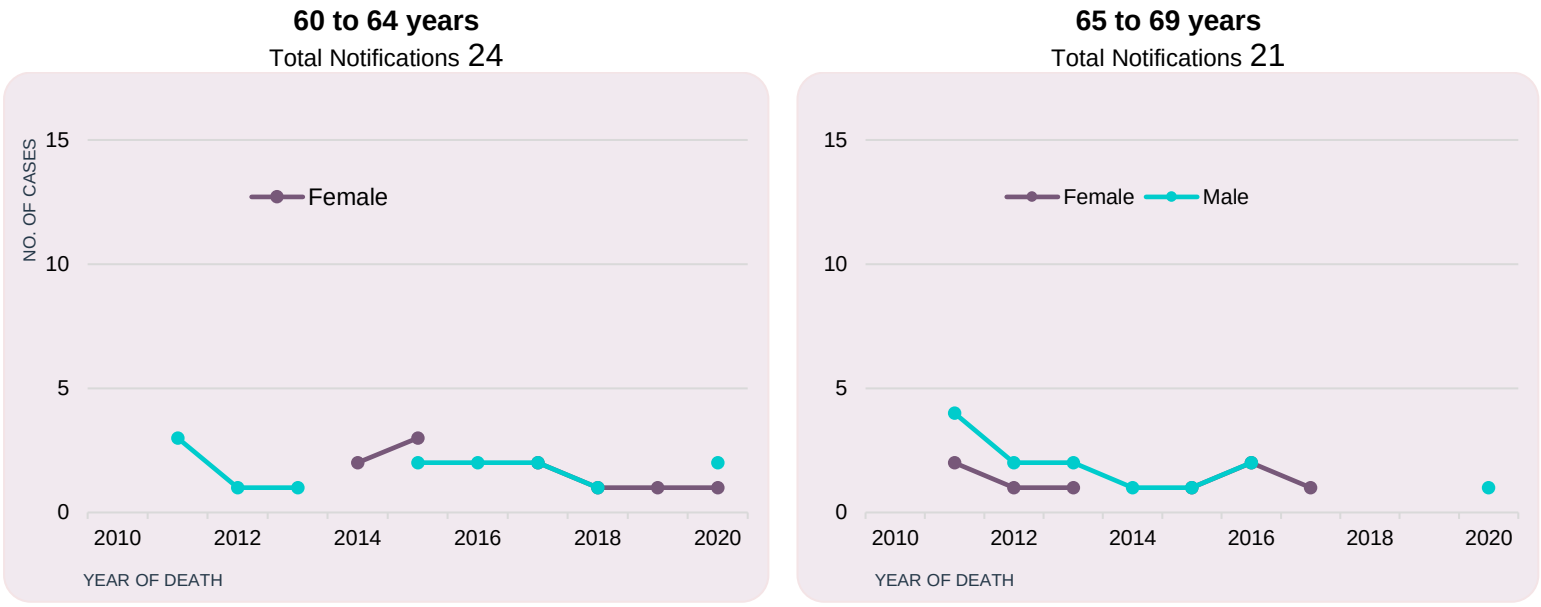


Figure 44: Distribution of the 'Top 8' age bands for anaesthesia-related deaths by gender and calendar year over the 11-year period (2010-2020).

3.20. ASA Physical Status Distribution

Figure 45 below shows the majority of deaths were patients assessed as ASA grade 4 or 5, at 83.7% (n=2,604).

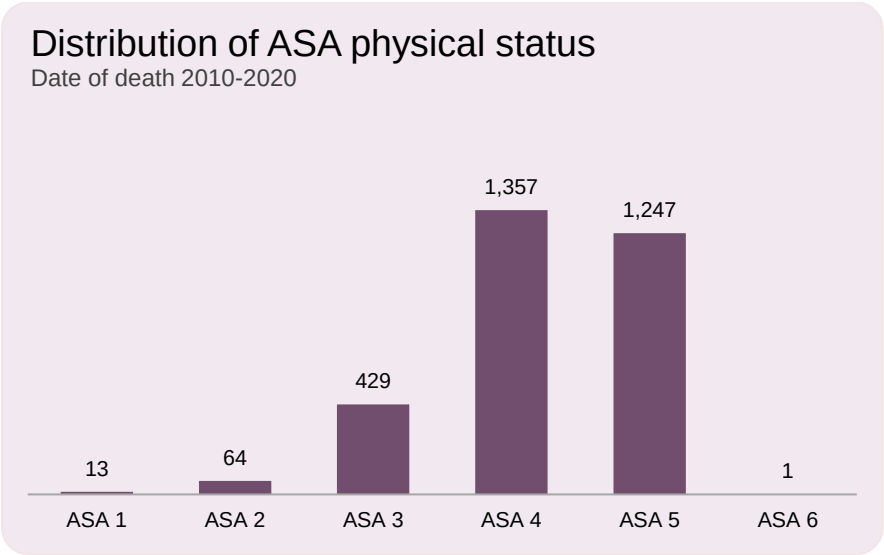


Figure 45: Distribution of ASA physical status (n=3,111) over the 11-year period (2010-2020).

Note: Cases classified as excluded (n=162) are not included in this analysis.

Figure 46 below shows the percentage distribution of ASA against anaesthesia playing a part to death, 2010-2020. 90.06% (n=2,238) of patients where the anaesthesia played no part in the death were assessed as ASA grade 4 or 5.

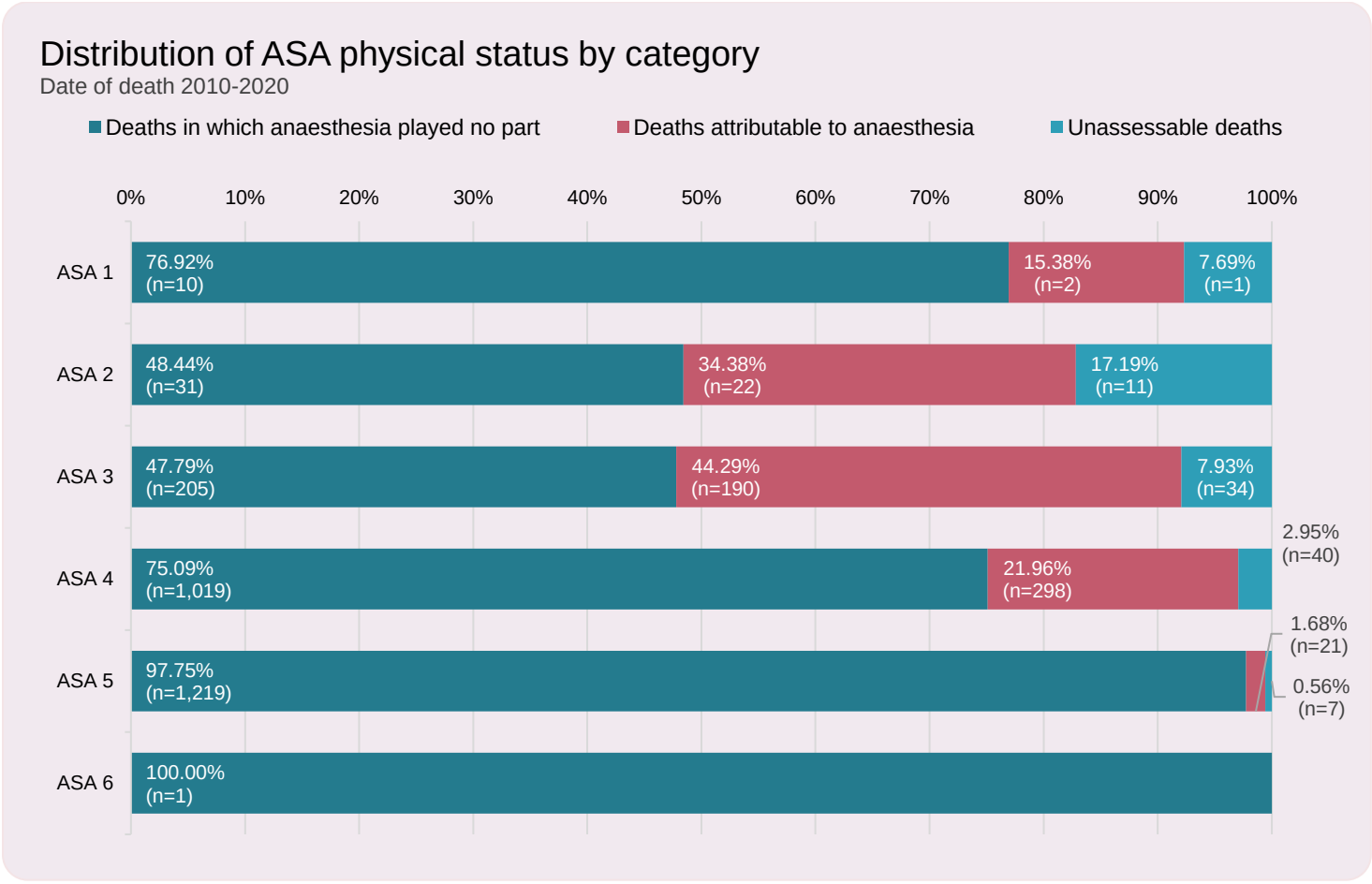


Figure 46: Percentage distribution of category for ASA physical status (n=3,111) over the 11-year period (2010-2020).
Note: Cases classified as excluded (n=162) are not included in this analysis.

Figure 47 below shows that 91.56% (n=488) of the deaths attributable to anaesthesia identified were patients assessed as ASA grade 3 or 4.

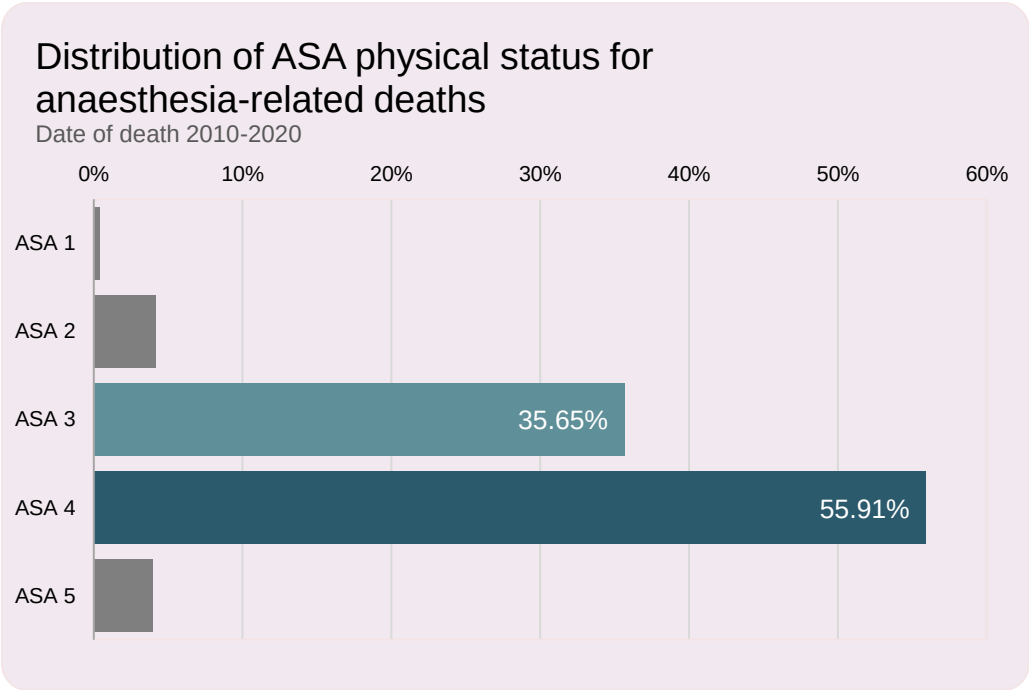
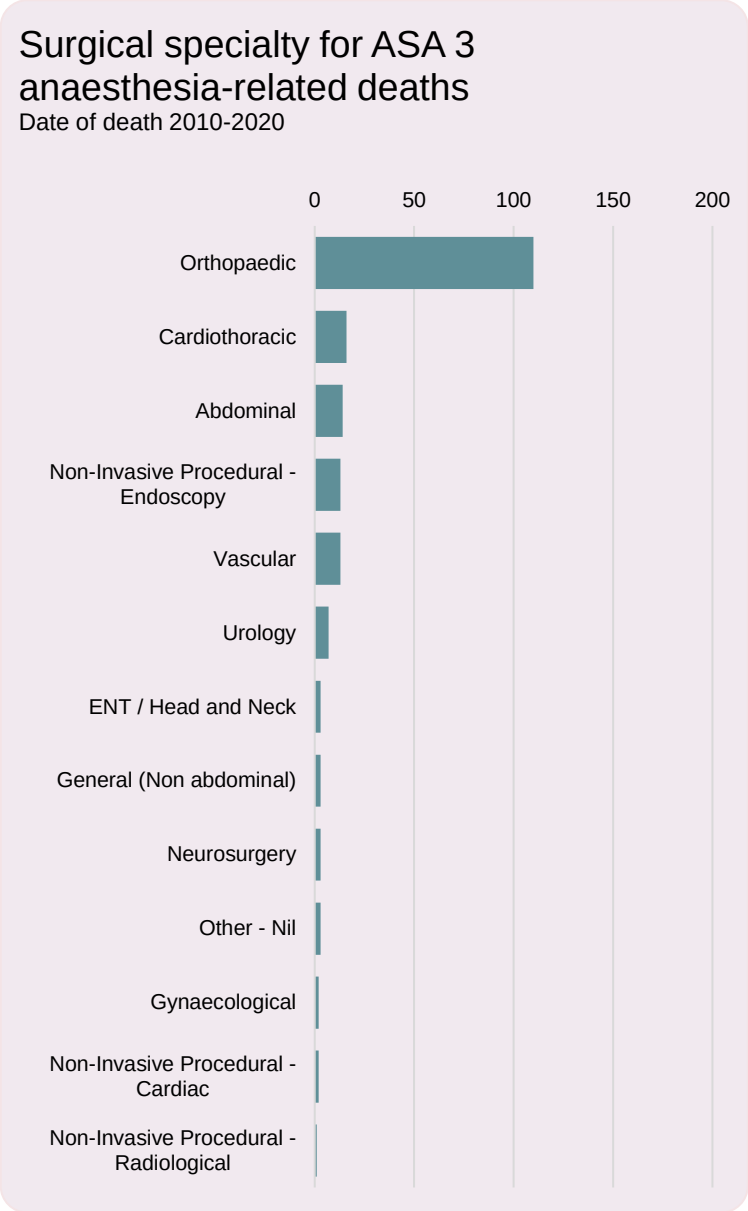
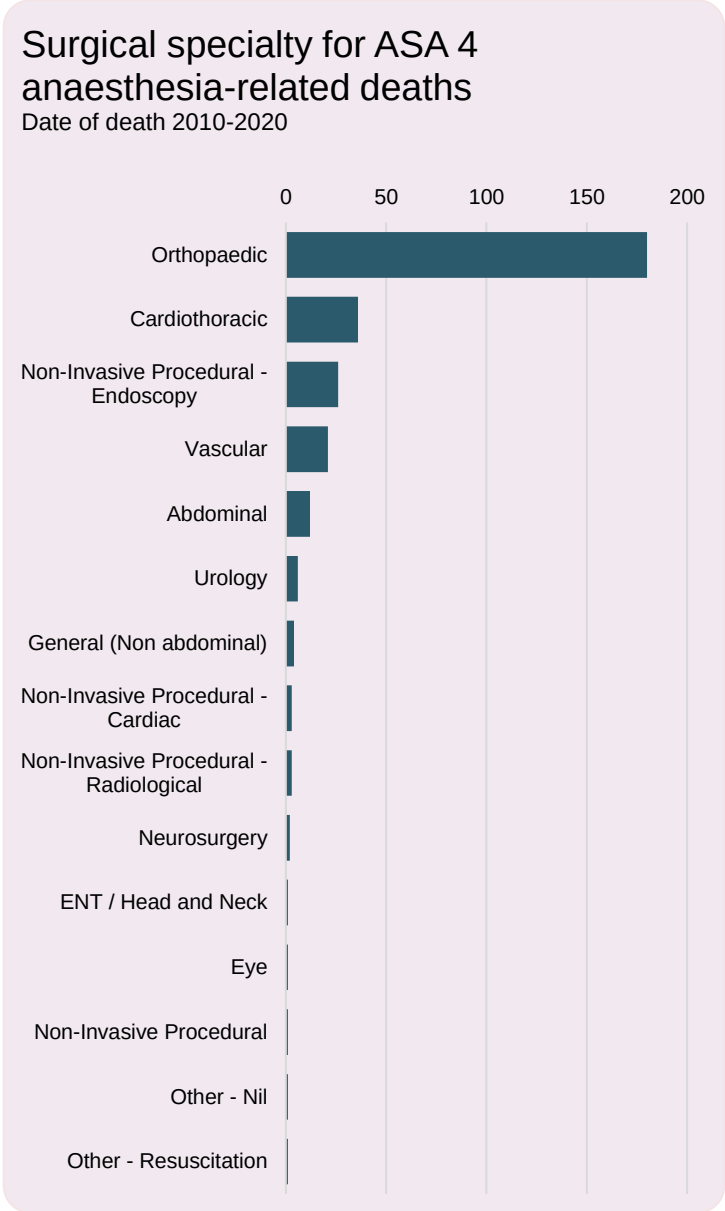


Figure 47: Percentage of anaesthesia-related deaths by ASA over the 11-year period (2010-2020).

Figures 49 and 50 below show the distribution of surgical specialties for the ASA 3 and ASA 4 anaesthesia-related deaths. Over half of the combined ASA 3 and ASA 4 anaesthesia-related deaths occurred in the surgical orthopaedic specialty at 59.43% (n=290).





Figures 48 and 49: Distribution of surgical specialty for ASA physical status 3 (n=190) and ASA physical status 4 (n=298) for anaesthesia-related deaths over the 11-year period (2010-2020).

Figure 50 below shows the highest number of ASA 4 anaesthesia-related deaths occurred in 2014 (n=38), while the highest for ASA 3 occurred in 2011 (n=26).

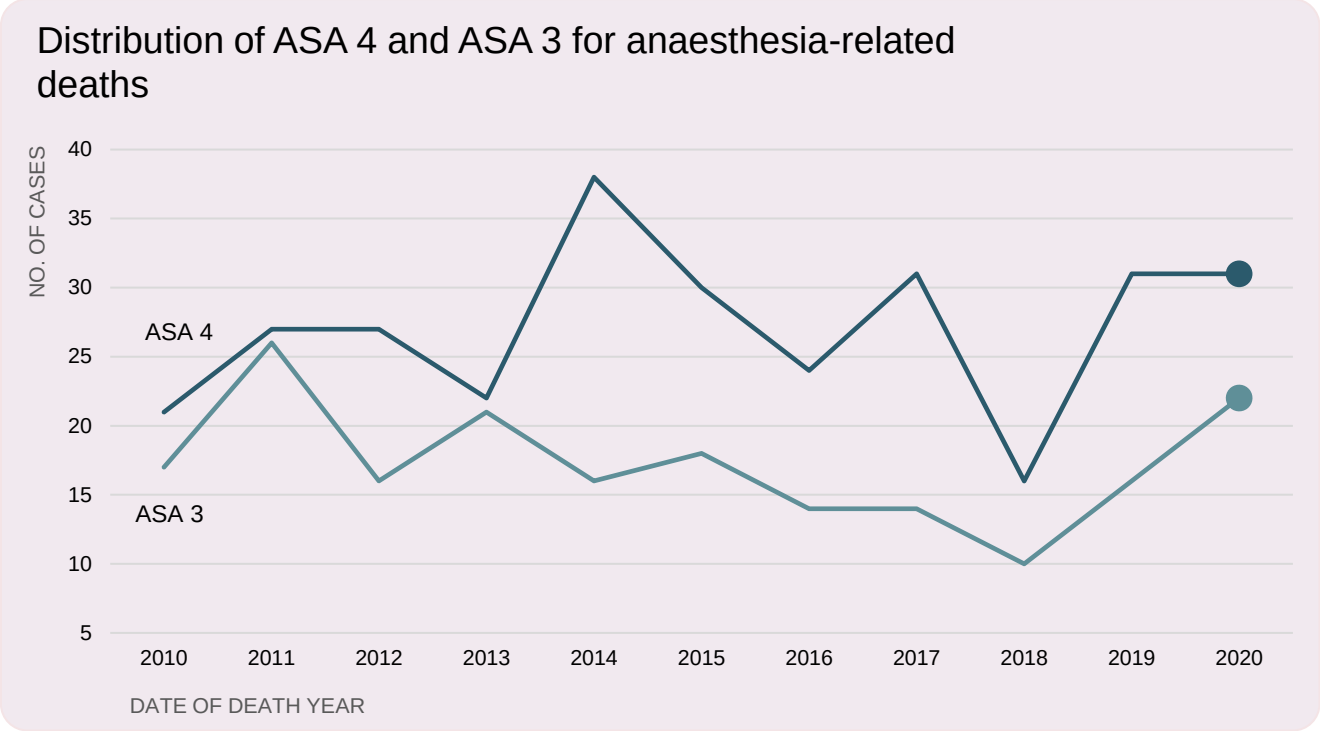


Figure 50: ASA 4 and 3 status (n=488) for anaesthesia-related deaths over the 11-year period (2010-2020).

3.21. Grade of Anaesthetist

Figure 51 below shows that of the 533 anaesthesia-related deaths identified, 91.37% of anaesthesia was administered by a specialist.

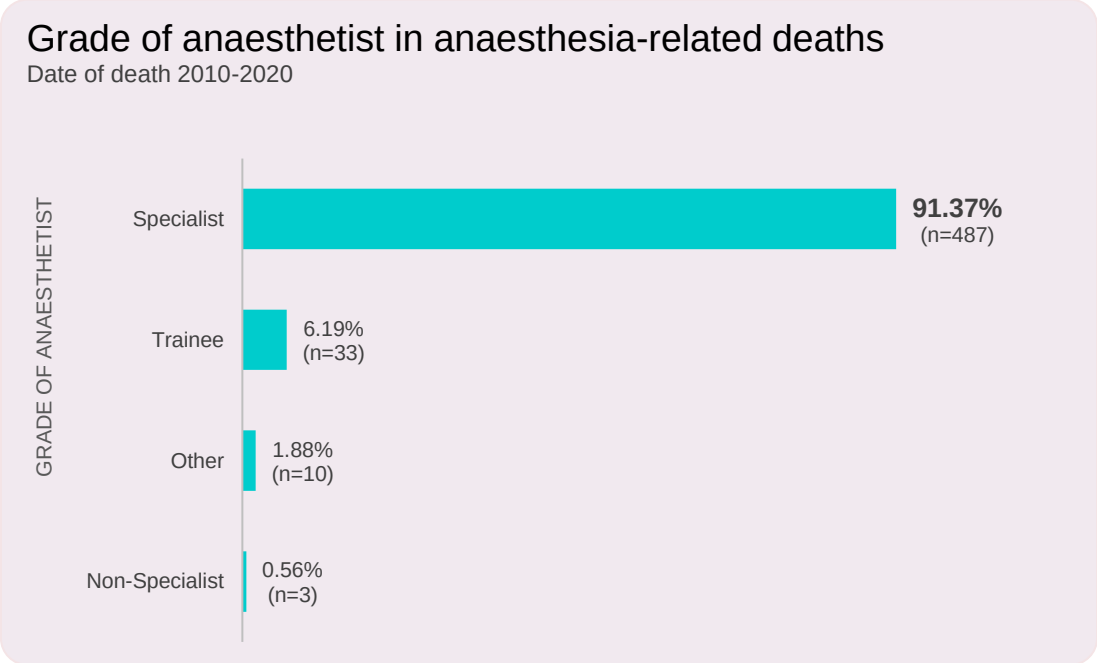


Figure 51: Distribution of anaesthetist grade for anaesthesia-related deaths (n=533) over the 11-year period (2010-2020).

Figure 52 below shows the distribution by year for anaesthetic specialists and anaesthesia-related deaths, 2010–2020. The decrease in the numbers in 2016 and 2018 is reflective of a smaller number of notifications being classified as anaesthesia-related deaths compared with other years.

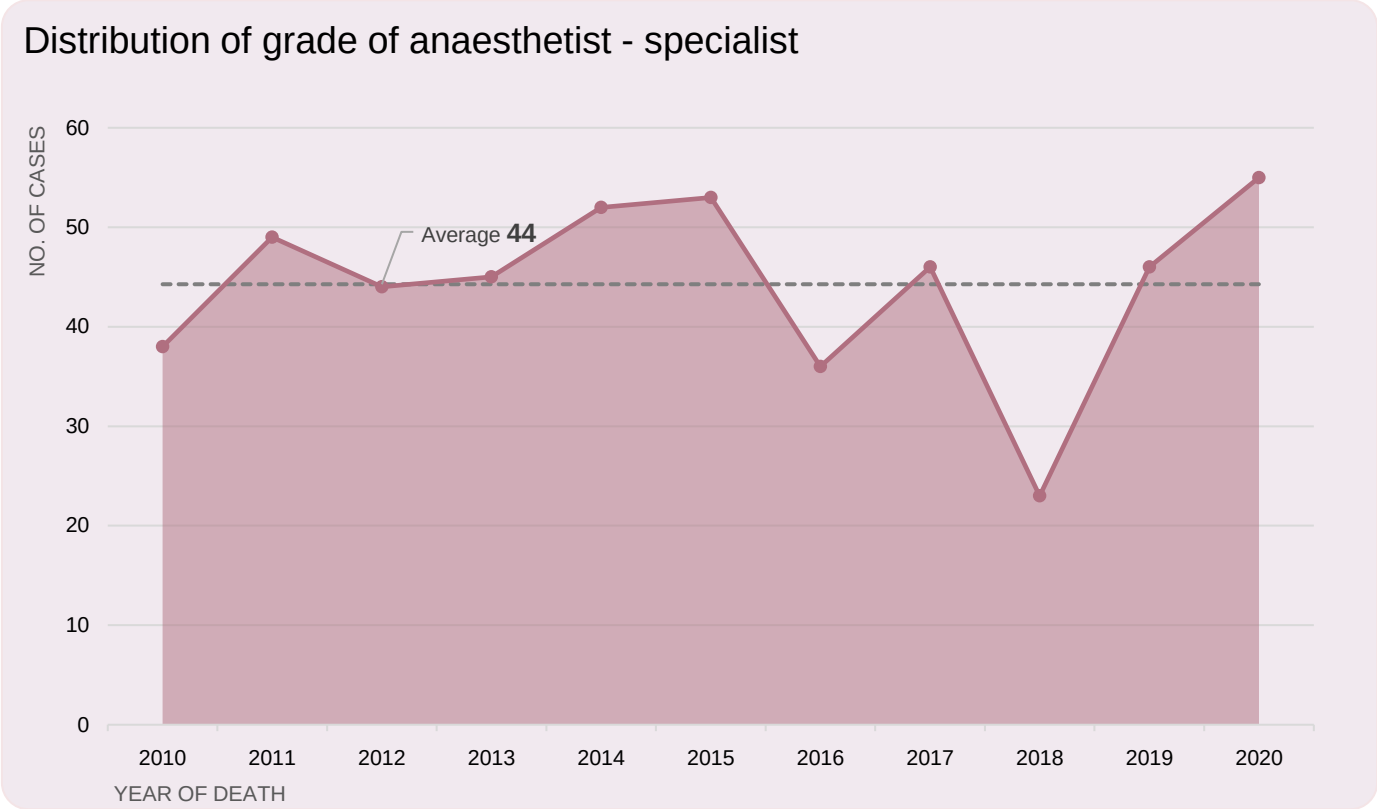


Figure 52: Distribution by year for specialist in anaesthesia-related deaths (n=487) over the 11-year period (2010-2020).

3.22. Sedation Deaths

Over the 11-year period 2010-2020, sedation only was administered in 192 patients of which 67.19% (n=129) was administered by an anaesthetic specialist. Figure 53 below shows that between 2016 to 2020 there was a steady above the average (n=13) increase in sedation only deaths in which anaesthesia played no part. There was an increase in anaesthesia-related deaths in 2020 (n=6) above the average (n=2).

Of the sedation deaths, 62.92% (n=112) were male patients with a median age of 68.5 years, and female patients (n=66) had median age of 75.5 years.

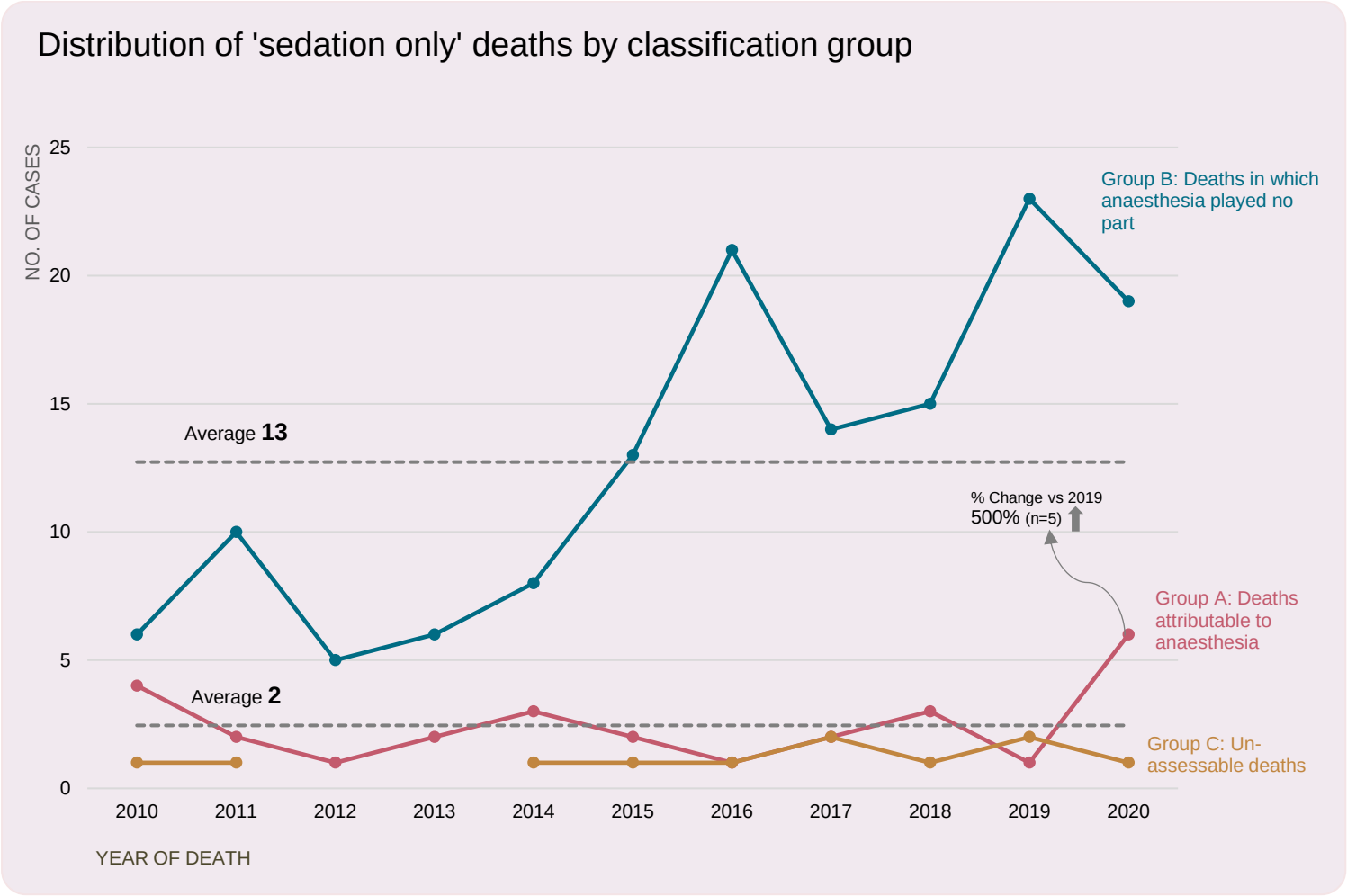


Figure 53: Distribution by category and calendar year for sedation only deaths (n=192) over the 11-year period (2010-2020).

Note: Cases classified as excluded (n=14) are not included in this analysis.

Figure 54 below shows that for the sedation only deaths, the most frequent surgery type was non-invasive surgery (cardiac, endoscopy, radiological) representing 68.75% of the total (n=132). In sedation deaths attributable to anaesthesia, the majority of the patients involved non-invasive procedural - endoscopy (n=18).

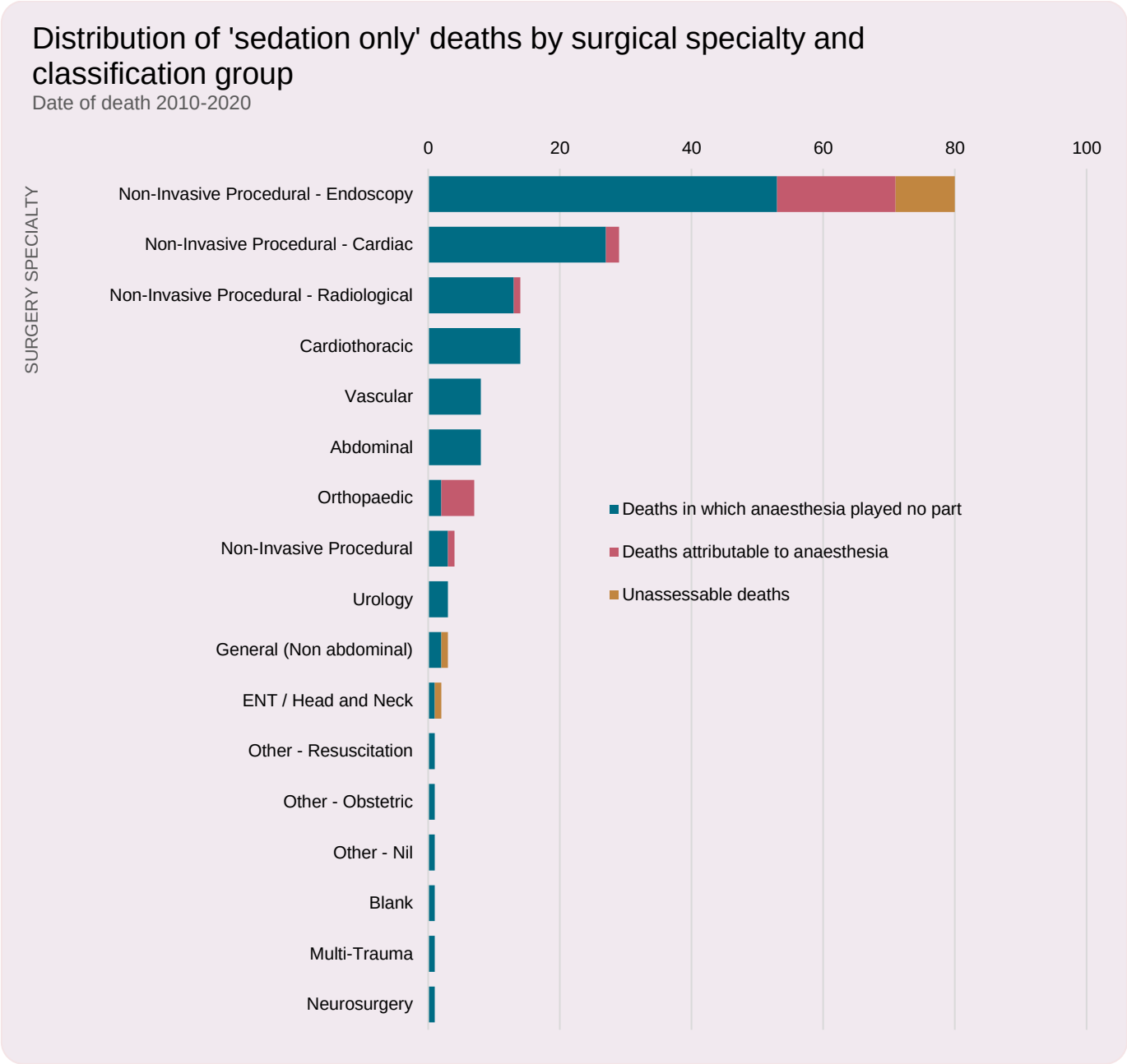


Figure 54: Distribution by surgical specialty and category for sedation only deaths (n=192) over the 11-year period (2010-2020).

Note: Cases classified as excluded (n=14) are not included in this analysis.

3.23. Location of Death

For the period 2010-2020, 63.31% (n=1,967) of deaths occurred in the intensive care units (ICU) or high dependency units (HDU) and 21.05% (n=654) are in the operating theatre or procedural room. 0.13% (n=4) of notifications did not specify location of death. Figure 55 below shows the locations of death 2010-2020.

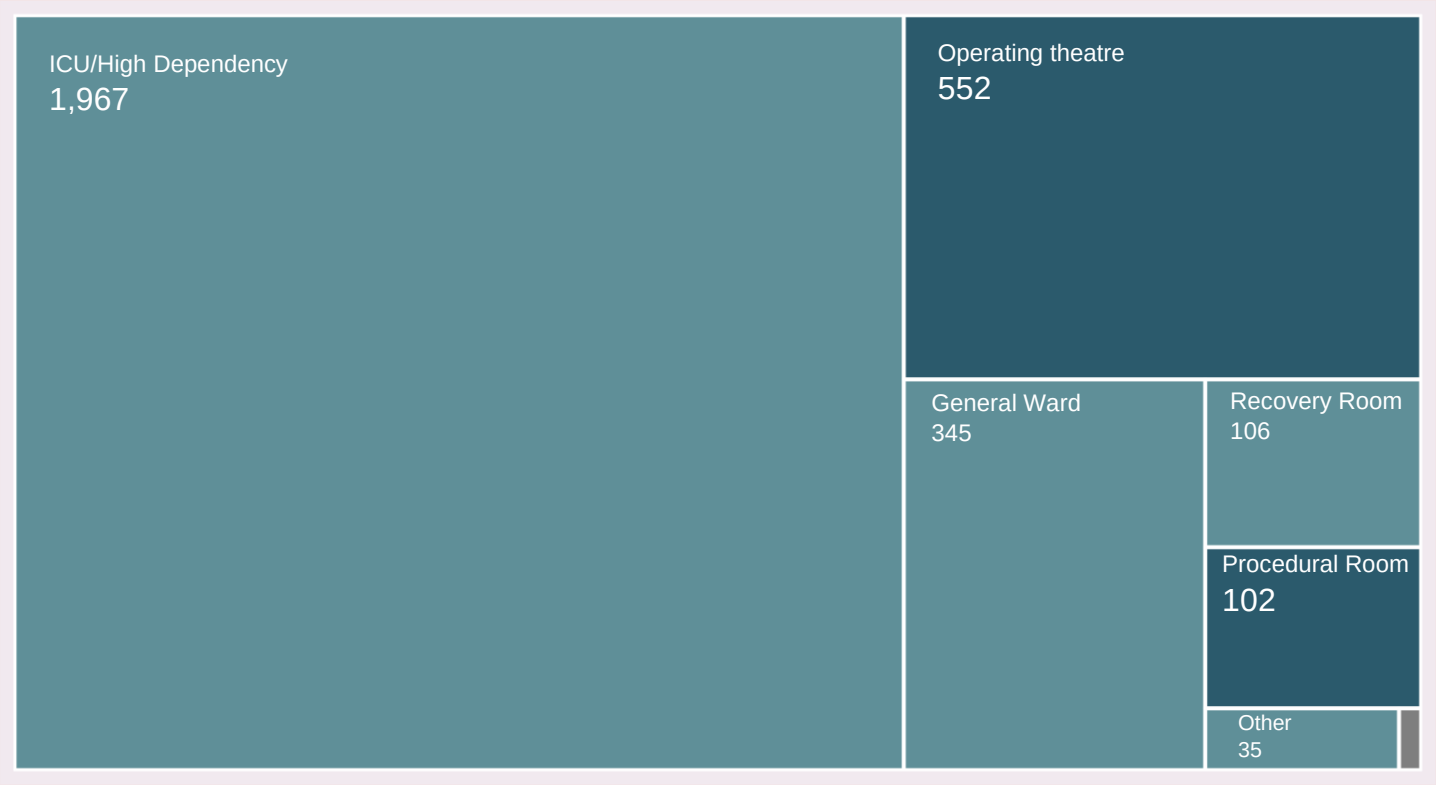


Figure 55: Distribution of location of death (n=3,111) over the 11-year period (2010-2020).

Note: Cases classified as excluded (n=162) are not included in this analysis.

Further review of the location of death and ASA status identified the majority of anaesthesia-related deaths that occurred in the intensive care units (ICU) or high dependency units (HDU) and operating theatre or procedural room were patients assessed as ASA grade 4 or ASA 3, as shown in Figure 56 below.

More than 55% of anaesthesia-related deaths that occurred in the intensive care units (ICU) or high dependency units (HDU) and operating theatre or procedural room were non-emergency surgery.

The median age of female patients for anaesthesia-related deaths that occurred in the intensive care units (ICU) or high dependency units (HDU) is 77 and male is 72.5 years.

The median age of female patients for anaesthesia-related deaths that occurred in the operating theatre or procedural room is 79 and male is 74 years.

Of the 134 anaesthesia-related deaths that occurred in the operating theatre or procedural room there were 56 trauma deaths.

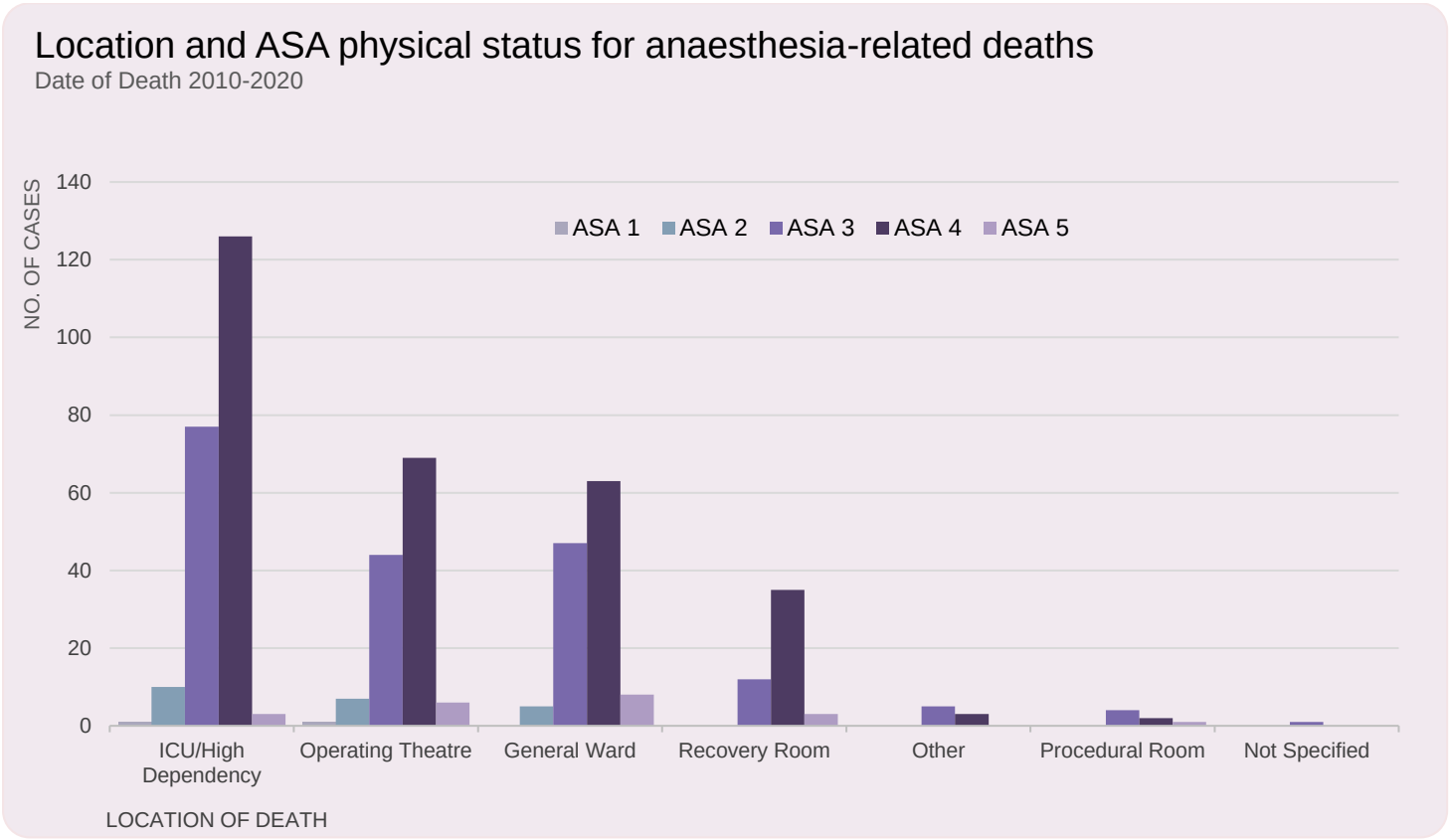


Figure 56: Distribution of location of death and ASA physical status for anaesthesia-related deaths (n=533) over the 11-year period (2010-2020).

Figure 57 below shows that, on average over the 2010-2020 period, 25% of anaesthesia-related deaths had occurred directly in the operating theatre or procedural room. The lowest number occurring in 2018 (14%; n=4) and 2019 (9%; n=5).

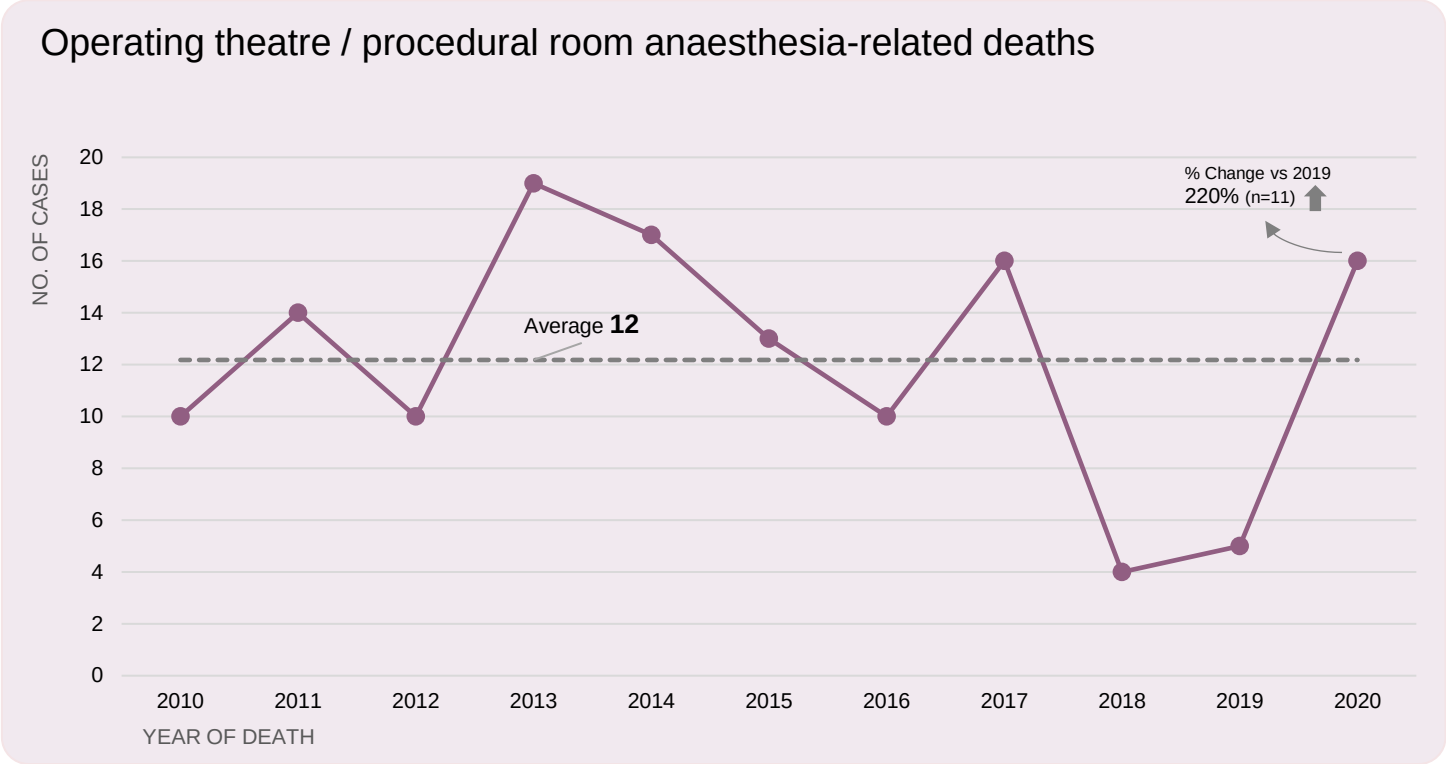


Figure 57: Distribution of operating theatre or procedural room anaesthesia-related deaths (n=134) over the 11-year period (2010-2020).

3.24. Hospital Level

Over the 2010-2020 period, 60.98% (n=1,897) of deaths occurred in Hospital Level 6, with the majority of these concerning emergency surgery (n=1,357). Figure 58 below shows the distribution of anaesthetic-related deaths across the hospital role delineation levels.

For anaesthesia-related deaths, 44.47% (n=237) occurred in Level 6 hospitals with the majority (n=203) accessed as Category 3 deaths. 31.33% (n=167) occurred in Level 5 hospitals, of which 116 were 'urgent non-emergency' surgeries.

'Urgent non-emergency surgery' accounted for the majority of Level 6 (n=64.14%; n=152) and Level 5 (69.46% n=116) anaesthesia-related deaths, with most cases continuing to be orthopaedic surgeries.

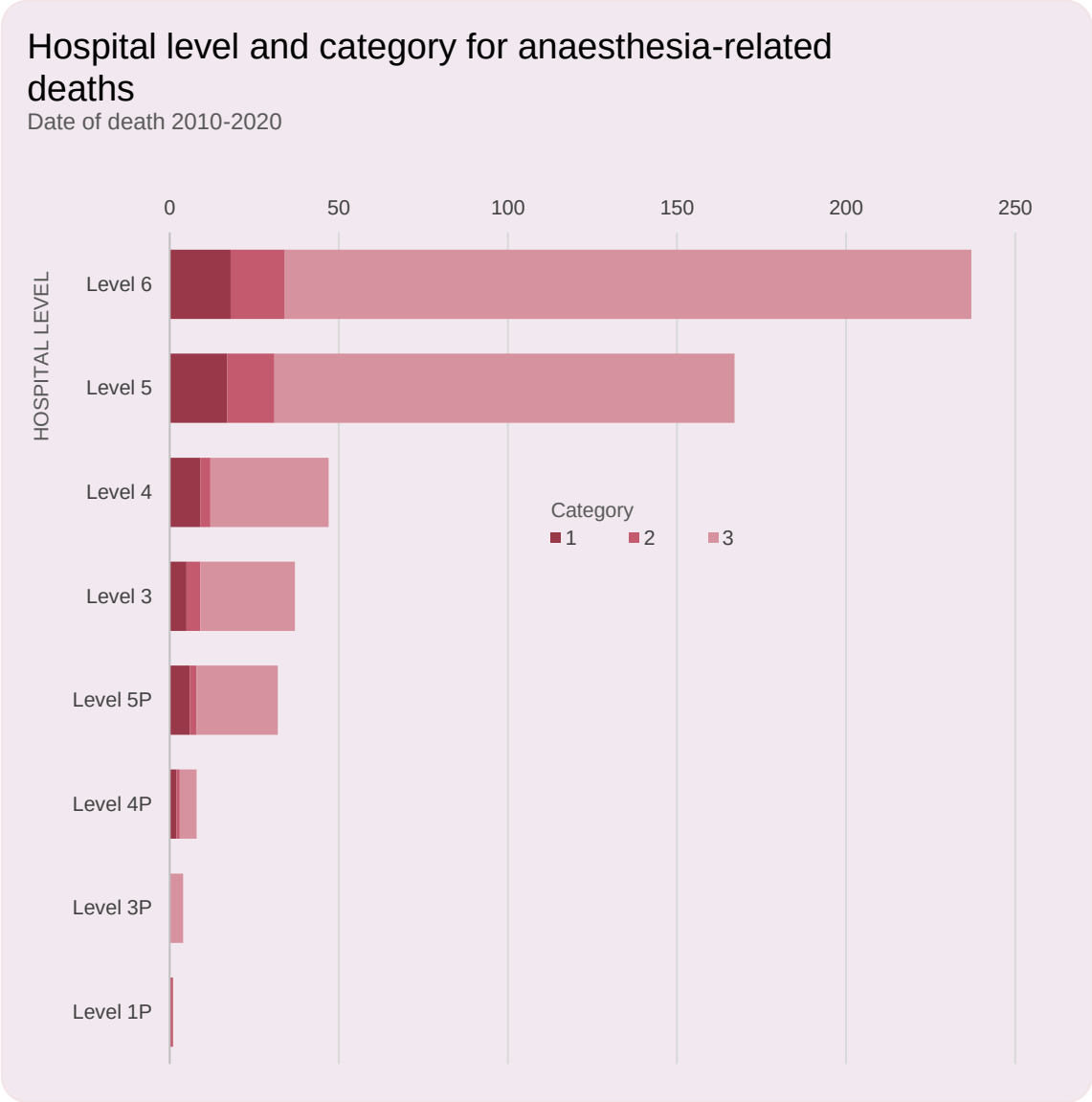


Figure 58: Distribution of hospital level and category for anaesthesia-related deaths (n=533) over the 11-year period (2010-2020).

The lowest number of anaesthesia-related deaths were notified to SCIDUA in 2018. The highest number of hospital Level 5 notifications occurred in 2019 (n=22), and in 2015 for hospital Level 6.

52.91% (n=282) of anaesthesia-related deaths occurred in metropolitan public teaching hospitals. These hospital types and levels typically perform higher volumes of complicated and emergency surgeries.

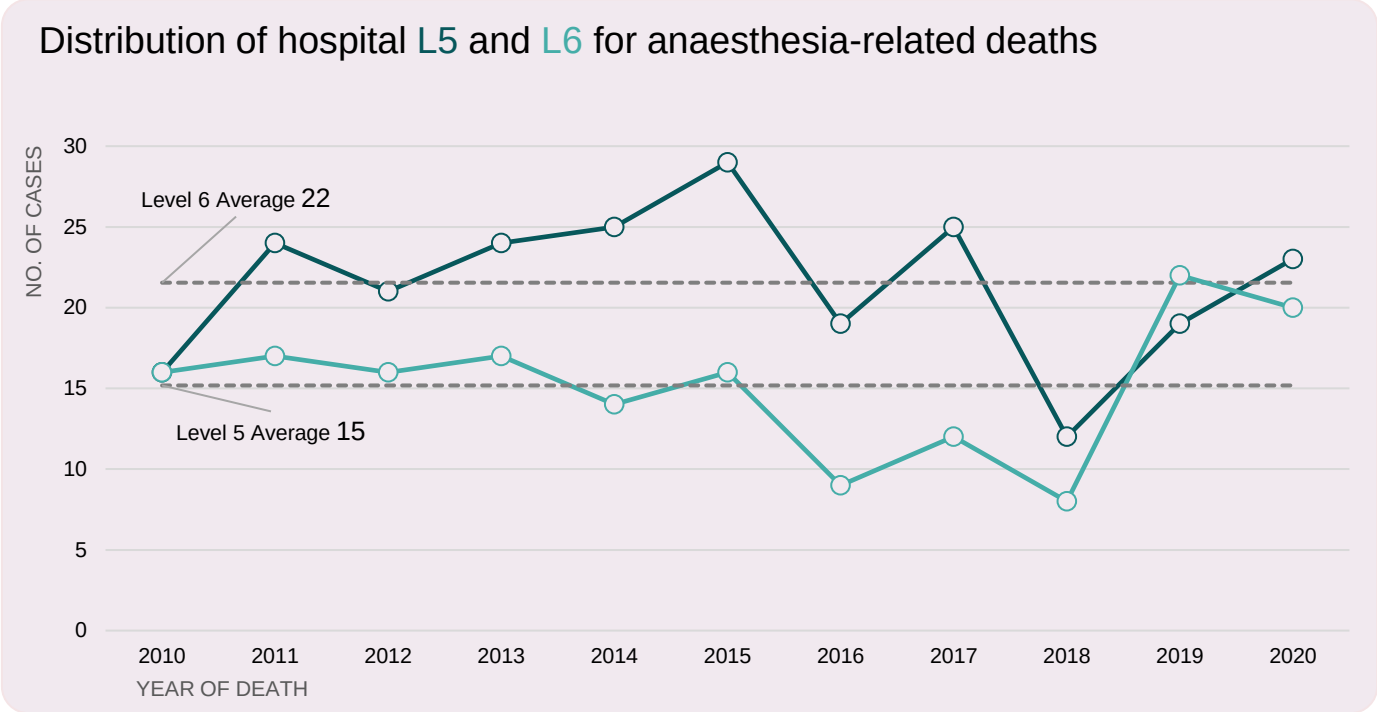


Figure 59: Distribution of hospital levels 6 and 5 for anaesthesia-related deaths (n=404) over the 11-year period (2010-2020).

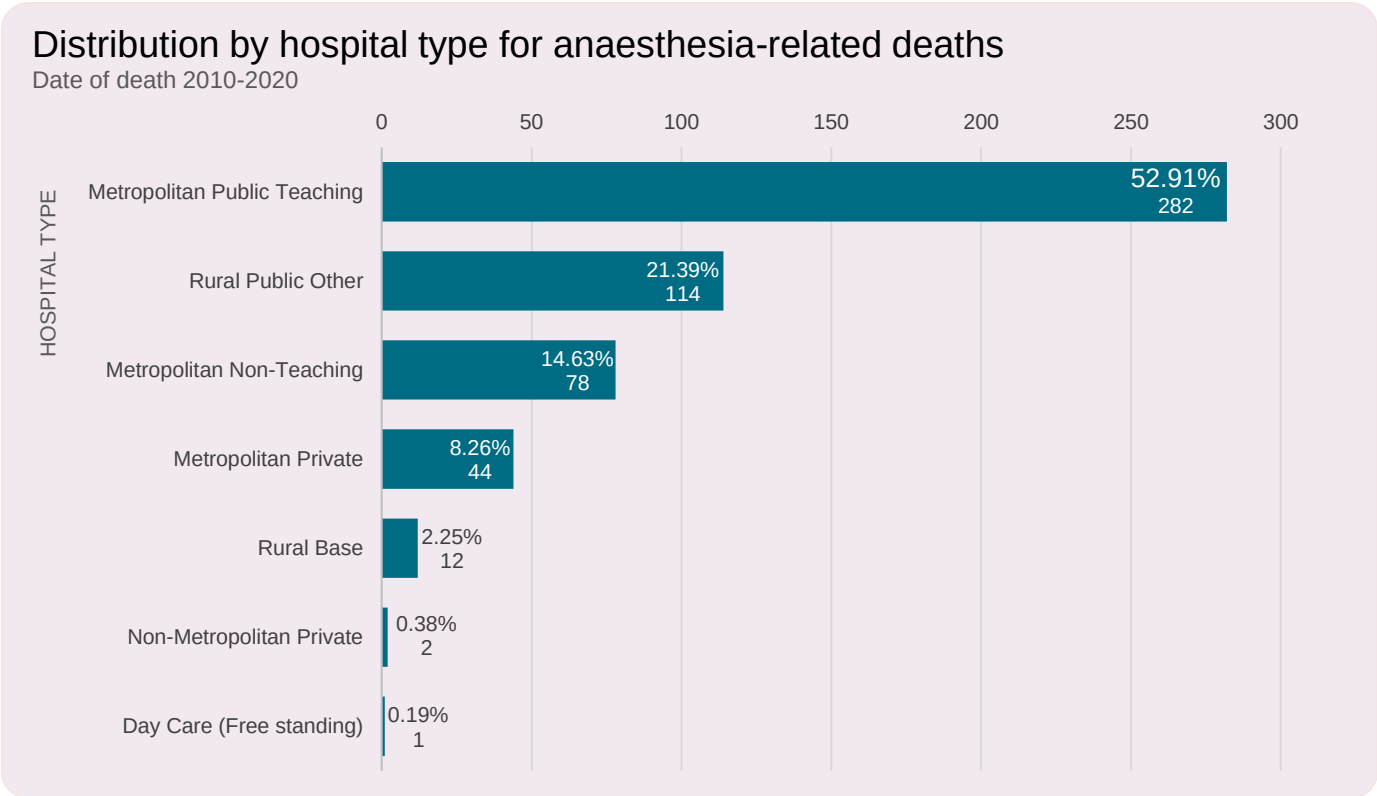


Figure 60: Distribution of hospital type for anaesthesia-related deaths (n=533) over the 11-year period (2010-2020).

ANZCA SAFETY ALERT

The Australian and New Zealand College of Anaesthetists notifies its members on safety, quality, and supply issues affecting the medicines and medical devices used. An ANZCA safety alert was issued following the death of a patient from a suspected venous air embolism, after consultation with SCIDUA.

Air embolism is a recognised phenomenon occurring during endoscopic procedures. In New South Wales, various hospital endoscopy units are set up differently with some using cylinders for their gas supply, and some using pendants. It is not uncommon to find that endoscopy units still have the ability to use air for their procedures.

In one particular case the use of air was not accidental. It is what is used for ERCPs at that particular institution. However, since the review of the death, the multi-disciplinary surgical team determined that the standardised use of CO_2 for ERCPs was required, and the change management process to implement this has been finalised.

ANZCA safety alert link: https://www.anzca.edu.au/safety-advocacy/safety-alerts/co2-insufflation-in-endoscopy-reduces-risk-of-gas

CO_2 insufflation in endoscopy reduces risk of gas embolism

ANZCA has been alerted to the death of a person from a suspected venous air embolism sustained during an endoscopic retrograde cholangiopancreatography (ERCP) procedure, in which air rather than CO_2 had been used for insufflation.

Hospital endoscopy units may be set up to use air for insufflation in gastrointestinal endoscopy procedures. Evidence suggests using CO_2 instead of air for insufflation reduces the risk of embolism, as CO_2 is more readily absorbed. For a number of endoscopy procedures, CO_2 is also associated with reduced postprocedural pain and less abdominal distension.

ANZCA advises that fellows be aware when air insufflation is in use in endoscopy procedures. Maintain a high index of clinical suspicion of gas embolism if there is any abrupt change in vital signs or neurological status during or after the procedure, as aggressive treatment is needed to avoid a fatal outcome.

Further reading on diagnosis and management of air embolism during endoscopy and/or ERCP is below:

- Basavana G, Saumoy M. Anesthesia for Advanced Endoscopic Procedures. Clin Endosc 2022; 55(1): 1-7. DOI: https://doi.org/10.5946/ce.2021.236
- Lanke G, Adler DG. Gas embolism during endoscopic retrograde cholangiopancreatography: diagnosis and management. Ann Gastroenterol. 2019;32(2):156-167. doi: 10.20524/aog.2018.0339

APPENDICES

TABLES

IMAGES

FIGURES

Appendix A - ASA Physical Status Classification System

American Society of Anesthesiologists®

ASA Physical Status Classification System

Committee of Oversight: Economics

(Approved by the ASA House of Delegates on October 15, 2014, and last amended on December 13, 2020)

The ASA Physical Status Classification System has been in use for over 60 years. The purpose of the system is to assess and communicate a patient's pre-anesthesia medical co-morbidities. The classification system alone does not predict the perioperative risks, but used with other factors (eg, type of surgery, frailty, level of deconditioning), it can be helpful in predicting perioperative risks.

The definitions and examples shown in the table below are guidelines for the clinician. To improve communication and assessments at a specific institution, anesthesiology departments may choose to develop institutional-specific examples to supplement the ASA-approved examples.

Assigning a Physical Status classification level is a clinical decision based on multiple factors. While the Physical Status classification may initially be determined at various times during the preoperative assessment of the patient, the final assignment of Physical Status classification is made on the day of anesthesia care by the anesthesiologist after evaluating the patient.

Current Definitions and ASA-Approved Examples

ASA PS Classification	Definition	Adult Examples, Including, but not Limited to:	Pediatric Examples, Including but not Limited to:	Obstetric Examples, Including but not Limited to:
ASA I	A normal healthy patient	Healthy, non-smoking, no or minimal alcohol use	Healthy (no acute or chronic disease), normal BMI percentile for age	
ASA II	A patient with mild systemic disease	Mild diseases only without substantive functional limitations. Current smoker, social alcohol drinker, pregnancy, obesity (30<BMI<40), well-controlled DM/HTN, mild lung disease	Asymptomatic congenital cardiac disease, well controlled dysrhythmias, asthma without exacerbation, well controlled epilepsy, non-insulin dependent diabetes mellitus, abnormal BMI percentile for age,	Normal pregnancy*, well controlled gestational HTN, controlled preeclampsia without severe features, diet-controlled gestational DM.

			mild/moderate OSA, oncologic state in remission, autism with mild limitations	
ASA III	A patient with severe systemic disease	Substantive functional limitations; One or more moderate to severe diseases. Poorly controlled DM or HTN, COPD, morbid obesity (BMI ≥40), active hepatitis, alcohol dependence or abuse, implanted pacemaker, moderate reduction of ejection fraction, ESRD undergoing regularly scheduled dialysis, history (>3 months) of MI, CVA, TIA, or CAD/stents.	Uncorrected stable congenital cardiac abnormality, asthma with exacerbation, poorly controlled epilepsy, insulin dependent diabetes mellitus, morbid obesity, malnutrition, severe OSA, oncologic state, renal failure, muscular dystrophy, cystic fibrosis, history of organ transplantation, brain/spinal cord malformation, symptomatic hydrocephalus, premature infant PCA <60 weeks, autism with severe limitations, metabolic disease, difficult airway, long term parenteral nutrition. Full term infants <6 weeks of age.	Preeclampsia with severe features, gestational DM with complications or high insulin requirements, a thrombophilic disease requiring anticoagulation.
ASA IV	A patient with severe systemic disease	Recent (<3 months) MI, CVA, TIA or CAD/stents, ongoing cardiac ischemia or severe	Symptomatic congenital cardiac abnormality, congestive heart	Preeclampsia with severe features complicated by HELLP or other adverse event, peripartum cardiomyopathy with EF

	that is a constant threat to life	valve dysfunction, severe reduction of ejection fraction, shock, sepsis, DIC, ARD or ESRD not undergoing regularly scheduled dialysis	failure, active sequelae of prematurity, acute hypoxic-ischemic encephalopathy, shock, sepsis, disseminated intravascular coagulation, automatic implantable cardioverter-defibrillator, ventilator dependence, endocrinopathy, severe trauma, severe respiratory distress, advanced oncologic state.	<40, uncorrected/decompensated heart disease, acquired or congenital.
ASA V	A moribund patient who is not expected to survive without the operation	Ruptured abdominal/thoracic aneurysm, massive trauma, intracranial bleed with mass effect, ischemic bowel in the face of significant cardiac pathology or multiple organ/system dysfunction	Massive trauma, intracranial hemorrhage with mass effect, patient requiring ECMO, respiratory failure or arrest, malignant hypertension, decompensated congestive heart failure, hepatic encephalopathy, ischemic bowel or multiple organ/system dysfunction.	Uterine rupture.
ASA VI	A declared brain-dead patient whose organs			

	are being removed for donor purposes			

** Although pregnancy is not a disease, the parturient' s physiologic state is significantly altered from when the woman is not pregnant, hence the assignment of ASA 2 for a woman with uncomplicated pregnancy.*
***The addition of "E" denotes Emergency surgery: (An emergency is defined as existing when delay in treatment of the patient would lead to a significant increase in the threat to life or body part)*

References

For more information on the ASA Physical Status Classification system and the use of examples, the following publications are helpful. Additionally, in the reference section of each of the articles, one can find additional publications on this topic.

1. Abouleish AE, Leib ML, Cohen NH. ASA provides examples to each ASA physical status class. *ASA Monitor* 2015; 79:38-9 http://monitor.pubs.asahq.org/article.aspx?articleid=2434536

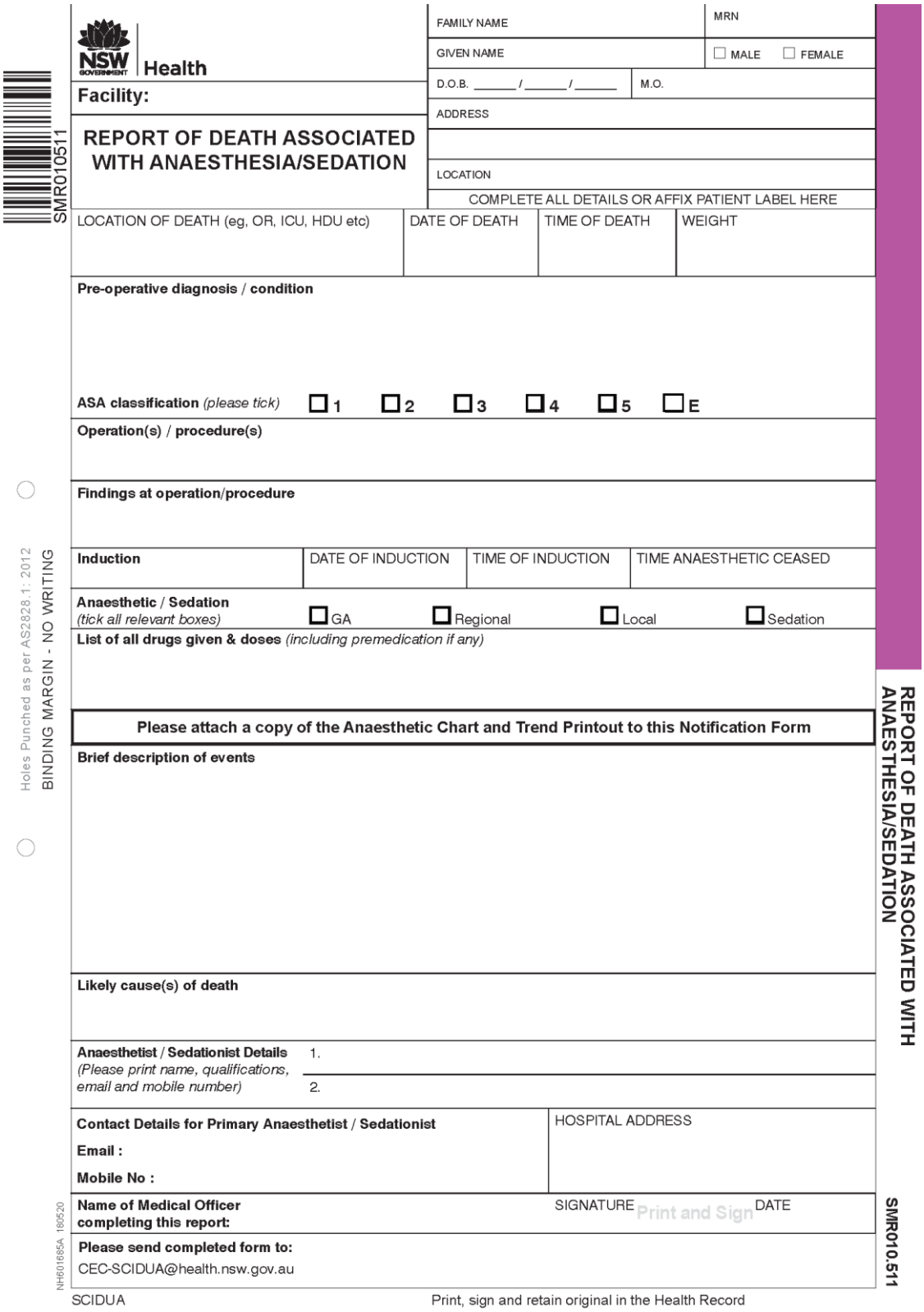
2. Hurwitz EE, Simon M, Vinta SR, et al. Adding examples to the ASA-Physical Status classification improves correct assignments to patients. *Anesthesiology* 2017; 126:614-22

3. Mayhew D, Mendonca V, Murthy BVS. A review of ASA physical status – historical perspectives and modern developments. Anaesthesia 2019; 74:373-9

4. Leahy I, Berry JG, Johnson C, Crofton C, Staffa S, Ferrari LR. Does the Current ASA Physical Status Classification Represent the Chronic Disease Burden in Children Undergoing General Anesthesia? Anesthesia & Analgesia, October 2019;129(4):1175-1180

5. Ferrari L, Leahy I, Staffa S, Johnson C, Crofton C, Methot C, Berry J. One Size Does Not Fit All: A Perspective on the American Society of Anesthesiologists Physical Status Classification for Pediatric Patients. Anesthesia & Analgesia, June 2020;130(6):1685-1692
6. Ferrari LR, Leahy I, Staffa SJ, Berry JG. The Pediatric Specific American Society of Anesthesiologists Physical Status Score: A Multi-center Study. Anesthesia & Analgesia 2020 (in press)

Appendix B – Notification Form - Report of Death



NSW GOVERNMENT Health

Facility:

REPORT OF DEATH ASSOCIATED WITH ANAESTHESIA/SEDATION

SMR010511

FAMILY NAME | MRN

GIVEN NAME | ☐ MALE ☐ FEMALE

D.O.B. _____ / _____ / _____ | M.O.

ADDRESS

LOCATION

COMPLETE ALL DETAILS OR AFFIX PATIENT LABEL HERE

LOCATION OF DEATH (eg, OR, ICU, HDU etc)	DATE OF DEATH	TIME OF DEATH	WEIGHT

Pre-operative diagnosis / condition

ASA classification *(please tick)* ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ E

Operation(s) / procedure(s)

Findings at operation/procedure

Induction	DATE OF INDUCTION	TIME OF INDUCTION	TIME ANAESTHETIC CEASED

Anaesthetic / Sedation *(tick all relevant boxes)* ☐ GA ☐ Regional ☐ Local ☐ Sedation

List of all drugs given & doses *(including premedication if any)*

Please attach a copy of the Anaesthetic Chart and Trend Printout to this Notification Form

Brief description of events

Likely cause(s) of death

Anaesthetist / Sedationist Details *(Please print name, qualifications, email and mobile number)*
1.
2.

Contact Details for Primary Anaesthetist / Sedationist
Email :
Mobile No :

HOSPITAL ADDRESS

Name of Medical Officer completing this report: SIGNATURE Print and Sign DATE

Please send completed form to:
CEC-SCIDUA@health.nsw.gov.au

SCIDUA

Print, sign and retain original in the Health Record

Holes Punched as per AS2828.1: 2012 BINDING MARGIN - NO WRITING

NH601685A 180520

REPORT OF DEATH ASSOCIATED WITH ANAESTHESIA/SEDATION SMR010.511

Appendix C – Questionnaire in association with Sedation and/or Anaesthesia

SPECIAL COMMITTEE INVESTIGATING DEATHS UNDER ANAESTHESIA

PRIVATE & CONFIDENTIAL REPORT

This document is designed for the purposes of SCIDUA and the information collected is privileged under Section 23 of the NSW Heath Administration Act 1982

Questionnaire: Death in Association with Anaesthesia/Sedation

Reporting cases to regional or national anaesthesia mortality committees qualifies for two (2) credit points per hour with the ANZCA Continuing Professional Development program.

PLEASE RETURN THIS QUESTIONNAIRE TO:

CEC-SCIDUA@health.nsw.gov.au

Case Number *(office use only)* «caseID»	**Hospital & Location** *(eg. ICU; Theatre; Recovery; Ward)* «FacName», «Location»		**Date & Time of Death** «deathDate» at «DeathTime»	
Name of Patient «firstName» «lastName»		**Age** «age»	**Sex** «Gender»	**Weight** «weight» kg
Name of Anaesthetist/Sedationist Dr «An1Firstname» «An1LastName»		**Qualifications** «Anaesthetist2_Quals»	**Appointment** «Anaesthetist1_Position»	
Name and appointment of other Anaesthetists present	«AnaesthetistId2» «Anaesthetist2_Quals», «Anaesthetist2_Position»			
Pre-operative diagnosis/condition	«PreOpDiagnosisCondition»			
Operation(s) / procedure(s)	«SurgeryOpProcedureDone»			
Findings at operation/procedure	«SurgeryFindingAtOpProcedure»			
Pre-anaesthetic assessment, including:				
1. Relevant history 2. Clinical findings 3. Relevant investigations				
Pre-anaesthetic preparation, including:				
1. Blood or fluids given pre-operatively and over what period 2. Pre-medication if any 3. Any other measures				
Likely cause of death	«QuestionLikelyCauseDeath»			
Opinion on the cause of death (if different from above)				

PLEASE SEE OVER

DESCRIPTION OF ANAESTHETIC GIVEN

Times may be of considerable importance. Please use 24-hour clock. Please include in your description:

1. Anaesthesia	2. Intra-operative Course	3. Other Information
· Drugs given & doses · Airway and ventilation management · Breathing circuit · T-wave inversion inferior monitoring techniques (SpO_2, ECG, invasive or non-invasive BP monitoring).	· Blood/fluid given · Please include intra-operative & observations · Critical events and their management (eg. hypotension or hypoxia) · Post-operative management plan	· Adjunct techniques · Positioning · Post-operative course & events leading to death

[Please use as much space for this section as you feel necessary]

TIME	DATE

If not already provided, please attach copies of Anaesthetic and Recovery room records

Appendix D – SCIDUA Case Classification – Glossary of Terms

CAUSAL OR CONTRIBUTORY FACTORS IN CATEGORY A DEATHS

Note that this is common for more than one factor to be identified in the case of anaesthesia attributable death.

SUB-CATEGORIES

A. Pre-operative

(i) Assessment	This may involve failure to take an adequate history or perform an adequate examination or to undertake appropriate investigation or consultation or make adequate assessment of the volume status of the patient in an emergency. Where this is also a surgical responsibility the case may be classified in Category 3 above.
(ii) Management	This may involve failure to administer appropriate therapy or resuscitation. Urgency and the responsibility of the surgeon may also modify this classification.

B. Anaesthesia Technique

(i) Choice or application	There is inappropriate choice of technique in circumstances where it is contra-indicated or by the incorrect application of a technique which was correctly chosen.
(ii) Airway maintenance including pulmonary aspiration	There is inappropriate choice of artificial airway or failure to maintain or provide adequate protection of the airway or to recognise misplacement or occlusion of an artificial airway.
(iii) Ventilation	Death is caused by failure of ventilation of the lungs for any reason. This would include inadequate ventilator settings and failure to reinstitute proper respiratory support after deliberate hypoventilation (e.g. bypass)
(iv) Circulatory support	Failure to provide adequate support where there is haemodynamic instability, in particular in relation to techniques involving sympathetic blockade.

C. Anaesthesia Drugs

(i) Selection	Administration of a wrong drug or one which is contra-indicated or inappropriate. This would include 'syringe swap' errors.
(ii) Dosage	This may be due to incorrect dosage, absolute or relative to the patient's size, age and condition and practice is usually an overdose.
(iii) Adverse drug reaction	This includes all fatal drug reactions both acute such as anaphylaxis and the delayed effects of anaesthesia agents such as the volatile agents.
(iv) Inadequate reversal	This would include relaxant, narcotic, and tranquilising agents where reversal is indicated.
(v) Incomplete recovery	E.g. prolonged coma.

D. Anaesthesia Management

(i) Crisis management	Inadequate management of unexpected occurrences during anaesthesia or in other situations which, if uncorrected, could lead to death.
(ii) Inadequate monitoring	Failure to observe minimum standards as enunciated in the ANZCA Professional Documents or to undertake additional monitoring when indicated e.g. use of a pulmonary artery catheter in left ventricular failure.
(iii) Equipment failure	Death as a result of failure to check equipment or due to failure of an item of anaesthesia equipment.
(iv) Inadequate resuscitation	Failure to provide adequate resuscitation in an emergency situation.
(v) Hypothermia	Failure to maintain adequate body temperature within recognised limits.

E. Post-operative

(i) Management	Death as a result of inappropriate intervention or omission of active intervention by the anaesthetist or a person under their direction (eg. Recovery or pain management nurse) in some matter related to the patient's anaesthesia, pain management or resuscitation.
(ii) Supervision	Death due to inadequate supervision or monitoring. The anaesthetist has ongoing responsibility but the surgical role must also be assessed.
(iii) Inadequate resuscitation	Death due to inadequate management of hypovolaemia or hypoxaemia or where there has been a failure to perform proper cardiopulmonary resuscitation.

F. Organisational

(i) Inadequate supervision, inexperience or assistance	These factors apply whether the anaesthetist is a trainee, a non-specialist or a specialist undertaking an unfamiliar procedure. The criterion of inadequacy of supervision of a trainee is based on the ANZCA Professional Document on supervision of trainees.
(ii) Poor organisation of the service	Inappropriate delegation, poor rostering and fatigue contributing to a fatality.
(iii) Failure of interdisciplinary planning	Poor communication in peri-operative management and failure to anticipate need for high dependency care.

G. No Correctable Factor Identified

Where the death was due to anaesthesia factors but no better technique could be suggested.

H. Medical Condition of the Patient

Where it is considered that the medical condition was a significant factor in the anaesthesia related death.

Suffixes

Suffix Code	Suffix Description
c	Where bone cement is implicated
f	Where surgery is performed in circumstances in which it is clear before commencement of surgery that the chance of a successful outcome is negligible or non-existent.
t	Critical event at transfer.
01	Patient died as a result of surgical bleeding

Appendix E – Participating Hospitals

List of Participating Hospitals 2010-2020

Albury Base Hospital	Moree District Hospital
Armidale Rural Referral Hospital	Moruya District Hospital
Auburn Hospital	Mudgee District Hospital / Mudgee-Gulgong District
Bankstown / Lidcombe Hospital	Murwillumbah District Hospital
Bateman's Bay District Hospital	Muswellbrook District Hospital
Bathurst Base Hospital	Nepean Hospital
Belmont Hospital	Nepean Private Hospital
Blacktown Hospital	Newcastle Eye Hospital
Blue Mountains District Anzac Memorial Hospital	Newcastle Private Hospital
Bowral & District Hospital	North Shore Private Hospital
Broken Hill Base Hospital	Northern Beaches Hospital
Calvary Mater Hospital - Newcastle	Norwest Private Hospital
Campbell Hospital (Coraki)	Orange Base Hospital
Campbelltown Hospital	Port Macquarie Base
Canterbury Hospital	Port Macquarie Base Hospital
Castle Hill Day Surgery	Prince of Wales Hospital
Coffs Harbour Base Hospital	Prince of Wales Private Hospital
Concord Hospital	Royal Hospital for Women
Coonabarabran District Hospital	Royal Newcastle Hospital
Denman Multi-Purpose Service	Royal North Shore Hospital
Dubbo Base Hospital	Royal Prince Alfred Hospital
Fairfield & Braeside Hospitals	Ryde Hospital
Glen Innes / Emmaville Health Service	Shoalhaven & District Memorial Hospital
Gosford Hospital	Singleton District Hospital
Gosford Private Hospital	South East Regional Hospital
Goulburn Base Hospital	Southern Highlands Private Hospital
Grafton Base Hospital	St George Private Hospital & Medical Centre
Griffith Base Hospital	St. David's Private Hospital
Hamilton Day Surgery Centre	St. George Hospital
Hawkesbury District Health Service	St. Vincent's Hospital (Darlinghurst)
Hawkesbury Private Hospital	St. Vincent's Hospital (Lismore)
Hornsby & Ku-Ring-Gai Hospital	St. Vincent's Private Hospital
Hunter Valley Private Hospital	St. Vincent's Private Hospital (Lismore)
Hurstville Community Private Hospital	Strathfield Private Hospital
Inverell & District Health Service	Sutherland Hospital
John Hunter Hospital	Sydney Adventist Private Hospital
Kareena Private Hospital	Sydney Children's Hospital Randwick
Lake Macquarie Private Hospital	Sydney Southwest Private Hospital
Lakeview Private Hospital	Tamara Private Hospital
Lightning Ridge Multi-Purpose Service	Tamworth Base Hospital
Lingard Private Hospital	The Children's Hospital at Westmead
Lismore Base Hospital	The Tweed Hospital
Liverpool Hospital	Wagga Wagga Base Hospital & District
Macksville District Hospital	Westmead Hospital
Macquarie University Hospital	Westmead Private Hospital
Maitland Hospital	Wollongong Hospital
Maitland Private Hospital	Wollongong Private Hospital
Manly District Hospital	Wyong Hospital
Manning Base Hospital	
Mater Private Hospital	
Mona Vale & District Hospital	

Original Articles

SPECIAL COMMITTEE INVESTIGATING DEATHS UNDER ANAESTHESIA

REPORT ON 745 CLASSIFIED CASES, 1960–1968

Deaths in association with anæsthesia for the State of New South Wales over a period from 1960 to 1968 have been investigated by a Special Committee. Of the total of 1,603 which occurred during this time, information has been obtained on 1,462, and of this total, 745 have been considered as sufficiently related to the anæsthetic to warrant detailed examination; 286 were finally assessed as having been wholly or partly due to anæsthesia. The patients, hospitals, anæsthetists and anæsthetics involved in these deaths are discussed and the errors responsible for them examined.

THE Special Committee Investigating Deaths Under Anæsthesia (S.C.I.D.A.) was formed in 1960. The Committee was appointed by the Minister for Health, and consists of nominees of several professional organizations, public health agencies and university departments.[1] Its terms of reference are to "advise the Minister" of any means whereby the mortality from anæsthesia may be reduced.

The cooperation of anæsthetists in New South Wales was sought, and the Committee's objective in the first instance was to collect useful data on all anæsthetic deaths occurring within this State. Guarantees of confidence were given, and the response of anæsthetists has been quite remarkable; over 90% have cooperated in providing case reports, despite the entirely voluntary nature of the survey, a figure which has not been approached in the conduct of similar investigations elsewhere.

Address for reprints: Dr R. Holland, Secretary, Special Committee Investigating Deaths Under Anæsthesia, Lidcombe Hospital, Joseph Street, Lidcombe, N.S.W. 2141.

[1] The bodies represented on the Special Committee, and the persons who have served or are still serving thereon, are as follows: *Department of Public Health, New South Wales*: Dr C. J. Cummins; Dr E. S. A. Meyers (the present Chairman); Dr R. Holland (Secretary); Dr B. E. Sharkey (Assistant Secretary); Dr T. O'Connell (Acting Secretary, February to May, 1966). *Faculty of Anæsthetists, Royal Australasian College of Surgeons*: Dr J. F. McCulloch; Dr L. T. Shea (serving member); Dr B. Pollard (serving member). *Australian Society of Anæsthetists, N.S.W. Section, and the Section of Anæsthetics, N.S.W. Branch of the Australian Medical Association*: Dr C. A. Sara; Dr Janet Bowen; Dr P. Jobson (serving member). *Royal Australasian College of Surgeons*: Dr E. Hedberg (serving member). *Department of Anæsthetics, University of Sydney*: Professor Douglas Joseph (serving member). *Department of Surgery, University of Sydney*: Professor John Loewenthal; Associate Professor G. W. Milton; Associate Professor F. Stephens (serving member, on leave); Associate Professor T. S. Reeve (serving member). *The Royal Australian College of General Practitioners*: Dr C. Everingham; Dr R. Geeves; Dr J. B. Glass (serving member). *N.S.W. State Committee, Royal College of Obstetricians and Gynæcologists*: Dr S. D. Meares; Dr R. Gill (serving member); Dr W. Garrett. *Hospitals Commission of New South Wales*: Dr H. Selle; Dr D. Storey (serving member).

Since this is a State-wide study and therefore relates to a relatively unselected community sample, it must give a more accurate picture of the incidence, nature and causes of anæsthetic disaster than information derived from a single hospital. The Committee considers that an important part of its function is to submit reports to the Minister for Health, in a form suitable for publication, with the advice that he permit this to be done.

In 1962, an interim report (Special Committee appointed to Investigate Deaths Under Anæsthesia, 1962) covering the first 100 completed cases was published, and in 1963 a communication on inhalation of vomitus was presented in THE MEDICAL JOURNAL OF AUSTRALIA (Special Committee Investigating Deaths Under Anæsthesia, 1963). The time now seems opportune for a review of 745 classified cases. A series of this magnitude is unusual, and only a few such investigations have previously been published (Beecher and Todd, 1954; A.A.G.B.I. Committee on Anæsthetic Deaths, 1952; Edwards *et alii*, 1956; Phillips *et alii*, 1960; Dinnick, 1964).

Most investigations into the subject of anæsthetic mortality have been collections of non-controversial, verifiable data obtained from hospital records. No subjective judgements on the reasons for the patient's death have been made, and the figures have been presented in such a way that the age, sex, disease state and surgery performed are stated, together with the agents used in the anæsthetic, and possibly including the status of the anæsthetist.

Useful though these investigations are, their overwhelming shortcoming is that they do little to display the cause of anæsthetic disaster. They show when and where it occurs, and to whom it occurs, but not why it occurs.

The first large-scale investigation to adopt a more searching approach was that sponsored by the Association of Anæsthetists of Great Britain and Ireland (A.A.G.B.I.). This body sent *questionnaires* to a large number of hospitals, seeking the cooperation of anæsthetists in submitting details of cases in which death had occurred in association with anæsthesia. Cooperation was, not unnaturally, patchy. Many areas were apparently free of anæsthetic mortality, whilst others sent numerous reports. Within four years, the subcommittee of the A.A.G.B.I. which had been charged with the responsibility of assessing the data was able to publish the results of 1,000 cases (Edwards *et alii*, 1956).

The chief difference between this and preceding investigations was that an attempt was now made to find what had gone wrong. This subjective judgement cannot be made wholly scientifically, but in many instances the real reasons for the patient's death are obvious, whilst in others there is some doubt. To cope with this problem, the A.A.G.B.I. subcommittee introduced a classification of anæsthetic deaths which would enable a reasonable assessment of each case based on the evidence supplied. This classification was adopted by the S.C.I.D.A. (see below) and has proved, on the whole, to be very satisfactory.

The A.A.G.B.I.'s study, first published 15 years ago, still repays reading. The validity of its approach has been confirmed by the fact that other studies since have elected to follow the same path. Thus the present-day review of anæsthetic mortality takes on more of the aspect of an audit, and it is this which the S.C.I.D.A. has attempted.

MATERIAL AND METHODS

In New South Wales, the *Births, Deaths and Marriages Act* provides that a medical practitioner shall not sign a death certificate in respect of any person who:

> (V) has died while under, or as a result of, or within twenty-four hours of, the administration of an anæsthetic administered in the course of a medical, surgical or dental operation or procedure, or an operation or procedure of a like nature, but shall as soon as practicable after the death, report the death to the officer in charge of the police station nearest to the place where death occurred.

It is the duty of the above-mentioned police officer to inform the district coroner, who will then decide on whether an inquest shall be held or not.

Thus there is a legal obligation to notify all cases in which death occurs within 24 hours of the administration of an anæsthetic. This was not always so, and the clause relating to the 24-hour period was inserted into the Act half-way through the present investigation, with certain results which will be discussed later.

At its inception, the Committee sought to secure notification of deaths in association with anæsthesia by enlisting the cooperation of the State's coroners. There are over 100 coroners in New South Wales, and changes frequently occur, so that the new coroner may be unaware of the practice of his predecessor in notifying the Committee; so that whilst it is useful, this system was never entirely satisfactory. It has been supplemented by notification by the hospital concerned to the Secretary of the Committee at the same time as the coroner is informed. Though a few anæsthetics nowadays are given outside hospitals, they are a small fraction of the total, and if they do end in the death of a patient, this fact becomes known fairly quickly.

Once information of a death has been received, a screening letter (Appendix 1) is sent to the anæsthetist to establish whether the case is one covered by the Special Committee's definition of an "anæsthetic death", namely:

> The death of a patient under, or prior to complete recovery from, an anæsthetic, or arising out of any incident during the anæsthetic.

If the case does not conform to this definition, it is excluded from further consideration. The effect of the "24-hour clause" (see above) has been to require the notification of many deaths which do not comply with the Committee's definition. Since 1963, these "excluded" deaths have comprised an increasing proportion of cases referred to the Committee (Table 1).

Case Retrieval

As mentioned previously, one of the most remarkable aspects of this study has been the cooperation of anæsthetists in providing details of their cases. In view of the potential medico-legal consequences of an "anæsthetic death", it is of great credit to anæsthetists in New South Wales that they should be so ready to divulge this information. Nevertheless, it is of some interest to analyse the cases in which no information could be obtained, since the effects on the final data, though small in total, could affect certain subcategories if heavily loaded in their direction.

Table 3 shows that there is an excellent record of retrieval from deaths occurring in metropolitan teaching

TABLE 1
Summary of Cases Notified

Year	Total Notified	Number of Cases in which Information was Obtained	Number of Cases in which Information was Not Obtained	Percentage Retrieval	Number of Cases Excluded by Definition	Number of Classified Cases	Number Awaiting Consideration	Number Awaiting Information
1960	91	90	1	98	5	85	—	—
1961	83	79	4	94	0	79	—	—
1962	97	88	9	90	7	81	—	—
1963	126	108	18	89[1]	30	69	—	—
1964	183	153	30	83[1]	79	74	—	—
1965	234	218	16	93	114	104	—	—
1966	282	264	18	93	143	121	—	—
1967	230	224	—	98	116	100	8[2]	6[3]
1968	277	238	—	84[3]	135	32	71[2]	39[3]
Total ..	1,603	1,462	96	94	638	745	79	45[3]

[1] In the years 1963 and 1964, there was a marked decline in the proportion of cases in which information could be obtained from the anæsthetist, reaching a minimum of 83% in 1964. This was largely due to lack of preparedness, in that no provision had been made for the considerably greater number of cases which would require notification under the new provisions of the Act. The position was not restored until 1965, when the introduction of new, abbreviated *questionnaire* (Figure 1) and additional streamlining of secretarial procedure became effective.

[2] Compilation of figures for the tables in this report was begun at the close of the calendar year 1968. No case not then considered by the Committee was included.

[3] A number of cases for which information had still not been obtained are listed as awaiting information, and are not included in the retrieval figures for 1968. The consequent reduction in significance of results for this year accounts for its exclusion from certain subsequent tables and figures.

hospitals and from country hospitals. Retrieval is poorest from cases occurring in metropolitan private hospitals. Nearly twice as many non-specialists declined to provide information to the Committee as did specialists (Table 4). The record of resident medical officers and registrars was good, and was impaired, for the most part, only by the essentially transient nature of their appointments, leading to loss of contact when they moved interstate or overseas. It should be stressed that in a voluntary survey such as this, the overall response has been excellent, reflecting great credit on the anæsthetists of New South Wales, whatever their status.

TABLE 2
Cases for Which Information Could Not be Obtained

Year	Number of Cases	Percentage of Cases Notified
1960	1	1
1961	4	5
1962	9	10
1963	18	11
1964	30	17
1965	16	7
1966	18	7
1967	0	0
Total ..	96	6

When the replies to questions in the screening letter indicate that the case should be considered by the Committee, either a seven-page detailed *questionnaire* (Appendix 2) or a single page "abbreviated case record" (Figure 1) is sent to the anæsthetist, together with a covering letter and a reply-paid envelope. If no reply is received within a reasonable period, a follow-up letter is sent, and if this produces no result, a telephone call is made.

TABLE 3
Cases for Which No Information Could be Obtained: Hospital

Hospital	Number of Cases	Percentage of All Cases Notified
Metropolitan teaching ..	35	4
Metropolitan non-teaching	38	11
Metropolitan private ..	15	24
Country base and district..	8	5
Total	96	6

Once they are returned, copies of the *questionnaires* are made for circulation to Committee members one week before the monthly meetings. At the meeting, each is classified according to the A.A.G.B.I. scheme, as follows:

Category 1: Cases in which it is reasonably certain that death was caused by the anæsthetic agent or technique of administration or in other ways coming entirely within the anæsthetist's province.

Category 2: Similar cases, but those in which there is some element of doubt as to whether the agent or technique was entirely responsible for the fatal result.

Category 3: Cases in which the patient's death was caused by both the anæsthetic and the surgical techniques.

Category 4: Deaths entirely referable to surgical technique.

Category 5: Inevitable deaths: for example cases of severe general peritonitis, but in which the anæsthetic and surgical techniques were apparently satisfactory.

Category 6: Fortuitous deaths, for example due to pulmonary embolism.

Category 7: Cases which cannot be assessed despite considerable data.

Category 8: Cases on which an opinion could not be formed on account of inadequacy of data.

The circulated copies and the minutes of the meeting contain no references to indentifiable data, such as time, place, or persons. In addition to these precautions, all copies are burnt after the meeting, with the exception of one which is returned to the anæsthetist, together with a letter giving the Committee's opinion on his case. Data are preserved only on punch cards, which contain no reference to personal details. The following information has been derived from the processing of these cards by an IBM sorter.

RESULTS

It will be apparent from the foregoing, and from Table 5, that three different types of "anæsthetic" death may be described, namely: (i) A "legal" type, which conforms to the Act, but which may have occurred quite independently of the anæsthetic or the associated surgical procedure. The total of all such deaths for 1960-1968 is 1,603. When deaths which do not conform to the Committee's definition are deducted from this total, the residue constitutes the second type. (ii) The "Committee-defined" deaths, which are more strictly related to the combined anæsthetic-surgical episode, the total number of which for the period is 745. This group still includes cases in which the anæsthetic has played no part in the fatal outcome, death having been due to surgical causes or to the inevitable consequences of the disease process, etc. When these cases (that is, categories 4 to 8 of the classification system) have been deducted, the remainder constitute the third type. (iii) The "true" anæsthetic deaths, in which the anæsthetic may be said to have played some part in the death of the patient. This type corresponds to categories 1, 2 and 3 of the Committee's classification. The total for 1960-1968 of these "true" anæsthetic deaths is 286 (Figure 2).

For the most part, the remainder of this report is concerned with deaths of type (iii), but before proceeding to analyse the "true" anæsthetic deaths, it is instructive to study the year-by-year changes which have occurred in the category distribution of all the "Committee-defined" deaths (Table 6).

Table 6 shows that despite a progressive gradual rise in "Committee-defined" deaths, there has been a slight fall in "true" anæsthetic deaths over the same period. The results of the survey for 1967 are in marked contrast to the findings in 1960 (Figure 2), despite improvements in the system of notification which would, if anything, have had the opposite effect. This is most encouraging and probably reflects the general rise in standards of medical care over this period, though it is tempting to speculate whether the Special Committee might have played some part in this improvement, as far as anæsthetics are concerned.

The quantitative figures do not tell the whole story. In the early years of the survey, the patients in the

cases reviewed by the Committee and ascribed wholly to anæsthesia were sometimes fit, healthy individuals whose deaths were preventable and due to major errors of anæsthetic management. Such cases are now rare. Predominant amongst cases in categories 1, 2 and 3 nowadays are poor-risk patients with serious disease, in whom the degree of physiological impairment is unrecognized, or in whom resuscitation before surgery is inadequate.

In other series, especially those from hospitals or groups of hospitals, incidence figures (that is, deaths per so many anæsthetics administered) are usually given (Clifton and Hotten, 1963). Ratios from 1: 1,500 to 1: 3,500 are quoted, but comparison between surveys is unreliable because of difference in reporting, assessment, and classification.

It has been necessary to adopt a different approach to assessing the significance of the data obtained in this survey. One method has been to use figures obtained from metropolitan teaching hospitals for a sample year (1967) of all anæsthetics given therein and to relate these to the number of deaths from all such hospitals. This gives a figure of eight "true" anæsthetic deaths for over 66,000 administrations, an incidence of 1: 8,250, and seems to compare very favourably with results in other countries for university hospitals.

Perhaps a more meaningful expression of the incidence of true anæsthetic mortality is to relate it to population

HOSPITAL:			DATE OF DEATH	
	NAME:	Age:	Sex:	Weight Kg
Diagnosis				
Operation(s) Actually Performed				
Brief & Relevant Pre-Anaesthetic History				
Assessment of Risk	☐ Good	☐ Fair	☐ Poor	☐ Desperate
Pre-Anaesthetic Preparation (Including Premedication)				
ANAESTHETIC: Please include Drugs Given & Doses Intubation or Not - If so, size & Type of tube; Gases Given & Flow Rates; Inhalational Agents & Concentrations; Respiration (Spontaneous or Controlled); Circuit including Vaporisers; Reversal Duration Difficulties or Episodes				
Blood & Other IV Fluids (Give Quantities) (a) Before Anaesthetic (b) During Anaesthetic				
Condition(s) found at Operation				
Brief Statement of Fatal Episode and its Management				
Opinion as to Cause of Death				
Signature	Surname in Block Letters	Qualifications	Appointment	

FIGURE 1: Abbreviated case record of death in association with anæsthesia.

We are still without a means of estimating with any accuracy the total number of anæsthetics annually administered in the State of New South Wales. Whilst it may soon be possible to produce a figure derived from the returns from all public hospitals, this too will be incomplete, since anæsthetics in private hospitals, doctors' and dentists' surgeries and other locations are subject to no statistical check. It is thus not possible to give any figure for the overall incidence of anæsthetic deaths in New South Wales.

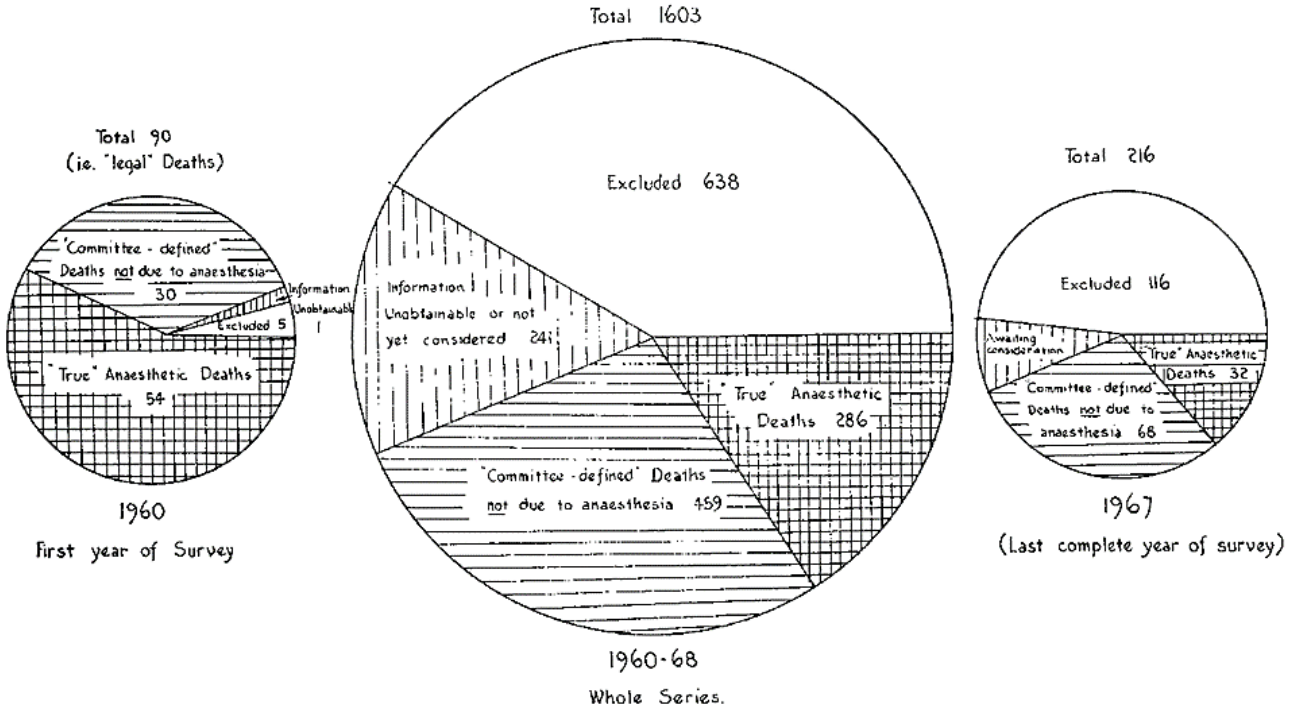


FIGURE 2: Proportions of "legal", "Committee defined" and "true" anaesthetic deaths.

figures and to use the conventional statistical yardstick of deaths per 100,000 of the population. Table 7 shows the population data on which this calculation was made, and Table 8 the results obtained.

TABLE 4
Cases for Which No Information Could be Obtained: Status of Anæsthetist

Anæsthetist	Number of Cases	Percentage of Total Number Notified
Specialist	33	5
Non-specialist	39	9
Registrar	16	5
Resident medical officer ..	3	4
Not known	5	—
Total	96	6

As an overall cause of death in the community, anæsthetic mortality ranks ahead of influenza, the complications of childbirth, and meningitis not of meningococcal origin. Tuberculosis kills twice as many, primary kidney

TABLE 5
Total Number of Cases in All Categories for the Period 1960–1968

Category	Number of Cases
1	163
2	56
3	67
Total categories 1, 2 and 3	286
4	151
5	234
6	24
7	26
8	24

disease ten times as many, diabetes mellitus twenty times as many, and bronchitis thirty times as many (New South Wales Statistical Bulletin, 1968).

Deaths from anæsthetics, however, are only the visible and readily identifiable tip of a much larger iceberg, namely, death due to therapeutic misadventure. The untoward effects of drug therapy, the technical complications of surgery, and even the (admittedly occasional) fatal results of investigative procedures between them account for many more. Charitably, the community takes the view that each of the practitioners involved in these disasters has tried his best, and he is not presumed to have acted carelessly, criminally or ignorantly. No such trust is extended to the anæsthetist. His patient has died, and he must now placate the law with reassurances, on oath if necessary, that nothing was left undone, nor was any other thing done which ought not to have been. The extension of this principle into all therapeutic fields would provoke storms of protest, and rightly so. The anæsthetist must nevertheless feel some chagrin as he observes his colleagues untouched by concern for the coroner, unmentioned in the Acts which empower that officer, and unpublicized when they make an error of judgement. The impartial observer would be forgiven for regarding this practice as discriminatory; its origin might well repay investigation, and its relevance to the present-day status and quality of anæsthesia might well merit review. The Special Committee believes that the proceedings of the coroner's court seldom succeed in establishing the real cause of an anæsthetic fatality, and for this reason are of little value in the prevention of further deaths from similar causes. It remains to be seen whether confidential evaluation by a Special Committee may ultimately be of greater value to the community.

The remainder of this report will deal almost exclusively with the 286 "true" anæsthetic deaths, under the following headings: (i) the patients (and their operations); (ii) the hospitals; (iii) the anæsthetists; (iv) the anæsthetics.

THE PATIENTS

Table 8 shows the age distribution of anæsthetic mortality, and it will be noted that there is a steep climb in the incidence in the latter decades. These patients obviously are more at risk, in that they require major surgery more often, and the surgical lesions themselves are likely to be grave and life-threatening. They are also victims of other intercurrent medical or surgical illness, which reduces their ability to withstand the stresses of anæsthesia, to the point perhaps at which the margin for error is gone. A single error of judgement on the part of the anæsthetist is sufficient to tip the

TABLE 6
Classified Cases 1960–1968

Category	Number of Cases									
	1960	1961	1962	1963	1964	1965	1966	1967	1968	Total
1	33	18	25	14	14	19	14	17	9	163
2	5	7	6	5	3	5	11	13	1	56
3	16	13	14	7	4	1	8	2	2	67
Total, categories 1, 2 and 3	54	38	45	26	21	25	33	32	12	286
4	9	10	12	13	22	23	21	31	8	149
5	13	24	18	18	24	46	53	20	9	234
6	4	2	2	0	2	2	5	5	2	24
7	3	2	1	6	4	4	2	3	1	26
8	2	3	3	6	1	4	5	0	0	24
Total	85	79	81	69	74	104	121	100	32	—

TABLE 7

Age Distribution of Persons in New South Wales at June 30, 1960 to 1968

Age Group (Years)	Number of Persons								
	Estimate, 1960	Census, 1961	Estimate, 1962	Estimate 1963	Estimate, 1964	Estimate, 1965	Census, 1966	Estimate, 1967	Estimate, 1968
0 to 4 ..	388,910	396,567	409,490	412,670	413,520	412,050	403,100	401,210	397,900
5 to 9 ..	370,810	373,632	378,700	384,280	392,150	401,020	410,220	422,120	428,800
10 to 19 ..	649,250	670,880	692,480	715,500	730,050	746,140	758,801	768,310	776,470
20 to 29 ..	496,430	511,120	519,380	531,340	554,490	579,010	596,039	620,590	660,150
30 to 39 ..	563,770	571,010	563,980	557,100	550,830	546,440	541,679	543,320	545,220
40 to 49 ..	501,170	510,262	519,510	527,300	530,890	538,110	546,734	554,090	564,900
50 to 59 ..	381,470	390,158	401,250	413,100	423,460	433,410	446,389	454,940	460,110
60 to 69 ..	272,170	277,092	278,420	279,940	280,800	285,900	293,332	298,480	305,240
70 to 79 ..	162,020	167,583	171,390	174,150	175,380	174,540	178,027	179,240	180,670
80 to 84 ..	31,540	32,414	33,290	34,670	35,470	36,630	39,350	40,110	42,330
85 or more ..	14,330	16,295	17,350	17,850	18,190	19,110	20,152	20,540	20,610
Total ..	3,832,450	3,917,013	3,985,050	4,047,700	4,105,230	4,172,360	4,233,823	4,306,950	4,382,400

balance irreversibly against the patient, whereas in a younger, fitter subject, a minor crisis only would have resulted.

Figure 3 shows the changing incidence of true anæsthetic deaths over the period 1960-1967. Comparison of the earlier with the later years of the survey shows that there is now a heavier concentration at the right-hand end of the age spectrum, that is amongst the older age groups. But though the incidence in the lower age groups is decreasing, it nevertheless persists and is a reminder that the margin for error is also small in the very young.

Table 9 illustrates the preponderance of emergency procedures over the elective. Naturally the patients undergoing the former are sicker, and the emergency situation itself adds more in the way of anæsthetic hazards, for example that of the full stomach.

TABLE 8

Age Groups, Percentage Incidence of Anæsthetic Mortality, and Incidence per 100,000 of Population

Age Group (Years)	Number of Cases	Percentage of Total	Average Incidence (Deaths per 100 000 of Population per Year)
0 to 4	19	7	0·5
5 to 9	14	4	0·45
10 to 19	15	4·5	0·23
20 to 29	25	9·5	0·45
30 to 39	20	7	0·4
40 to 49	23	8	0·5
50 to 59	32	11	0·87
60 to 69	51	18	2·0
70 to 79	59	21	3·6
80 and over	28	10	6

The term "indeterminate" merits explanation. There is a class of operation which cannot truly be called emergency in that it may be deferred, but not indefinitely. Thus time may be available for the treatment of preexisting disease and improvement in the patient's condition, but this time is limited—pinning of hips, amputation of ischæmic limbs, subacute obstructive lesions, for examples.

Nevertheless, nearly 40% of anæsthetic deaths occur in elective situations, in which the anæsthetist is in a position to make all possible adjustments to the patient's general health and to secure the best conditions in which to undertake the anæsthesia.

Table 10 shows the ten commonest procedures in 745 "Committee-defined" deaths, and thus gives a guide to those operations which pose the greatest immediate threat to the patient's survival. The last column of this table shows the number of cases of "true" anæsthetic deaths for each of these operations, for comparison.

The terms "laparotomy for hæmorrhage" and "laparotomy for peritonitis" are unfortunately vague, but were deliberately chosen because the data at the Committee's disposal often do not permit more precise diagnosis to be made. Thus the hæmorrhage may have been due to liver or splenic injury, or to postoperative bleeding from a surgical site. Peritonitis is frequently of unknown origin, and death occurs before a precise diagnosis has been made.

Table 11 shows the ten commonest procedures for the 286 patients in categories 1, 2, and 3, that is, the "true" anæsthetic deaths. In the last column of this table, the number of "Committee-defined" deaths for each operation is shown for comparison. In Table 11, intestinal obstruction moves to the top of the list, and peritonitis to second place. These two procedures occur in association with one-fifth of all "true" anæsthetic deaths. Though this may have been suspected, the position of cæsarean section is surprising, and when to these cases are added those in association with forceps delivery, 6·3% of "true" anæsthetic mortality is seen to occur in obstetric cases—a ratio which must be regarded as disproportionate.

The presence of seven cases of tonsillectomy is tragic, in that it must be admitted that but for the anæsthetics, these children would never have died. The only consolation to be derived is that the great majority of these deaths occurred early in the series, and it is now most unusual to receive notification of a death during or after tonsillectomy.

The position of cystoscopy is surprising and should cause some second thoughts on this supposedly "minor" procedure. In connection with deaths occurring in association with these and other specific procedures, it is proposed to deal with them in some detail in subsequent papers. To do so at this point would unduly lengthen this report.

Table 12 shows the broad types and situations of surgery in "true" anæsthetic deaths analysed by years. Here the preeminence of abdominal surgery is shown

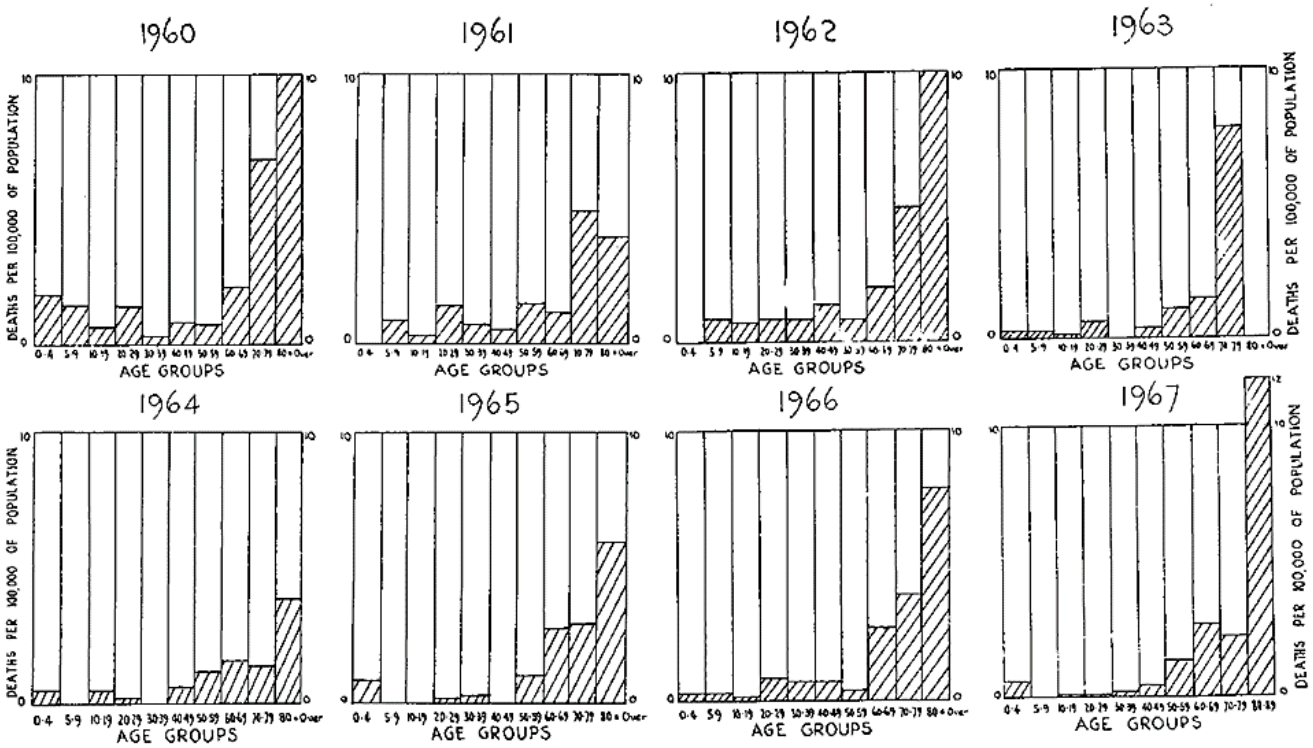


FIGURE 3: Comparison of age incidence of "true" anaesthetic deaths, 1960-1967.

even more strikingly, but concealed within this total are also the cæsarean sections.

THE HOSPITALS

Table 13 shows the distribution of hospitals, and also the ratio of elective to emergency cases in these hospitals.

The comparison between country and city shows that little more than one-third of "true" anæsthetic deaths occur outside the metropolitan area. Of these, twice as many anæsthetics are for emergency as for elective procedures. The ratio of emergency to elective procedures

TABLE 9
True Anæsthetic Deaths: Urgency of Procedure

Procedure	Number of Cases	Percentage
Elective	111	39
Emergency ..	155	54
Indeterminate ..	20	7
Total ..	286	100

in the metropolitan hospitals is much more nearly equal. The present distribution of population in New South Wales is in the ratio of 2·5 : 1·5 in favour of the city. If an allowance is made for the number of patients who come to the metropolis for their surgery, the proportion of anæsthetic deaths occurring in either situation, metropolitan or rural, would appear to be appropriate.

The total for teaching hospitals might be thought disappointing, in view of their supposed monopoly of highly trained staff, and the fact that every year they

TABLE 10
Ten Commonest Procedures: "Committee-Defined" Deaths

Order	Operation	Number of Cases	Percentage	Number of "True" Anæsthetic Deaths
1	Laparotomy for peritonitis	67	9	24
2	Laparotomy for hæmorrhage	59	7	10
3	Resection and grafting of abdominal aortic aneurysm	54	7·2	1
4	Intestinal obstruction	50	6·7	37
5	Aortic valve replacement or valvotomy	42	5·5	1
6	Repair of Fallot's tetralogy	18	2·3	1
7	Gastrectomy	16	2·2	8
8	Cæsarean section	15	2	11
9	Mitral valve replacement	14	1·9	0
10	Appendicectomy	13	1·7	11

take the cream of the university graduates. The incidence for one year (1: 8,250) has already been quoted and must be regarded cautiously in comparison with figures from other centres for the reasons stated.

The Committee is unable to make judgements on the merits of this or that institution. Errors have occurred in all types of hospitals.

More interesting differences emerge from a study of Table 14, which analyses age groups in terms of hospital distribution. In metropolitan teaching hospitals, only 9 of 75 patients were in the 20 to 49 years age group, whilst in country hospitals, 28 out of 92 patients were in this age group, nearly a threefold difference. Possible reasons for this discrepancy would include the age distribution of patients in the respective hospitals, the part played by high-speed road accident trauma in country areas, and the tendency for the large teaching hospital to attract patients with the severe surgical lesions of the older age group.

THE ANÆSTHETISTS

For the purpose of this survey, the following categories of anæsthetists were adopted:

Specialists: those anæsthetists with consultant standard qualifications in the specialty.

Non-specialists: all other anæsthetists not included in the former or subsequent categories.

Registrars: anæsthetists occupying full-time training posts in anæsthetics, but not holding postgraduate qualifications in the specialty.

Resident: full-time hospital resident medical officers performing general duties including some anæsthetics.

Others: including nurses, dentists, or surgeons (administering local anæsthetics, etc.).

TABLE 11
Ten Commonest Procedures: "True" Anæsthetic Deaths

Order	Operation	Number of Cases	Percentage	Number of "Committee-Defined" Deaths
1	Intestinal obstruction	37	12·5	50
2	Laparotomy for peritonitis	24	8·4	67
3	Cæsarean section	11	3·9	15
4	Appendicectomy	11	3·9	13
5	Laparotomy for hæmorrhage	10	3·5	59
6	Hysterectomy	8	2·5	11
7	Gastrectomy	8	2·5	16
8	Forceps delivery	7	2·4	7
9	Tonsils and adenoids	7	2·4	7
10	Cholecystectomy	7	2·4	7
	Cystoscopy	7	2·4	7

In 286 cases of "true" anæsthetic deaths, none of the last miscellaneous group was involved.

The crude breakdown into specialists and so on is shown in Table 15, combined with the risk category of the patient. When the anæsthetist had commented on the risk involved in anæsthesia for his patient, it was his assessment which was adopted by the Committee. If no such assessment had been made by the anæsthetist, the Committee made its own estimate when possible.

The use of terms "good", "fair", "poor", and "desperate", whilst unscientific, has the merit of being readily understandable to most anæsthetists. Furthermore, these are terms employed in a number of institutions to categorize patients before anæsthesia, and custom has tended to legitimize their use, whereas grading systems based on major and minor procedures, the magnitude of pre-existing disabilities and so on have proved cumbersome and impracticable. In a retrospective study like the present one, they are unusable.

What does Table 15 reveal? Unfortunately, whilst it appears to show a lot, it is open to grave interpretative difficulties, owing to a lack of additional knowledge. For example, specialists appear to be responsible for just under one-quarter of all true anæsthetic deaths, and non-specialists for about three-fifths of the total. Or, to put it another way, non-specialists have two and a half

TABLE 12
Site of Operation: True Anæsthetic Deaths, 1960–1968

Type of Surgery	Number of Cases									
	1960	1961	1962	1963	1964	1965	1966	1967	1968	Total
Non-surgical	0	1	0	0	1	0	0	2	0	4
Limbs and peripheral tissues	7	4	11	4	1	6	4	2	3	42
Abdominal	29	26	25	14	12	15	23	17	4	165
Thoracic (including cardiac)	3	1	1	1	2	0	1	2	0	11
Ear, nose and throat and oral	7	0	1	2	2	1	1	0	2	16
Eye	2	1	1	1	0	0	0	0	0	5
Endoscopy	2	1	1	1	1	2	3	6	1	18
Neurosurgery	0	1	0	0	1	0	0	1	1	4
Vascular (non-cardiac)	1	0	0	0	0	0	0	2	0	3
Other	3	3	5	3	1	1	2	2	1	21
Total										286

times as many anæsthetic deaths as do specialists. But no reliable statistics are available to show what proportion of anæsthetics overall is given by either group. Furthermore, these proportions are changing, and are undoubtedly different now from what they were at the beginning of the survey. There are now approximately 140 practising specialist anæsthetists in New South Wales, and though their output per anæsthetist would vary widely, they are probably responsible for about 150,000 anæsthetics per year. An incidence figure of about one true anæsthetic death per 20,000 anæsthetics given by each member of this group would be an informed guess. For the non-specialist, no such approximation is possible.

TABLE 13
"True" Anæsthetic Deaths: Hospital Distribution

Hospital	Number of Cases				
	Procedure Not Known	Elective Procedure	Emergency Procedure	Indeterminate	Total
Metropolitan teaching	0	33	37	5	75
Metropolitan non-teaching	0	29	43	7	79
Country base or district	0	29	58	5	92
Metropolitan private	0	14	12	2	28
Country private	0	1	1	0	2
Obstetric	0	2	4	1	7
Not in hospital	0	3	0	0	3
Total	0	111	155	20	286

Examination of the risk categories shows a most interesting ratio of good-risk and fair-risk patients to the total of "true" anæsthetic deaths for each category of anæsthetists (Table 16).

In the cases in which the anæsthetic was administered by a registrar, less than one-quarter of those who died were good-risk or fair-risk patients, compared with nearly half in the cases in which it was administered by a non-specialist. Somewhat more than half of the whole series were patients whose condition before operation was poor, but 123 were, by usual standards, fit for the ensuing procedure, and their disease process was not a significant contributing factor to their deaths. The very high proportion of good-risk and fair-risk patients who died as a result of anæsthetics given by residents would

TABLE 15
Patient Risk and Status of Anæsthetist in "True" Anæsthetic Deaths

Anæsthetist	Number of Cases					
	Good Risk	Fair Risk	Poor Risk	Desperate Condition	Condition Not Known	Total
Specialist	5	19	33	11	0	68
Non-specialist	36	43	78	6	1	164
Registrar	3	8	22	9	0	40
Resident	6	5	3	0	0	14
Total	50	73	136	26	1	286

TABLE 14
"True" Anæsthetic Deaths: Hospital Distribution of Age Groups

Hospital	Number of Cases									
	0 to 4 Years	5 to 9 Years	10 to 19 Years	20 to 29 Years	30 to 39 Years	40 to 49 Years	50 to 59 Years	60 to 69 Years	70 to 79 Years	80 Years and Over	Total
Metropolitan teaching	7	5	7	1	3	5	7	13	15	12	75
Metropolitan non-teaching	4	2	3	7	5	6	7	17	18	10	79
Country base or district	3	2	4	11	7	10	11	16	23	5	92
Metropolitan private	4	2	0	3	1	2	7	5	3	1	28
Country private	0	2	—	—	—	—	—	—	—	—	2
Obstetric	—	—	—	3	4	—	—	—	—	—	7
Not in hospital	1	1	1	—	—	—	—	—	—	—	3
Total	19	14	15	25	20	23	32	51	59	28	286

be due to the fact that doctors at this stage of their training would not normally be required to anæsthetize poor-risk patients.

Table 17 shows the relationship between urgency of procedure and the anæsthetist involved in the case. Some surprising results are evident here. In the cases in which the anæsthetic was administered by a registrar, deaths occurred in three times as many emergency as elective cases, and for non-specialists, nearly twice as many. In

TABLE 16
Proportion of Good-Risk and Fair-Risk Patients in Total of "True" Anæsthetic Deaths

Status of Anæsthetist	Percentage of Patients
Specialist	35
Non-specialist	48
Registrar	24
Resident	78
Average for series	42

the case of residents, the proportions are equal, but for specialists, there is a preponderance of non-urgent cases—nearly 60%. What could be the explanation of these differences?

The specialist, of course, gives anæsthetics for a living, and his elective cases, which are his bread and butter, make up the bulk of his working day. When the non-specialist is attending to the remainder of his practice, the anæsthetist in consultant practice is giving more anæsthetics, and the overwhelming majority of these will be non-urgent. The proportion would be difficult to establish accurately, but is likely to be about 90% in favour of

TABLE 17
"True" Anæsthetic Deaths: Status of Anæsthetist and Urgency of Procedure

Status of Anæsthetist	Number of Cases			
	Elective Procedure	Emergency Procedure	Indeterminate	Total
Not known	0	0	0	0
Specialist ..	38	24	6	68
Non-specialist ..	56	95	13	164
Registrar	10	29	1	40
Resident	7	7	0	14

elective surgery. At the opposite end of the scale, the registrar is the man on the spot when emergencies arise, and he usually is involved because of his availability. Between these extremes, the non-specialist occupies the middle position.

Rural practitioners, in particular, administer anæsthetics in a higher proportion of emergencies than the specialist anæsthetist in the metropolitan area. Since it is in emergency cases that the mortality of anæsthesia is highest, it follows that all anæsthetists obliged to care for these patients should be aware of the principles of anæsthesia in the emergency situation and should apply them diligently.

THE ANÆSTHETICS

No attempt has been made to analyse the cases in this series on the basis of anæsthetic agents used. The Committee does not, in fact, believe that agents themselves play any significant part in anæsthetic mortality, except when they are misused.

Every anæsthetic agent and every technique of administration appears to have been used in this series. The incidence of any particular agent, as far as it is possible to tell, does not seem to be out of proportion to its rate of usage in anæsthetic practice. Muscle relaxants, for example, were used in 68% of cases, which in view of their widespread application nowadays would appear to be appropriate.

Further analysis of these figures reveals that the muscle relaxants were significant in contributing to half of the true anæsthetic deaths in which they were used (Table 18).

TABLE 18
"True" Anæsthetic Deaths: Use of Muscle Relaxants

Muscle Relaxants	Number of Cases
Not used	84
Not known	4
d-Tubocurarine	77
Gallamine	56
Suxamethonium	142
Decamethonium	15
Other	2
Total, muscle relaxants used	198
Muscle relaxants significant in patient's death (inadequate reversal of hypoventilation)[1]	98

[1] Plus 10 further cases in which postoperative supervision was unsatisfactory.

Previous investigations, and notably that of Beecher and Todd (1954), have laid great emphasis on agents employed, and have often suggested that particular agents or techniques were unduly productive of mortality. Whilst it may be true that certain techniques are undesirable, this is usually predictable on theoretical grounds, in that the method obviously transgresses some of the basic physiological and pharmacological rules which govern anæsthesia. It is also notable that certain agents which required a greater sophistication of approach (such as, the muscle relaxants), or which constituted new and hitherto unexplored fields of anæsthetic technique (such as thiopentone) tended to be associated with higher mortality rates when first put into clinical practice. Overuse and inappropriate application were responsible for these unfavourable results.

In recent times, this has been less noticeable, and the introduction of halothane was not marked by a flush of untoward consequences in New South Wales. Anæsthetists nowadays adopt a much more wary and critical approach to the place of new agents in anæsthesia.

Claims continue to be made for the safety of traditional methods as opposed to the newfangled. The intrinsic safety of ether is often advocated. It seemed worthwhile, therefore, to test the validity of these claims as far as the data of the survey permit. Ether was used in 62 of the cases of "true" anæsthetic death, a level of utilization which probably reflects its frequency in present-day anæsthetics.

The "open" method of administration was used in a little over half of these, whilst more elaborate techniques were employed in the remainder (Table 19).

Of the 35 cases in which "open" ether was used, 25 patients died owing to overdosage, as did 15 out of the remaining 27 patients who received ether in combination with other agents. Forty deaths due to overdosage of ether hardly justify a claim of intrinsic safety.

TABLE 19
"True" Anæsthetic Deaths in which Ether was Agent Used

Method of Administration	Number of Cases	Number in which Death was Due to Overdose
"Open"	35	25
With apparatus and other agents, such as nitrous oxide	27	15

TIME AT WHICH DEATH OCCURRED

Only 10% of deaths occurred during induction, just over one-quarter occurred in the postanæsthetic period, and the remainder at some stage during anæsthesia. The proportion of deaths during induction in this series is thus smaller than in some other studies, but this probably reflects a more critical evaluation of the part of the anæsthetic in the fatal issue, leading to larger numbers in the other stages.

Table 21 shows agents involved in the 29 cases of death at induction. The ubiquity of thiopentone in present-day anæsthesia no doubt accounts for its presence in 21 of these cases. Nevertheless, it was considered to have been

TABLE 20
Time at which Death Occurred

Time	Number of Cases
Induction..	29
Maintenance	182
Postoperative	75
Total	286

wrongly chosen, given in too high a dosage, or both, in 17 cases. In four cases, the drug itself was not regarded as having played a significant role in the patient's death, disaster having been due to other factors, for example inhalation of vomitus.

In the case of each of the other agents, the numbers are so small that conclusions could not be drawn. It is nevertheless interesting to note that the three cases involving the use of ethyl chloride all occurred early in the series. This agent would appear to be following chloroform into obscurity.

LOCAL ANÆSTHESIA

There were 12 "true" anæsthetic deaths in which the technique employed was of a regional nature. It is not proposed to review these deaths in detail at this point, but a subsequent paper will examine them more closely. In six of these cases death was due to overdosage, and in five of these the agent used was lignocaine. It seems a pity that the great advantages of regional methods in certain circumstances (such as obstetrics) should be nullified by overdosage. Reference to the section on overdosage should be made for further discussion.

ERRORS OF MANAGEMENT

In those cases classified in categories 1, 2 and 3, the Committee has held that the anæsthetic was in part or wholly responsible for the patient's death. This implies that there has been some error of judgement, management or technique on the part of anæsthetist, and these cases have been analysed according to the errors thought to have been involved. In some cases errors were multiple, so that the total number of these errors will exceed the total number of cases.

TABLE 21
Deaths During Induction: Agent Used

Agent	Number of Cases
Thiopentone	21
Ethyl chloride	3
Halothane	1
Nitrous oxide	1
Cyclopropane	1
Ether	1
Extradural	1

Table 22 is large and somewhat elaborate, but it repays study because it shows 12 major errors of management, any one of which may have led to the patient's death. These are then analysed according to their crude incidence, their distribution amongst patients according to age group, amongst hospitals, and amongst anæsthetists. Before discussing the errors themselves individually, it is instructive to examine the table for significant differences.

Specialists, as may be expected (or hoped), make fewer errors per case than non-specialists. For each true anæsthetic death, the former have an average of 3·5 errors, the latter nearly 5. While the proportion of total errors between non-specialist and specialist is approximately 3 : 1, there are some outstanding variations of this ratio in the table.

For instance, the number of cases in which technical error occurs is the same for specialists and non-specialists; but this represents a case incidence of 1 : 5 for the former, as against 1 : 11 for the latter, despite the better record of specialists for observation of the patient. Other disproportionate results include inadequacy of postanæsthetic supervision, where again in specialist hands it occurs once in five cases, and in non-specialists only once in six.

Non-specialists are twice as likely to use dangerously hypoxic mixtures, but overdosage is an error common to both and in equal proportions.

Errors made in emergencies and in elective cases are equal over-all, but inevitably certain errors are much more frequent in the urgent situation. Inadequate preparation for anæsthesia was a factor in two-thirds of all deaths

TABLE 22
Errors of Management

Errors	Number of Cases																						
	Specialist Anæsthetist	Non-Specialist Anæsthetist	Registrar Anæsthetist	Resident Anæsthetist	Elective Procedure	Emergency Procedure	Indeterminate Procedure	Metropolitan Teaching Hospital	Metropolitan Non-Teaching Hospital	Country Base or District Hospital	Metropolitan Private Hospital	Obstetric Hospital	Country Private Hospital	Not in Hospital	0 to 4 Years	5 to 9 Years	10 to 19 Years	20 to 29 Years	30 to 39 Years	40 to 49 Years	50 to 59 Years	60 to 69 Years	70 to 79 Years	80 Years and Over	Total
Inadequate preparation for anæsthesia and surgery	28	99	18	5	34	106	10	29	43	56	15	6	0	1	4	6	6	17	17	12	16	23	36	13	150
Inadequate resuscitation during anæsthesia	26	107	15	8	64	85	7	27	44	59	18	4	1	3	15	10	10	14	15	11	15	18	31	17	156
Incorrect choice of anæsthetic technique	40	102	24	6	68	91	13	39	46	59	19	5	1	3	8	8	14	15	13	14	15	30	36	19	172
Overdose	25	75	11	7	59	51	8	26	29	45	11	1	1	2	11	8	6	13	7	9	13	15	20	16	118
Hypoxic gas mixture	4	21	3	0	10	16	2	5	5	13	2	1	0	2	1	3	0	5	2	0	4	5	4	4	28
Inadequate ventilation	30	105	14	7	76	68	12	30	30	59	20	4	1	3	12	8	4	13	12	13	19	32	31	12	156
Inadequate observation of patient by anæsthetist	10	72	6	6	45	46	3	11	25	39	13	4	1	1	12	9	4	11	9	7	8	10	17	7	94
Technical mishap	15	15	5	2	22	13	2	11	9	10	5	0	1	1	5	3	4	3	2	5	3	6	5	1	37
Inhalation of vomit	12	30	5	1	5	42	1	8	16	14	7	2	0	1	4	1	4	8	8	3	1	2	12	5	48
Inadequate management of crisis situation	27	98	9	6	57	75	8	21	40	53	19	5	0	2	9	8	4	14	13	8	15	25	30	14	140
Incorrect reversal	12	38	9	3	23	36	3	18	22	15	6	0	1	0	2	1	0	3	4	3	7	19	14	9	62
Inadequate postoperative supervision	15	27	8	3	18	33	2	16	22	10	4	0	1	0	2	2	1	5	4	3	6	12	13	5	53
Total	245	780	127	54	481	672	71	241	340	432	139	32	11	19	85	67	57	121	106	88	122	197	249	122	1215
Errors per case	3·5	4·7	3·1	3·2	4·4	4·4	3·5	3·5	4·3	4·7	5·0	4·5	5·5	6·3	4·5	4·8	3·8	4·4	5·3	3·8	3·9	4·0	4·1	4·1	4·3

in emergency cases, but in only one-third of deaths during elective procedures. Inhalation of vomitus was five times as common in emergencies, emphasizing the threat of this mishap in the urgent case.

In the hospital analysis, the frequency of errors is least in the teaching hospital situation and greatest in relation to deaths occurring outside hospitals, for example in dental surgeries, whilst the rural hospital occupies an intermediate position.

Inadequate Preparation for Anæsthesia and Surgery

Inadequate preparation is one of the five commonest causes of death in this series, occurring in 150 out of 286 true anæsthetic deaths, that is, more than half. As might be expected, it is more common in emergencies (106 out of 155 cases). Non-specialists fail twice as often as specialists to prepare their patients adequately.

What are the clinical situations in which this error occurs? They are cases of intestinal obstruction and long-standing cases of peritonitis and ileus for the most part, and the patient's perilous state is usually recognized by the anæsthetist himself. Indeed, he often describes the patient's condition as "grave", "desperate", "serious" or some similar term. This is followed by the assertion that it was essential to operate at once if the patient was to survive. Thus patients who had been ill for some hours or usually days were subjected to surgery after only the briefest of delays and the most perfunctory preparation. Frequently no attempt at all was made to restore blood or extracellular fluid volume, or to determine the degree of electrolyte deficit, even when facilities to do so were available.

It cannot be emphasized too strongly that surgery of itself does nothing to replace these deficits immediately, but rather makes them worse for a time. Resuscitation must be begun in the preoperative period as early as possible. If patients are to survive emergency surgery, it is essential that their fluid, electrolyte and blood volume state be brought as close to normality as the urgency of the situation allows.

In the case of obstructions, especially those of long standing, there is everything to be gained by spending some hours correcting fluid and electrolyte deficits. Should there be any reason to fear rapid fluid infusion because of circulatory overload, the use of the central venous pressure manometer will provide a warning.

When the patient's preoperative care has been as much in the hands of the surgeon as of the anæsthetist, and such care is regarded as having been inadequate, the case is classified in category 3, since both surgeon and anæsthetist have a responsibility to ensure that the patient comes to operation in the best possible condition. Too often pressure is on the anæsthetist to begin the anæsthetic as soon as he arrives, with the patient already in the operating theatre suite, having been in hospital all day, but without having been adequately resuscitated.

Sometimes, although there is evidently some awareness of the need for fluid replacement, the quantity and nature of the fluids given amount to no more than a gesture. For example, in a patient with peritonitis of 48 hours' standing, little benefit can result from the infusion of 500 ml of 4% dextrose in N/5 saline. Surgeons as well

as anæsthetists should appreciate the major nature of the fluid deficit present in many of these cases—it may be as great as 7 or 8 litres. To replace quantities of this magnitude with salt-poor solutions is dangerous, and replacement should be with an electrolyte-rich fluid which should match, as closely as possible, the qualitative nature of that which has been lost. Of the preparations available as a routine, Hartmann's solution would appear to be best, in that it closely approximates the sodium, potassium, and chloride composition of extracellular fluid.

Anæsthesia for patients with unreplaced blood loss carries grave risks, and it would seem that this fact has become appreciated to a much greater degree in recent years. Nevertheless, patients still die because replacement before operation has been inadequate or lacking altogether, and the commonest situations in which this error is made are those in which the quantity of blood loss is not readily apparent, such as the "bleeding tonsil" (when much of the blood is in the stomach), and the case of trauma, in which the blood may have been left at the roadside or is concealed within the abdomen. Here again the central venous pressure may provide most valuable information as to the adequacy or otherwise of preoperative replacement.

Inadequate Resuscitation During Anæsthesia

Closely allied with the previous error, inadequate resuscitation during anæsthesia is often a continuation of inadequate resuscitation before operation. It stems from the same lack of appreciation of the magnitude of the pre-existing deficits and/or failure to observe or appreciate the fact that losses are continuing.

Occasionally, when a patient has been dying from blood loss, supplies of blood have been inadequate, but only one or two units of albumin (or stable plasma protein solution) have been given. If bleeding is potentially curable, or is from an intrinsically non-fatal condition, there would seem to be no reason why the adequate administration of plasma substitutes should not continue as long as the patient still lives. He stands no chance at all without restoration of the intravascular fluid volume, though there is evidence to suggest that considerable dilution of red-cell mass may occur before the myocardium fails.

Even an electrolyte solution containing no protein or protein substitute may enable the patient to survive until the bleeding can be arrested, at which time more specific corrective measures may be undertaken. Once the heart stops as a consequence of inadequate circulating volume, restarting it is a matter of the utmost difficulty and is rarely achieved.

Incorrect Choice of Anæsthetic

The commonest error of all is to adopt a technique carrying a greater potential hazard, when a satisfactory and less risky alternative was available. Examples are as follows.

The Selection of General Anæsthesia Rather than a Regional Technique

Some operations are readily carried out out under regional methods of great technical simplicity. Though it should not be uncritically assumed that "locals" are always less risky than "generals", there are times when this is clearly true. For example, the operation of suprapubic cystostomy for acute urinary retention has frequently to be carried out on desperately ill, unprepared patients, in whom correction of acid-base derangements or control of decompensated heart failure is out of the question.

This is a procedure which can be performed under a very simple local technique, which, apart from the infiltration of the skin and lower rectus muscle, requires only adequate injection of the cave of Retzius with dilute anæsthetic solution. Restlessness and non-cooperation can be managed by the judicious use of sedation, with the preservation of consciousness.

Patients undergoing cystoscopy are often elderly males with respiratory or cardiac disability of marked degree, not amenable to correction. Saddle-block spinal anæsthesia requires proficiency only in the performance of lumbar puncture, and with a suitable dose of hyperbaric solution and maintenance of the sitting position for five minutes, excellent anæsthesia may be achieved at the cost of minimal physiological disturbance.

The place of this "minor" procedure in the statistics of this survey has been noted above; in each of these deaths, the Committee considered that the (general) anæsthetic chosen had been selected with insufficient regard to the possible alternatives.

Injudicious Use of Intravenous Agents

No agent is more nearly universal in anæsthetic practice today than thiopentone. Patients expect it and are liable to protest if they do not get the "needle in the arm". Whilst its undoubted superiority as a pleasant means of induction cannot be denied, it is by no means a suitable agent for every clinical situation. In those circumstances in which the circulation is markedly unstable, its known ability to produce vasodilatation and myocardial depression may contraindicate its use. The greater the deviation from normal, the greater is the hazard.

It may not be widely appreciated that the dose of thiopentone required to produce hypnosis may exceed that which will produce serious circulatory depression, for example in a patient habituated to sedatives or alcohol, but whose cardio-vascular state is precarious owing to prolonged illness and toxæmia. The alternative of inhalational induction may not be popular, but this should not dissuade the anæsthetist from doing what he believes to be in the interests of his patient's survival.

Choice of Spontaneous Respiration Techniques in Unfavourable Circumstances

There are certain postural handicaps to ventilation imposed on patients by the exigencies of surgery and the requirements of surgeons.

The Trendelenburg position, the prone and semi-prone postures, and the lithotomy position in obese patients all reduce the patient's ability to ventilate his lungs. If anæsthesia is prolonged, a gradually increasing respiratory acidosis results. The stage is set for cardiac arrhythmia, especially if a state of suboxygenation also develops. Patients should not be allowed to incur these

handicaps. It is the anæsthetist's responsibility to provide the necessary assistance to, or better still, control of, respiration in these situations.

Failure to Use an Endotracheal Tube when Indicated

An essential part of modern anæsthesia and a significant contribution to patient safety is the use of an endotracheal tube when indicated. Abdominal procedures associated with muscle relaxants and prolonged anæsthesia demand this added protection for the airway. Operations in which the access of the anæsthetist to his patient is restricted by the needs of the surgeon also require that the patient be intubated. Failure to do so adds to the risks of the anæsthetic. Should any doctor doubt his ability to perform intubation safely, it is surely incumbent on him to defer to someone who can.

Overdosage

Overdosage occurred in about 40% of all cases, but was more common in elective procedures than in emergencies. Thus it was an error of significance in 54% of elective cases, but in only 30% of emergencies, although the actual number in each category was nearly equal. It occurred equally in all categories of anæsthetists. As far as patients were concerned, there was a disproportionately higher incidence in the younger age groups, overdosage occurring in 19 out of 33 patients aged under 10 years (57%).

Amongst hospitals, overdosage is a factor in one-third of the true anæsthetic deaths from teaching hospitals, in slightly more in other metropolitan hospitals, and in nearly half of the cases in rural public hospitals.

The commonest agents were ether and thiopentone. In the case of ether, toxic concentrations are produced in two ways, either by the "open" method, in which it is possible to accumulate very high blood concentrations over 20 to 30 minutes, or by the use of the "in-circle" vaporizer of anæsthetic machines. This last piece of apparatus is capable of producing lethal concentrations of ether in a circle system in a surprisingly short time, especially if respiration is being assisted or controlled. After several fatalities, the Committee published a memorandum drawing attention to the dangers of this vaporizer (New South Wales Department of Public Health, 1964).

It is not generally appreciated that the position of the on-off control does not affect the output of the vaporizer nearly as much as the movement of gases through it. Vigorous gas movement can achieve high concentrations on quite low settings, and the effect is cumulative. Within 15 minutes it is possible to reach a concentration of 37% of ether in the circle (L. T. Shea, personal communication). A design defect in some machines is that the housing of the ether vaporizer is identical to that of the soda lime canister, which leads to confusion. It is pleasing to note that in most hospitals in which new equipment has been installed since the publication of the Committee's memorandum, "in-circle" vaporizers have not been included in the new machine. Probably they will die out as a new generation of anæsthetists is trained on new equipment.

The passage of years has seen a gradual acceptance of thiopentone as an agent for induction only, and a single dose for this purpose is now almost standard anæsthetic practice. The size of this induction dose has also undergone gradual diminution, until an average of 250 mg for healthy patients has been reached at the present time. It should be appreciated, however, that this dose may be far from safe in an elderly, debilitated patient suffering from a serious emergency illness in which severe blood or fluid deficits often exist, and which may also be accompanied by toxæmia. It is only common sense that dosage should be drastically reduced in such cases, and the point will be reached in some cases at which the patient would be better off having no intravenous induction at all.

Overdosage of Local Anæsthetic Agents

Apart from one case of amethocaine overdosage, all examples of this error were with lignocaine, and in most of these it was evident that the anæsthetist was not aware of the maximum safe dose of this agent.

To a great extent this is due to early claims for the drug, which suggested that its toxicity was comparable with that of procaine. It is now realized that this is not the case, and that 500 mg of lignocaine, without a vasoconstrictor, injected into a vascular area such as the pudendal region, carry a grave risk of toxic results.

Hypoxic Gas Mixture

The majority of anæsthetists are undoubtedly aware of the physical principles which apply to gas flows and anæsthetic circuit arrangements. They ensure that their patients will at all times be provided with an atmosphere containing an adequate concentration of oxygen. From time to time a case does come to the Committee's notice in which these principles have not been recognized, so that it may be as well briefly to review the technical argument upon which correct practice is based.

In a system which permits rebreathing, such as the "circle" (sometimes rather inaccurately referred to as a "closed circuit"), provision is made for the chemical absorption of carbon dioxide from that system, and quite low flow rates into the apparatus may be permitted without the risk of carbon dioxide retention. However, when low flow rates are employed, allowance must be made for the metabolic consumption of oxygen in calculating the concentration of that gas which will result.

For example, if the flow rate of oxygen into the system is 1 l./min, 250 ml of that litre will be consumed by the patient every minute, and thus of every 4 ml of oxygen which enters the system, 1 ml is immediately consumed. This metabolized oxygen is therefore not available to dilute the nitrous oxide which may also be entering, and the concentration of oxygen in the circle will then be lower than would be suggested by the flow meters.

In addition to the consumption factor, other gases compete as well, notably water vapour (present in a high degree of saturation in circle systems) and volatile agents if used. Table 23 shows theoretical oxygen concentrations in a circle system for various flow rates, assuming metabolic consumption to be 250 ml/min.

From Table 23 it can be seen that the lower the flow rates, the greater the disparity between the concentration

at the flow meters and the predicted concentrations inside the circle. The addition of 5% ether vapour (not a high concentration) reduces the proportion of oxygen in the inspired mixture by a further 1% to 2%. Recent work suggests that, owing to ventilation perfusion inequalities which accompany controlled respiration, the oxygen concentration of gas mixtures may have to be considerably greater than for spontaneous respiration, and in any anæsthetic an adequate margin for safety is necessary.

Inadequate Ventilation

Inadequate ventilation is one of the five major causes of disaster. Its distribution seems to be even throughout hospitals, patients and anæsthetists. It may be due to many causes, several of which have been found in this series, namely: (i) prolonged deep anæsthesia with potent agents, for example ether; (ii) obstruction to the airway; (iii) inadequate diameter of endotracheal tube; (iv) postural handicaps to ventilation; (v) failure to control or assist respiration in the patient who has been given muscle relaxants.

TABLE 23
Theoretical Oxygen Concentrations in Circle System

Nitrous Oxide Flow Rate	Oxygen Concentration (Percentage)		
	0·5 l./min Oxygen	1 l./min Oxygen	2 l./min Oxygen
1 l./min :			
No added ether ..	19	41	—
Ether 5%	18	40	—
2 l./min :			
No added ether ..	11	27	45
Ether 5%	10	25	43
3 l./min :			
No added ether ..	—	19	36
Ether 5%	—	18	35
4 l./min :			
No added ether ..	—	16	29
Ether 5%	—	15	28

Prolonged Deep Anæsthesia

One of the greatest advantages of modern methods of anæsthesia is that the anæsthetist is relieved of the necessity of inducing hypoventilation in order to produce adequate operating conditions for the surgeon. In this series, the benefits of these newer techniques have not been made available to children to the same extent as they have been to adults. Nearly all the 20 deaths in the under 10 years age group in which this factor played some part were examples of prolonged "surgical" anæsthesia, usually with ether. Elegant and simple pædiatric equipment is now readily available, and techniques made possible by this and newer agents, such as halothane, make dangerously deep anæsthesia unnecessary.

Airway Obstruction

It is an elementary principle of anæsthesia that the unconscious patient may have an obstructed airway, owing to simple soft-tissue obstruction by the toneless musculature of the tongue and pharynx. Obstruction should always be suspected when a patient's colour is unsatisfactory despite the use of high oxygen concentrations.

Inadequate Diameter of Endotracheal Tube

Even when apparatus has been used to ensure patency of the airway, it may be inadequate for the needs of the patient. Restriction of the airway by an endotracheal tube with too small a diameter can have disastrous consequences. Whether respiration is spontaneous or controlled, it is unlikely that ventilation in an adult will be adequate through a size 6 or 7 Magill's tube. Adult females require a tube size of 8 mm, and males at least 9 mm, and as age advances these diameters increase further. Since resistance to flow through tubes varies as the fourth power of the radius, even a 1 or 2 mm difference may have substantial effects on ventilation when other factors remain the same.

Postural Handicaps

These have already been touched upon, but it is worth repeating here that the commonly used Trendelenburg position reduces the patient's ability to ventilate himself. Obesity also always increases the magnitude of these handicaps, and even in the supine position it may be impossible for the grossly overweight unconscious patient to ventilate adequately.

Failure to Assist or Control Respiration in Patients Given Muscle Relaxants

Probably owing to an intensive educational campaign from various sources, the practice of allowing a partly paralysed patient to breathe spontaneously is disappearing, but in the earlier years of the survey it was common. The Committee believes that if a muscle relaxant has been given to an anæsthetized patient to facilitate the work of the surgeon, then it must also affect the ability of the patient to ventilate adequately. It is essential, therefore, to provide whatever assistance the patient needs to bring his ventilation to correct levels. In fact, it is probably preferable to institute control of respiration at the outset, since it is usually easier to ensure adequate ventilation by full control rather than by assistance. Despite its reduced frequency in recent years, failure to institute full control of respiration is still the commonest cause of inadequate ventilation in the whole series.

After the use of muscle relaxants, even if the patient is breathing satisfactorily, there will still be some residual paralysis. The cessation of surgery will reduce the sensory input to the respiratory centre, and dangerous hypoventilation can follow at a time when the patient is not under the direct supervision of the anæsthetist. This is such an important matter that it has been isolated as a separate error (see below: Inadequate Reversal).

Inadequate Observation by Anæsthetist

Some striking differences in distribution appear in Table 22. This error occurs in only 15% of "true" anæsthetic deaths in which the anæsthetic was administered by a specialist, but in over 40% for non-specialists. In the teaching hospitals, it is involved in 15% of cases, but is nearly twice as common in metropolitan non-teaching hospitals, and nearly three times as frequent in country hospitals. It contributes disproportionately to the deaths of younger patients, being a significant factor in two-thirds of these deaths, compared with less than one-third of the remainder.

Numerous mechanical aids to patient observation are marketed, some of them very expensive. Helpful though

these devices undoubtedly are, they are not essential for the adequate monitoring of a patient's physiological well-being unless the circumstances are exceptional. Minimum safe practice for anæsthesia demands the attention of the anæsthetist at all times to the state of the patient's respiration (if breathing is spontaneous), or to the ventilation achieved by artificial means if breathing is controlled. For this purpose, it is essential to be able to observe some portion of the patient or the apparatus which will give an unequivocal indication of rate and depth of respiration. This may be a bag, or a meter, or an unimpeded view of the patient's chest and abdominal movement; a precordial stethoscope is a simple and useful device where the last-named is impracticable, and is especially applicable to children.

It is equally vital that the anæsthetist at all times be aware of the state of oxygenation of his patient, and clinical observation of the colour of either skin or blood is still the most reliable practical means of achieving this under operating conditions. It is nevertheless important to realize that when hypoxia develops slowly, as in the case of a gas mixture with a gradually falling oxygen concentration, a vasoconstrictor response may produce pallor of the skin and a reduction in bleeding in the wound so that cyanosis is not apparent. This phenomenon accounts for many instances of collapse of his patient taking the anæsthetist by surprise.

There are also limitations to the subjective appreciation of colour, particularly when lighting and the colour of surrounding drapes or walls are concerned. It is quite impossible to make safe observations on colour if lighting levels fall below certain limits. The limit will vary with each individual anæsthetist, but each must judge for himself when conditions of lighting are inadequate for safety. No surgical procedure requires complete darkness, and it is always possible to achieve a compromise between the needs of the anæsthetist and of the surgeon.

Important information regarding the efficiency of the circulation can be obtained from the regular observation of pulse and blood pressure. Such observations are essential whenever the circulation is already threatened or unstable, as in blood loss, the poor-risk patient and prolonged surgery.

The Committee has been concerned with the frequency with which these elementary principles of observation have been neglected, to the extent that a third of all "true" anæsthetic deaths in this series have been due in part to this error.

Technical Mishap

The obstruction of tubes, mismatching of gas lines, accidental air embolization of patients undergoing infusion and similar accidents continue to occur, and would seem inevitable so long as anæsthesia remains in the hands of human agents. There is a higher incidence of this error in specialist hands than with non-specialists in this series. Yet specialists have a better record of observation of their patients. How may this paradox be explained?

The Committee believes that technical mishap is an error with a more or less statistical rate of occurrence which depends largely on the number of anæsthetics given. Each specialist anæsthetist, of course, gives far more anæsthetics than the average non-specialist, and is thereby exposed to the risk of technical mishap much more often. Reference to Table 22 also shows that, contrary to the general trend of the series, this error is more common in elective than in emergency surgery, a phenomenon which can be explained only on the basis of there being more of the former type of case for accidents to occur in.

These incidents serve as a sad reminder that only vigilance and a constant devotion to the technicalities of the anæsthetic can protect against disaster. Cases in which misadventure of a technical kind has occurred are inevitably those which attract the most publicity; it should be noted that they are responsible for only 13% of "true" anæsthetic deaths in this series. A detailed examination of accidents in this category will be made in a future paper.

Inhalation of Vomitus

Though the first 100 cases considered by the Committee were remarkable for the absence of this accident, subsequent experience showed that it has been the cause of a number of anæsthetic deaths in this State. A memorandum on inhalation of vomitus and recommendations for its prevention was published by the Committee (Special Committee Investigating Deaths Under Anæsthesia, 1963). Since publication of this memorandum, further cases have been reported. It is clear that if patients are not to die as a result of this complication of anæsthesia, some precautionary measures must be taken.

An awareness of the circumstances under which this accident can occur is perhaps the most important preventive measure. If general anæsthesia can be avoided, so much the better; but if a technique involving loss of consciousness is essential, two considerations are preeminent: (i) the airway must be protected by a cuffed endotracheal tube as soon as possible, perhaps even before induction; (ii) the technique of induction adopted should not pose additional risks.

Induction by inhalational methods is recommended by some authorities on the grounds that vomiting which may occur during such an induction takes place when the larynx is still active and able to protect the bronchial tree. The additional safeguard of a head-down lateral posture during induction, combined with suction, will then clear the pharynx, and the patient suffers no harm. The addition of 5% carbon dioxide to the mixture to be inhaled is also recommended, since it is said that the patient is "too busy overbreathing" to vomit (Inkster, 1963). However, this technique is not generally applicable.

Intravenous induction, plus paralysis by a rapid-acting muscle relaxant and "crash" intubation, is defended on the grounds that the least possible time elapses between loss of consciousness and intubation. Of course, the safety of this method depends very much on rapid and skilful intubation, and even the most experienced cannot guarantee to get a tube into the larynx promptly every time. Table 24 does not offer support to either view, but further refinements of technique have done much to improve the safety of the latter method, namely: (i) preoxygenation, which allows the patient to be intubated immediately relaxation is adequate, and without additional ventilation, which has been shown to be dangerous (Wylie, 1965); (ii) cricoid pressure (Sellick,

1961) applied by an assistant, thereby closing the upper end of the œsophagus and preventing regurgitation; this greatly prolongs the period during which intubation may be safely accomplished; (iii) the 45° foot-down position during induction, which is an additional safeguard against regurgitation, though not against active vomiting. This manœuvre is dangerous in patients with a depressed circulation.

Preliminary decompression of the stomach with an adequate-sized gastric tube, presence of an effective sucker at the anæsthetist's hand, and a competent assistant are all contributions to safety in this hazardous situation.

Despite all such precautions, cases in which the patient does inhale gastric material will nevertheless happen. The management of the patient in whom this incident

TABLE 24

Deaths from Inhalation of Vomitus: Possible Role of Muscle Relaxants and Technique of Induction

Inhalation of Vomitus	Number of Cases		
	Relaxant Used	Relaxant Not Used	Not Known
Inhalation	33	15	0
No inhalation	165	69	4

has occurred has already been outlined in the Special Committee's memorandum (Special Committee Appointed to Investigate Deaths Under Anæsthesia, 1962). A brief revision of the principles involved is included as Appendex 3 to this report.

Inhalation of vomitus was once regarded almost exclusively as a problem of the induction of anæsthesia. Many cases which have been reported to the Committee have occurred in the immediate postoperative period, when the patient was either *en route* to or had just arrived in the recovery area. Patients are particularly vulnerable at this time, since they usually lack the muscle power and/or coordination to be able to turn on to one side, which makes it very likely that some vomitus will be inhaled. Apart from stressing the need for close supervision at this time, the semi-prone position should probably be adopted more often than it is for the transport and recovery of patients after anæsthesia who may be expected to vomit copiously—for example, in cases of peritonitis or obstruction, or traumatic cases.

Inadequate Management of the Crisis

The overall standard in the management of cardio-respiratory collapse has greatly improved in the last few years, ever since the widespread adoption of the method of closed chest cardiac compression (Jude *et alii*, 1961). In fact, but for greater understanding of the principles of resuscitation and an improvement in technique, no doubt deaths in relation to anæsthesia would be more frequent than they are. In the Committee's previous report (1962), reference had to be made to the large numbers of fruitless manœuvres which were adopted by anæsthetists faced with a patient whose heart had stopped. Intracardiac injection of "stimulants" was widely practised, without an appreciation of the pharmacology of the drugs concerned. Artificial respiration was often by inefficient methods, and compression of the heart frequently attempted via the abdomen.

Errors in resuscitation continue to be made, particularly the inappropriate use of drugs in the collapsed patient, for example:

1. Pressors are of little value in the early stages of the management of circulatory collapse, and may even be contraindicated. They are useless and even dangerous in hypotension due to severe blood volume deficit.

2. Dramatic as it may appear, the effectiveness of injecting drugs such as adrenaline directly into the heart is unproved. Furthermore, it interrupts the performance of closed chest cardiac compression, and a further period of circulatory stagnation results. This practice should cease.

3. There cannot be any rationale for the administration of respiratory stimulants to a patient who has stopped breathing because his heart stopped first. Even in those cases in which the heart has been restarted, the apnœic patient is best served by adequate artificial ventilation rather than by pharmacological stimulation of a severely injured brain.

A brief résumé of the Committee's views on the essentials of cardio-respiratory resuscitation is included as Appendix 5.

Incorrect Reversal

As has already been mentioned, the use of non-depolarizing muscle relaxants (gallamine, *d*-tubocurarine) requires reversal of their action at the conclusion of anæsthesia, no matter how vigorous respiration may appear to be. The only exception to this practice is the patient for whom it is planned to provide respiratory support for some time, as is now customary in major cardiac surgery.

Omission of the reversal procedure, inadequacy of dosage of the reversing agents, occasionally overdosage of these agents, and failure to follow up the result of reversal have all been collected into the category of incorrect reversal. This group therefore includes cases of so-called "recurarization".

Where a single small or medium-sized dose of a muscle relaxant has been given, the decline in blood levels is rapid as redistribution in body fluids occurs. However, if during a long procedure large doses are used, and especially if several increments are given, the decline in blood levels will be slower and more dependent on the mechanisms of excretion and metabolism.

It can easily be seen that the effects of a single dose of a reversing agent could well be different in the two situations. The patient who has received a single dose of relaxant and reversal, in that order, is in little danger of recurarization, since the blood level of both drugs is declining at an approximately equal rate, and since the reversal was given later, its effect is likely to predominate. But where, owing to multiple doses, the curve of blood relaxant level has been flattened out, whereas that of the single dose reversal follows the usual pattern of rapid decline, the possibility exists that the patient will once more become partly paralysed some 20 to 40 minutes after the conclusion of the anæsthetic.

This need not be disastrous if those responsible for postoperative care are equal to the task of detection and management of respiratory inadequacy. The advent of the recovery ward has been instrumental in preventing many cases of recurarization from being more than a slight inconvenience. When specialized recovery facilities are absent, or journeys to the postoperative ward are lengthy, respiratory support for the recurarized may be delayed, with fatal consequences. In these circumstances, detention in the operating suite for longer periods may be necessary to ensure the patient's safety.

Of increasing importance nowadays is the episode of postoperative vomiting and inhalation (*vide supra*), an accident which will be much more serious if paralysis is only partly reversed, since the patient will now be much less able to cope with a pharynx full of gastric secretions. Severely ill patients, who are more prone to residual or recurarization, could well be managed more often than at present by continuing respiratory support via the endotracheal tube left indwelling.

Inadequate Postoperative Supervision

Reference has previously been made to the possibilities of disaster occurring in the postoperative period, especially with regard to recurarization.

Sometimes a completely appropriate anæsthetic, correctly administered, results in the death of a patient in the postoperative period, because of a breakdown in supervision at this time.

Episodes of vomiting or partial airway obstruction, reversible hypotension and/or cardiac arrhythmia happen while the patient is not under the supervision of persons able to deal with the crisis. Delay whilst the appropriate personnel are sent for is sufficient to render the patient's condition irretrievable.

Anæsthetists should be aware that the immediate postoperative period is a most hazardous time. The more ill the patient, the longer the period during which the risk is present. Responsibility for ensuring the patient's safety rests with the anæsthetist until the patient can be said to have recovered completely from the anæsthetic, and not merely when he has left the operating theatre. If the care of the patient is delegated before this time, it must be to persons who can cope with any emergency which might arise.

OPINIONS AS TO THE CAUSE OF DEATH

The Committee attempted to determine which error or errors were responsible for each "true" anæsthetic death. When such errors were considered to have been made, these were compared with the opinion of the anæsthetist himself, and the extent of agreement or disagreement is shown in Table 25.

Table 25 shows that specialists were twice as likely to have made a similar assessment to the Committee as to why the patient died, even though this might have implied some criticism of their management of the case. Non-specialists, on the other hand, were twice as likely to disagree. The major basic disagreement between Committee and anæsthetist was when the latter attributed death of the patient to an unproven coincidental occurrence, such as myocardial infarction, in cases in which the Committee considered an error or errors of management to have been responsible.

Collapse of a patient during an anæsthetic, even when accompanied by electrocardiographic signs of myocardial ischæmia, cannot be assumed to be due to coronary occlusion. An anoxic episode of sufficient severity can produce electrical changes which are very similar and which may persist for some hours. Furthermore, the discovery of long-standing coronary artery degeneration at autopsy does not prove infarction to have been the cause of collapse. In some cases which the Committee investigated, unequivocal evidence of myocardial infarction was found, and these were classified in category 6 (Table 5).

TABLE 25

"True" Anæsthetic Deaths: Opinion of Anæsthetist as to Cause of Death

Status of Anæsthetist	Number of Cases		
	Opinion Not Given	Opinion in Agreement with Committee's Assessment	Opinion Not in Agreement with Committee's Assessment
Specialist	11	37	20
Non-specialist ..	19	45	100
Registrar	1	24	15
Resident	4	4	6
Total	35	110	141

CONCLUSIONS

It is important to distinguish between "legal" anæsthetic deaths and "true" anæsthetic deaths, and in the present survey it has been shown that the latter represent only a fifth of those deaths notified to a coroner because of their association with an anæsthetic.

Critical examination of 286 "true" anæsthetic deaths shows that a limited number of errors is responsible, and that these errors are for the most part due to the neglect of established principles of preanæsthetic preparation, choice of anæsthetic and dosage, observation and postoperative care.

Anæsthetic agents themselves are not lethal except when they are misused.

The existence of an investigating committee which studies case data, issues reports and corresponds confidentially with anæsthetists tends to exert a restraining influence on anæsthetic mortality. This influence is not due to the fear of disciplinary or legal action, since the Committee has no powers to initiate either, nor would it welcome them. It is effective because, even though the anæsthetist may disagree with the Committee's views on a particular case, he will nevertheless be made more alert to the dangers of a similar situation when he next meets it.

ACKNOWLEDGEMENTS

The Special Committee is especially aware of its debt to the anæsthetists of New South Wales. Without their unselfish cooperation, this study would have been quite impossible. The Committee is also grateful to coroners and hospital authorities for their invaluable assistance in notifying cases of death in association with anæsthesia; thanks are especially due to Dr John Laing both for notification and the provision of autopsy results from his busy

Department. The Committee also wishes to acknowledge the assistance of Mr S. O'Keefe and Mr P. Apps of the Data Processing Branch, Department of Public Health; Dr John Warden, for advice on the management of aspiration pneumonitis; Miss A. H. Windsor, of the Department of Public Health, for drawing Figures 2 and 3; and finally the patient and painstaking work of Mrs N. Loughman in the preparation of the many drafts as well as the final report.

R. HOLLAND,
Secretary.

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APPENDIX 1

Special Committee Investigating Deaths Under Anæsthesia,
Lidcombe Hospital, Joseph Street, Lidcombe

The death of the above patient has recently been notified to me as having occurred in association with anæsthesia, and I understand that you were the anæsthetist. This Special Committee investigates only those cases in which:

(*a*) Death occurs during the anæsthetic, or prior to full recovery from it (no matter what the cause).

(*b*) Death, no matter how long afterwards, may have occurred as a result of the anæsthetic, or as the result of an incident during its administration.

Consequently, considerable time can be saved by your completing the brief *questionnaire* printed below, which will enable the Committee to establish whether this case falls into either of the above categories, thus warranting further consideration. Your cooperation would be greatly appreciated and of course all communications to this Committee are strictly confidential.

Yours faithfully,
R. HOLLAND, F.F.A.R.A.C.S.
Secretary.

Cross out which does not apply.

Did the patient recover fully from the anæsthetic? (i.e., recovery of consciousness, muscle power, reflexes, and return of the circulatory state to the preoperative level).

YES NO

Did any episode occur during the anæsthetic which led to difficulty?

YES NO

(such as an episode of hypoxia, circulatory arrest, hypotension, transfusion reaction, inhalation of vomit, etc.)

If death did not occur during the administration how long afterwards did the patient die?

Minutes or hours

APPENDIX 2

Questionnaire

Part A

(1) Name of Patient:
(2) Age: (3) Sex:
(4) Approximate weight:
(5) Preoperative diagnosis:
(6) Proposed operation or procedure:
(7) Place of operation (i.e., operating theatre, casualty department, X-ray, labour ward, etc.).

Part B

(1) What preoperative examination of the patient was performed?
(2) By whom?
(3) At what stage prior to induction of anæsthesia?
(4) What findings relevant to the conduct of anæsthesia were made at the clinical examination?
(5) What laboratory investigations were undertaken?
(6) What steps were taken to prepare the patient for anæsthesia? (e.g. transfusion, intestinal decompression, etc.)
(7) How long before induction did the patient eat:
(*a*) Liquids
(*b*) Solids
(8) Was the patient considered to be a good anæsthetic risk?
(9) If not, what was the assessment of the risk involved and why?

Part C

(1) Type of anæsthetic employed (i.e., general, local, regional, spinal, topical, etc.).
(2) Premedication: (drugs given, and times before induction).
IMPORTANT: When giving doses of drugs, whether in premedication, anæsthetic, or subsequently, please state quantities in grams, milligrams or grains whenever possible, e.g., "Pentothal" 0·5 G, not "Pentothal" 10 cc, which could be 0·25 G, 0·5 G or even 1·0 G, depending on the strength of solution used.
(3) If general anæsthesia was used, please state here drugs and doses used throughout. If several doses of the one drug were given, please state initial dose and subsequent increments.
(4) Duration of anæsthesia: (Note: If cardiac arrest occurred during the anæsthetic, give time up to when arrest occurred.)
(5) Posture of patient: (if table was tilted, please give approximate angle of tilt, and for how long maintained).
(6) Was the patient intubated? If so, please state:
(*a*) Type of tube: (i.e. Magill, Oxford, etc.)
(*b*) Size:
(*c*) Cuffed or plain:
(*d*) Nasal or oral:
(*e*) Difficulties experienced, if any:
(*f*) Whether successful at first or subsequent attempt:
(7) Whether intubated or not, was patient's airway always satisfactory? If not please add some details.
(8) Did vomiting occur during induction or later?
(9) Was any vomitus inhaled, and what was its nature?
(10) Were steps taken to empty the stomach before induction? If so, what method was used?

(11) Were any other measures taken to diminish the risk of regurgitation or vomiting, and if so, what were they? (e.g. cricoid pressure, head-up tilt)

(12) If anæsthesia was administered with the aid of an anæsthetic apparatus of any kind, please state:
- (a) Type of apparatus:
- (b) Was machine in good order? Please add details if not.
- (c) Flow rates of gases used (includes oxygen, nitrous oxide, cyclopropane, etc.).
- (d) What circuit arrangement was used?
- (e) If vaporizers were used:
  - (i) What was their position in relation to the circuit? (i.e., placed inside or outside circle)
  - (ii) What agent was employed?
  - (iii) For how long?
  - (iv) In what kind of vaporizer?
  - (v) What were the vaporizer settings?
- (f) If a closed circuit type apparatus was used, was the soda lime inspected or changed during the anæsthetic?

(13) What was the ambient temperature? (approximately)
- (a) Outside the theatre?
- (b) Inside the theatre?

(14) If muscle relaxants were used, please state:
- (a) Was respiration assisted or controlled, and if so, which?
- (b) Intermittently, or throughout?
- (c) Were antagonists given, and if so, in what doses?
- (d) To what extent did recovery from paralysis occur?
- (e) What were the criteria of assessment of this recovery?

Part D

(1) If local anæsthesia was used, please state:
- (a) Drugs used, and their concentrations:
- (b) Volume of injection:
- (c) Total dose of local anæsthetic (drug(s):
- (d) With or without adrenalin, or other vasoconstrictor, and in what final concentration?
- (e) Was an aspiration test performed?
- (f) Were the drugs used drawn directly into the syringe from the manufacturer's original container?
- (g) Had this container ever been previously opened or entered?
- (h) Was it opened immediately prior to this use?
- (i) Was anything further then added to the contents of the syringe, and if so what?

(2) If spinal anæsthesia was used, please state:
- (a) Drug, vehicle, and concentration:
- (b) Volume of injection:
- (c) Mode of injection—e.g. slow, swift, or barbotage.
- (d) Height of analgesia obtained:
- (e) Pressor agents used, if any, doses, and route(s) of administration.

Part E

(1) What conditions were found at operation?

(2) What operation was performed?

(3) Were blood pressure readings taken during anæsthesia and surgery? If so, please give some details:

(4) Was the patient's colour always satisfactory? If not, please give details:

(5) Did sweating occur?

(6) What blood loss took place?
- (a) Pre-operatively?

IMPORTANT: Please try to estimate loss in mls, rather than use terms such as "moderate" or "excessive". (1 pint = 560 ml) (1 fl oz = 30 ml.)
- (b) During operation?
- (c) Postoperatively?

(7) What blood replacement, or other IV fluids were given during the operation?
- (a) Before collapse:
- (b) After collapse:

(8) Was blood readily obtainable, if needed?

(9) Was an intravenous cannula or transfusion needle *in situ* before commencing anæsthesia?

(10) How long after induction of anæsthesia was the patient's condition first noticed to have deteriorated?

(11) At what stage was the operation at this time?

(12) What was noticed at this time, and what was the subsequent course of events?

(13) What measures were then taken?

(14) How long after the initial deterioration did the circulation cease?

(15) Was cardiac massage then done?

If so:
- (a) By whom?
- (b) By the external or internal method?
- (c) If internal, by the thoracic or abdominal route?
- (d) Was an effective artificial circulation produced? (i.e., palpable carotid pulse, systolic pressure of at least 80 mm Hg)
- (e) Was simultaneous artificial respiration carried out, and if so, by what method?
- (f) Was an apparatus capable of inflating the patient's lungs immediately at hand when the emergency arose?
- (g) If so, what was this apparatus?
- (h) Was it used, and did it work satisfactorily?

(16) When the circulation apparently ceased, was the heart in asystole or ventricular fibrillation, or was it not possible to tell?

(17) Did the heart subsequently fibrillate?

(18) Was a defibrillator available?

(19) Was it used and did it work?

(20) For how long were attempts at resuscitation employed?

(21) Would you please summarize, for the benefit of the Committee, the factors which, in your opinion, led to the death of this patient?

APPENDIX 3

Management of the Patient who has Inhaled Gastric Contents

Apart from the immediate need to relieve respiratory obstruction due to impaction of foreign material or to the presence of large volumes of fluid in the major airways, the most serious problem in the management of the patient who has inhaled vomited material is the development of the so-called "acid-aspiration syndrome".

Chemical pneumonitis results from the aspiration of gastric juice which has a pH of less than 2·5, producing intense bronchospasm and a congestive reaction with peribronchiolar exudation. Cyanosis, tachypnœa and tachycardia occur, and crepitant rales, rhonchi and wheezes are heard on auscultation. A chest X-ray film will show scattered soft, mottled irregular densities (Awe *et alii*, 1966). The principal respiratory derangement is hypoxia, not carbon dioxide retention (Hamelberg and Bosomworth, 1964). In severe cases, pulmonary œdema, right-sided heart failure and shock can develop.

Tracheo-bronchial lavage can remove the irritating aspirate if performed promptly, but only small amounts (5 to 10 ml) of sodium chloride or sodium bicarbonate solution should be used, as larger amounts will spread the aspirate further into the bronchial tree. A maximum of four such lavages should be performed (Bannister *et alii*, 1961).

The mainstay of treatment is prolonged positive-pressure ventilation with 100% oxygen to minimize hypoxia (Special Committee Investigating Deaths Under Anæsthesia, 1963). Bronchodilators (such as isoprenaline) and perhaps mucolytic drugs should be administered intermittently by nebulization. Corticosteroids appear to protect against extensive lung damage by interrupting the inflammatory process (Hamilton, 1967), but may not always be essential for successful management (Lawson *et alii*, 1966). They will probably be of benefit only within the first 24 hours. A broad-spectrum antibiotic should be given, because secondary bacterial infection is likely to occur.

Blood gas studies are of considerable value in the management of these patients, and acid-base investigations are also worthwhile. Considerable metabolic acidosis can develop, owing to the absorption of acid material and to hypoxia.

Needless to say, the use of positive-pressure respiration requires that the patient be intubated, or that a tracheostomy be performed, and as with any patient attached to and dependent on a mechanical respirator, the most vigilant and intensive supervision is required to prevent technical misadventure.

APPENDIX 4

Recommended Management of Cardio-Respiratory Collapse During Anæsthesia

Unless he is already aware, the surgeon should immediately be informed. Artificial respiration with oxygen must be instituted and should pose no problems, since equipment for this purpose is already on hand, and probably in use. Provided that the airway is satisfactory, there is no urgent need to intubate, but ultimately it will be necessary to do so. The time chosen for intubation should be such that no period of hypoxia will result from the interruption to the patient's ventilation. Spontaneous respiration should not be permitted until the circulation is normal and ventilation is adequate.

With a pause only to verify the absence of a pulse in one of the large arteries (carotid, femoral, or the aorta if the abdomen is open), closed chest cardiac compression should now be instituted.

When artificial respiration and artificial circulation have been commenced, and provided the necessary additional personnel are available, the following steps should be undertaken in the order stated:

1. Correct cause of arrest if possible—for example obstructed airway, blood loss, etc.

2. Set up intravenous infusion if not already present. Send for electrocardiograph and defibrillator.

3. Administer 100 to 150 mEq of sodium bicarbonate intravenously. This is 100 to 150 ml of 8·4% solution.

4. Connect ECG to patient and ascertain whether fibrillation or asystole is present.

5. If heart is fibrillating, apply countershock. Note that the myocardium will not defibrillate if it is anoxic. Effective ventilation and compression must be continued up to the last possible moment before countershock is applied, but no person must be in direct contact with the patient when shock is passed.

6. If normal rhythm is established, but hypotension (below 80 mm Hg) persists despite administration of bicarbonate, an infusion of isoprenaline should be prepared containing 1 to 2 mg in 500 ml. This should be administered slowly until blood pressure rises to a satisfactory level (which need not be more than 90 mm Hg systolic at this stage). The occurrence of ventricular arrhythmia will require that the infusion rate of isoprenaline be slowed.

7. As soon as sinus rhythm returns, the heart must be monitored electrocardiographically for the detection of arrhythmias, and for at least 12 hours after the last abnormality of rhythm has disappeared.

8. Meticulous fluid balance charting must be instituted, and urinary output recorded on an hourly basis. This necessitates catheterization. Input must be matched to output, except for an initial diuresis. (See 9 below.)

9. Controlled dehydration up to 1,500 ml (for example with 20% mannitol) may be indicated if consciousness is not rapidly regained.

10. Temperature must be continually watched, and should not be allowed to rise above 36°C, or to fall below 33°C.

11. Acid-base studies are of great value if facilities are available. More bicarbonate may be needed, but is better delayed until the patient's acid-base status is known.

12. Anyone not accustomed to dealing with cardio-respiratory resuscitation frequently should seek consultative advice, by telephone if necessary, from an expert in this field. The directors of anæsthetics and/or resuscitation in the major metropolitan hospitals are the most readily available sources of such advice in an emergency.

The use of other drugs than the above, for example steroids, lignocaine, adrenalin and so on, may be indicated in a particular individual case. Their exclusion from the Committee's recommendations is not intended to imply that they have no place at all in the management of this crisis. However, it is unlikely that any patient will fail to survive because their use is deferred until the stage of consultation.