

NATIONAL AUDIT ON ANAESTHETIC AIRWAY MANAGEMENT

Audit Report

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EXECUTIVE SUMMARY

Introduction

Data on major airway complications in Malaysia during general anaesthesia (GA) is scarce and insufficient. The fourth National Audit Project of the Royal College of Anaesthetists and Difficult Airway Society (NAP4) reported an incidence of one major airway complication per 22,000 general anaesthesia. Reported mortality rate due to airway complications was 1 per 180,000 general anaesthesia. The National Audit on Anaesthetic Airway Management aims to analyze and summarize data on the major complications of airway management during general anaesthesia as well as the preference of airway and rescue devices utilized in selected hospitals across Malaysia.

Objectives

The main objective of this audit was to determine the incidence of major complications of airway management during general anaesthesia in 14 Ministry of Health hospitals in Malaysia.

Secondary objectives were: -

- i. To identify the preferred airway devices used during patients' airway management for general anaesthesia in the selected hospitals.
- ii. To identify the preferred airway adjuncts used for management of difficult airway.
- iii. To study the outcome of patients as a result of airway management complications.

Methodology

This audit was conducted in **14 Ministry of Health hospitals** for the **duration of 6 months**. The data collection for this study was from 2 parts: -

- i. Part 1 – Census of clinical activity (denominator information)
- ii. Part 2 – Major events reported (numerator information)

For Part 1, census of primary airway management techniques used for all elective and emergency procedures requiring general anesthesia was obtained.

For Part 2, data was obtained when any one of the primary inclusion criteria of major complications of airway management for all elective and emergency procedures were encountered. Primary inclusion criteria are as listed: -

- a) **Death**
- b) **Anticipated and unanticipated difficult airway**
- c) **Unanticipated ICU, HDU or PACU admission**
- d) **Need for an emergency surgical airway**
- e) **Trauma to the airway**
- f) **Difficulty in sustaining oxygen saturation > 94% or a persistent fall in oxygen saturation to below 94%.**

Patients who were admitted to ICU, HDU or PACU as a consequence of airway management complications were followed up at 1 month to determine their outcome.

Findings and Conclusion

The overall incidence of major airway complications from this audit is 1054 per 100,000 general anaesthesia. The individual incidences are: -

	Events	Incidence per 100,000
1.	Death	0
2.	Difficult airway	1017
3.	Unanticipated ICU admission	44
4.	Emergency surgical airway	20
5.	Significant trauma to the airway	40
6.	Significant desaturation	148

The endotracheal tube was the primary airway management technique of choice (70%), followed by supraglottic airway (25%) and facemask (5%). For management of difficult airway, video laryngoscope was the adjunct of choice

(44.6%) followed by Bougie (24.8%) and Fibreoptic scope (28.4%). Other adjuncts (2.3%) included McCoy laryngoscope, other supraglottic airway devices and nasal endotracheal tube. It is worthy to note that 7.85% used a combination of Bougie and Video laryngoscope to secure the airway. Of the 20 patients who were admitted into ICU, one developed “Brain damage” directly from the airway event, and another developed stroke and died (unrelated to the airway event) while the rest had full recovery.

Recommendations

The following are the recommendations suggested by the committee:

1. It is necessary to have a “Difficult airway” trolley that is easily accessible during emergencies. The contents of the trolley will need regular checking and replacement of airway devices when deemed necessary. (Appendix 2)
2. Difficult airway algorithm charts should be made available in all designated areas dealing with airway management. (Appendix 3)
3. Introduction of an ‘equipment for intubation checklist’ for all areas where airway manipulation is performed.
4. Intubations must be confirmed with capnography.
5. It is encouraged that all anesthesia medical officers and anesthesiologists attend and participate regularly at ‘airway workshops’ to keep abreast with skills and latest developments in airway emergencies.
6. Trained anaesthetic assistants should be available during intubation.
7. Introduction of a ‘difficult intubation card’ should be made available to all patients who have a history of difficult intubation.
8. To create a National Registry for Difficult Airway.
9. Future airway study to include other sites such as Emergency and Trauma and Intensive Care Units.

ACKNOWLEDGEMENTS

On behalf of the committee members of National Audit On Anaesthetic Airway Management, we would like to acknowledge to those who were participated and made these audit successful.

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INTRODUCTION

Expertise in airway management is one of the prime clinical skills that defines an anaesthetist. Airway management is becoming increasingly routine and safe due to the availability of airway adjuncts and advancements in airway management skills training. Over the years, airway adjuncts such as laryngeal mask airways have established important roles in both primary and rescue steps of airway management algorithms around the globe. Major complications of airway management are rare but can be among the most life threatening in medicine¹⁻². The fourth National Audit Project of the Royal College of Anaesthetists and Difficult Airway Society (NAP4) reported an incidence of one major airway complication per 22,000 general anaesthesia. Reported mortality rate due to airway complications was 1 per 180,000 general anaesthesia². The 'can't intubate can't ventilate' (CICV) situation occurred in fewer than 1 in 5000 routine general anaesthetics (GA) and required an emergency surgical airway in approximately 1 in 50 000 but can account for up to 25% of anaesthesia-related deaths³⁻⁴.

Data on major airway complications in Malaysia during general anaesthesia (GA) is scarce and insufficient. Due to the paucity of data available the vast majority of the information and acquires are obtained from large close claim settlements and critical incident databases available overseas. Therefore, it is prudent to establish a database containing information pertaining to airway management in our own local setting. The information obtained will design the architectural blue print for local practice guidelines in airway management. It will be of interest to identify the preferred choice of airway devices used for GA while scrutinizing the common airway rescue tools used by anaesthetists within the country in an emergency scenario.

The National Audit on Anaesthetic Airway Management aims to analyze and summarize data on the major complications of airway management during general anaesthesia as well as the preference of airway and rescue devices

utilized in selected hospitals across Malaysia.

OBJECTIVES

This main objective of this audit was to determine the incidence of major complications of airway management during general anaesthesia in 14 Ministry of Health hospitals in Malaysia.

Secondary objectives were: -

- i. To identify the preferred airway devices used during patients' airway management for general anaesthesia in the selected hospitals.
- ii. To identify the preferred airway adjuncts used for management of difficult airway.
- iii. To study the outcome of patients as a result of airway management complications.

METHODOLOGY

This audit was conducted in **14 Ministry of Health hospitals** for the **duration of 6 months**. The participating hospitals were as listed:-

- i. Hospital Kuala Lumpur
- ii. Hospital Tengku Ampuan Rahimah, Klang
- iii. Hospital Pulau Pinang
- iv. Hospital Sultanah Aminah, Johor Bahru
- v. Hospital Melaka
- vi. Hospital Taiping
- vii. Hospital Raja Permaisuri Banun, Ipoh
- viii. Hospital Sultanah Nur Zahirah, Kuala Terengganu
- ix. Hospital Sultan Haji Ahmad Shah, Temerloh
- x. Hospital Sibul
- xi. Hospital Miri
- xii. Hospital Umum Sarawak, Kuching
- xiii. Hospital Duchess of Kent, Sandakan
- xiv. Hospital Likas

The proposed duration of this audit was 1 year; however the committee members decided that 6 months would be sufficient to yield the appropriate results following interim analysis done at 3 months and 5 months. The participating hospitals were selected based on geographical distribution and the availability of specialists' services.

The data collection for this study was from 2 parts: -

- iii. Part 1 – Census of clinical activity (denominator information)
- iv. Part 2 – Major events reported (numerator information)

For Part 1, census of primary airway management techniques used for all elective and emergency procedures requiring general anesthesia in the participating centers was obtained. Data obtained aimed to yield information on the number of GA conducted and airway management techniques in current use. Detailed information on the primary airway management technique was documented for every general anesthetic administered.

Primary airway management was defined in this audit as airway device used during anaesthesia (facemask [with or without nasopharyngeal or oropharyngeal airway], supraglottic airway device [with or without gastric access] or tracheal tube. Tracheal intubation included all forms of intubation of the trachea, which includes, single- and double-lumen tubes, tracheostomy, surgical bronchoscopy and transglottic (e.g. cricothyroidomy) technique.

Airway adjunct was defined as an airway device used to aid in securing the airway and ensuring oxygenation.

A local site investigator was appointed to each participating center. The site investigator facilitated as the liaison person with central working committee and was responsible for the monthly submission of the required data. Collected data was submitted at the end of each month to the principle investigator.

For Part 2, data was obtained when any one of the primary inclusion criteria of major complications of airway management during GA for all elective and emergency procedures were encountered. Included are complications that occur at any time during induction, maintenance and reversal.

Primary inclusion and exclusion criteria are as listed: -

c) Death

- Mortality occurring as a direct consequence of failure of ventilation during airway management;
- **Exclusion**– Deaths occurring later in the ICU, HDU, PACU or wards are not included.

d) Anticipated and unanticipated difficult airway –

- Difficult intubation (>3 attempts of laryngoscopy), **or**
- Failed intubation, **or**
- Planned use of video laryngoscope, supraglottic airway or fiberoptic scope for intubation (for reasons other than practice).

c) Unanticipated ICU, HDU or PACU admission –

- Admission to an Intensive Care Unit or High Dependency Area that occurred as a result of an airway problem or as a consequence of aspiration of gastric contents into the trachea.

d) Need for an emergency surgical airway –

- This included all forms of emergency access to the upper trachea as part of the airway management (surgical tracheostomy, cricothyroidotomy, or tracheostomy); when this was not part of the primary airway management.

e) Trauma to the airway –

- Any form of significant airway trauma (dental or soft tissue) directly due to airway manipulation, which necessitated referral to Dental/ Oral Surgeon or ENT Surgeon.

f) Difficulty in sustaining oxygen saturation > 94% or a persistent fall in oxygen saturation to below 94% as a consequence of difficult mask ventilation or difficult laryngoscopy requiring the presence of a specialist anaesthetist.

- **Exclusion** – Patients with baseline oxygen saturation < 94% under room air before the commencement of anesthesia.

The clinician (medical officer or specialist) involved in the case filled up a Data Collection Form (Appendix 1) and submitted it to the project team within 48 hours of the above such incident. The form was scanned and sent via email or fax to

the principle investigator. The original forms were then subsequently sent via mail to the principle investigator.

Data collection included: -

- Patient's registration number
- Age, airway assessment, gender
- ASA class,
- Body mass index (BMI)
- Pregnancy status (period of gestation of more than 20 weeks)
- Surgical discipline
- Elective or emergency surgery
- Level of anaesthetic training of the primary clinician
- Surgical procedure
- Phase of anaesthesia when the complication occur
- Presence of difficult airway predictor(s)
- Type of airway device used
- Airway adjunct used if used
- Complications that occurred

Patients who were admitted to ICU, HDU or PACU as a consequence of airway management complications were followed up at 1 month to determine their outcome (full recovery, brain damage or death). **Brain damage was defined as any manifestation of central nervous system injury or deficit.**

Site Investigators from respective participating centers additionally functioned as moderators to attend to site queries with respect to this audit.

STATISTICAL ANALYSIS

The data collected was entered into Microsoft Excel 2007 Spreadsheet and Epi Info statistic software where appropriate. Incidences were calculated for each of the airway complications.

RESULTS

1. Survey of Airway Adjuncts available in the 14 Audit Centres

	Hospital	Bougie	McCoy Laryngoscope	LMA without gastric assess	LMA with gastric assess	Intubating LMA	Fibreoptic scope	Video laryngoscope
1.	Hospital Kuala Lumpur	✓	✓	✓	✓	✓	✓	✓
2.	Hospital Tengku Ampuan Rahimah, Klang	✓	✓	✓	✓	✓	✓	✓
3.	Hospital Pulau Pinang	✓	✓	✓	✓	✓	✓	✓
4.	Hospital Sultanah Aminah, Johor Bahru	✓	✓	✓	✓	✓	✓	✓
5.	Hospital Melaka	✓	✓	✓	✓	✓	✓	✓
6.	Hospital Taiping	✓	✓	✓	✓	Not available	✓	✓
7.	Hospital Raja Permaisuri Banun, Ipoh	✓	✓	✓	✓	✓	✓	✓
8.	Hospital Sultanah Nur Zahirah, Kuala Terengganu	✓	✓	✓	✓	✓	✓	✓
9.	Hospital Sultan Haji Ahmad Shah, Temerloh	✓	✓	✓	✓	✓	✓	Not available
10.	Hospital Sibul	✓	✓	✓	✓	✓	✓	✓
11.	Hospital Miri	✓	✓	✓	✓	✓	✓	✓
12.	Hospital Umum Sarawak, Kuching	✓	✓	✓	✓	✓	✓	✓
13.	Hospital Duchess of Kent, Sandakan	✓	✓	✓	✓	✓	✓	Not available
14.	Hospital Likas	✓	✓	✓	✓	✓	✓	✓

Tabulated findings from a preliminary audit performed revealed that the 14 participating hospitals possessed the common airway adjuncts that are used in the management of difficult airway, with the exception of Hospital Duchess of Kent, Sandakan and Hospital Sultan Haji Ahmad Shah, Temerloh where there were no available video laryngoscopes; and Hospital Taiping where Intubating LMAs were not available.

2. Part 1 : Census of Primary Airway Management Technique in all General Anaesthesia (N= 45,411)

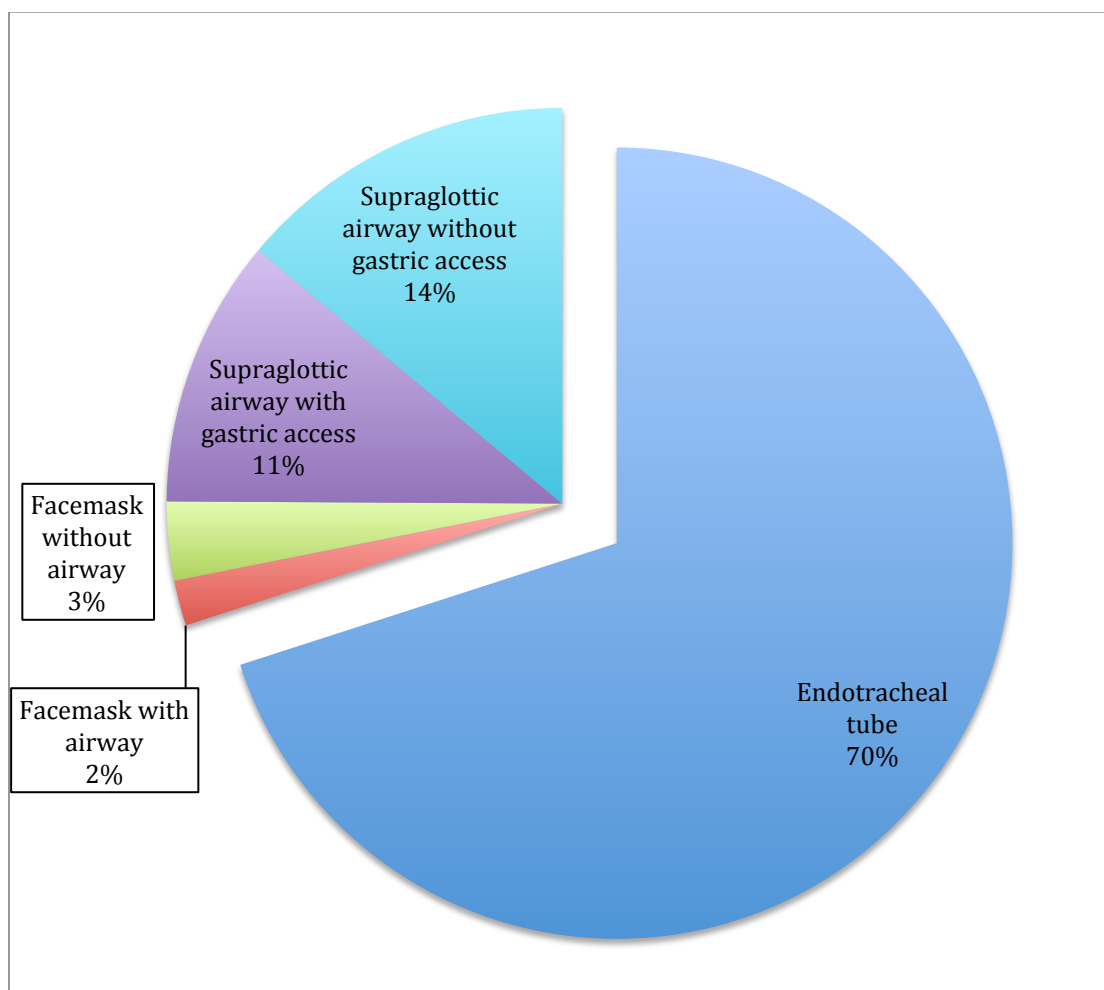


Chart 1 : Choice of primary airway device used during general anaesthesia. (n= 45,411)

A total of 45,411 cases were analyzed during the 6-month study period. This number included cases that were under the elective and emergency list undergoing GA. The vast majority 31,799 (70%) of the airway devices used in

this audit was the endotracheal tube. Supraglottic airway was used in 11,313 cases (25%); in which 11% (6331) were supraglottic airway with gastric access and 14% (4982) were classic LMAs. A mere 5% (2299) used facemask as their choice of airway device. Further analysis of the 5% facemask usage showed that 2% (841) used an airway (either nasopharyngeal or oropharyngeal) in addition to facemask while the remaining 3% (1458) did not.

3. Part 2: Events Reported

3.1. Incidence of major airway complications

	Events	Number of events (n)	Incidence per 100,000($n/N \times 100,000$)
1.	Total overall reporting	479	1054
2.	Death	0	0
3.	Difficult airway	462	1017
4.	Unanticipated ICU admission	20	44
5.	Emergency surgical airway	9	20
6.	Significant trauma to the airway	18	40
7.	Significant desaturation	67	148

Table 2 : Number of events reported and the incidence. (*N = 45411, derived from Part 1).

Over the 6-month audit period, the total number of major airway events reported was 479, resulting in an incidence of 1054 per 100,000 patients. While the incidences of other complications ranged from 0 to 148 per 100,000, the incidence of **difficult airway** is 1017 in 100,000 patients or **1.017%**. This figure is consistent with the difficult intubation rates of 1.5% to 3.8% as reported by Crosby et al⁵.

The number of **Desaturation** reported was 67, an incidence of 148 in 100,000 patients. There was no death reported as a direct consequence of an airway event.

We followed up the 20 patients who were admitted to ICU for 1 month; 1 of them developed "Brain damage" directly from the airway event, 1 developed stroke and died (unrelated to the airway event) while the rest had full recovery.

In the case of the patient who developed Brain Damage, there was a loss of surgical airway at the end of the procedure due to the surgeon's inability to exchange the J-Tube to a standard tracheostomy tube.

Thus, the incidence of Brain Damage is 1 per 45,411 general anaesthetic or 2.2 per 100,000 while the NAP4 recorded approximately 1 brain damage per 1 million general anesthetic.

3.2. Incidence of major airway complications according to centres.

	Centre	Total cases under General Anaesthesia	Total of events reported	Incidence per 100,000
1.	Hospital Kuala Lumpur	7238	81	1119
2.	Hospital Tengku Ampuan Rahimah, Klang	3722	40	1075
3.	Hospital Pulau Pinang	3909	55	1407
4.	Hospital Raja Permaisuri Banun, Ipoh	4095	9	220
5.	Hospital Melaka	3024	21	694
6.	Hospital Sultanah Aminah, Johor Bahru	5181	66	1274
7.	Hospital Umum Sarawak, Kuching	4324	85	1966
8.	Hospital Sibu	1603	27	1684
9.	Hospital Miri	1167	6	514
10.	Hospital Sultanah Nur Zahirah, Kuala Terengganu	3130	37	1182
11.	Hospital Likas	2546	11	432
12.	Hospital Duchess of Kent, Sandakan	1280	12	938
13.	Hospital Sultan Haji Ahmad Shah, Temerloh	1607	1	62
14.	Hospital Taiping	2585	28	1083

Table 3 : Incidence of major airway complications according to centres.

The incidences of major airway complications of most participating centers are quite close to the national incidence of 1017 in 100,000. Two centers recorded low incidences, namely Hospital Raja Permaisuri Banun, Ipoh (220 in 100,000) and Hospital Sultan Haji Ahmad Shah, Temerloh (62 in 100,000) while Hospital Umum Sarawak's incidence of reporting was the highest at 1966 in 100,000 incidences.

3.3. Descriptive statistics of the case reports (events) N = 479

3.3.1. Demography

		Demography	
1.	Gender	Male	65.1%
		Female	34.9%
2.	ASA Class	1	36.7%
		2	51.4%
		3	9.8%
		4	1.3%
		Missing data	0.8%
3.	Body mass index	<18.5	5.2%
		18.5-22.9	21.3%
		23-27.4	22.3%
		27.5-34.9	18.4%
		35-39.9	5.2%
		40-54.9	3.1%
		>55	0.4%
		N/A	24.1%
4.	Type	Elective	62.6%
		Emergency	37.4%
5.	Age [Mean (SD)]		43.5 (19.0)
6.	Obstetric patient	Yes	4.8%
		No	95.2%

Table 4 : Demography of the case reports

Analysis of the audit shows that the majority of airway events occurred in the following groups; male, elective cases, ASA Class I & II and in non-obstetric patients.

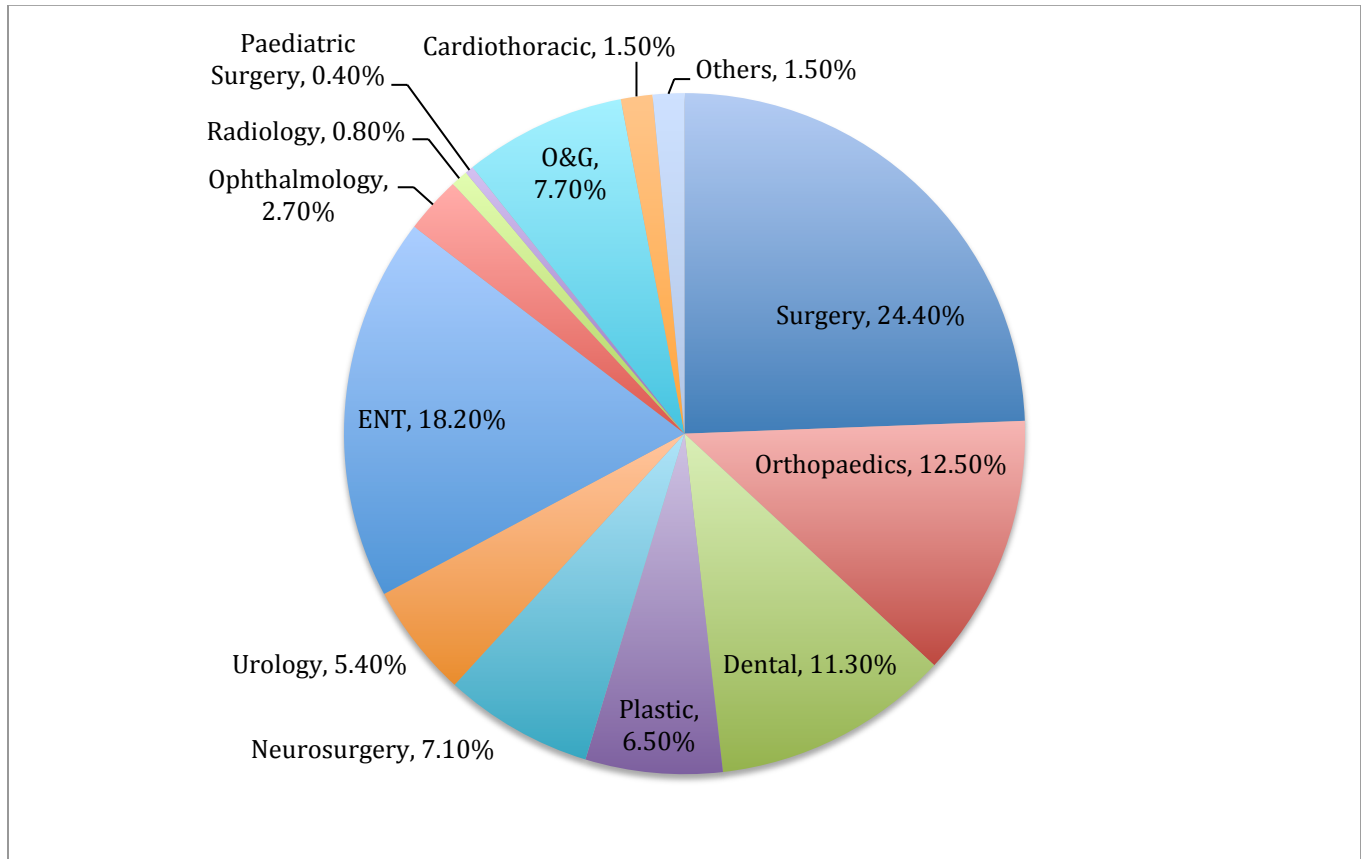


Chart 2 : Percentages of events reported according to surgical disciplines

Almost a quarter of the reported airway events were from General Surgery (24%), followed by ENT at 18.2%. Radiology and Paediatric Surgery were lower at 0.8% and 0.4% respectively.

3.3.2. Primary airway management device, primary clinician and phase of anaesthesia during the airway event.

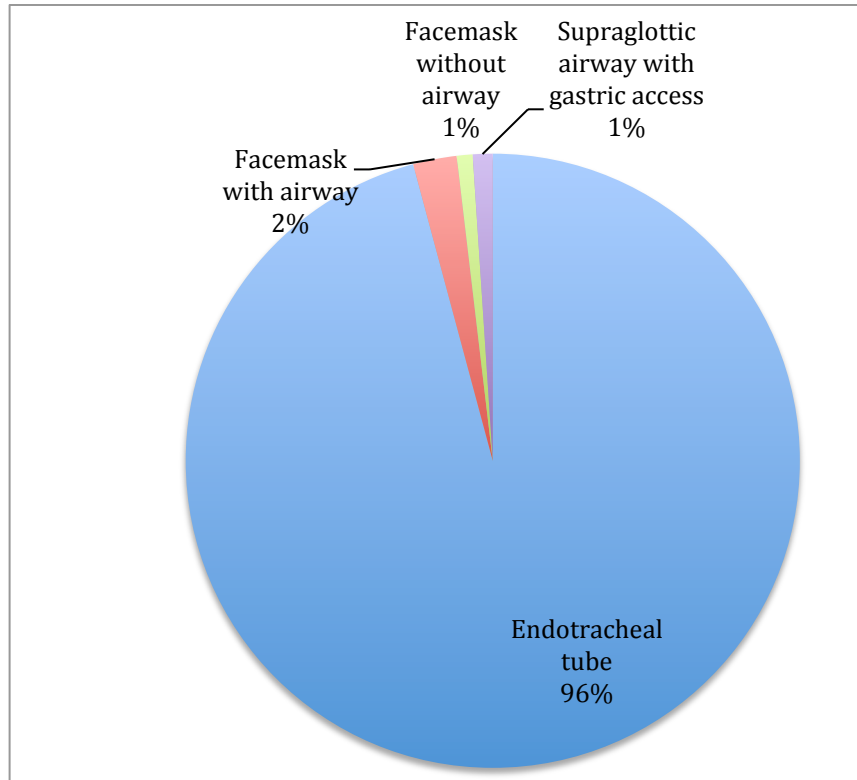


Chart 3 : Primary airway management techniques used during major airway events

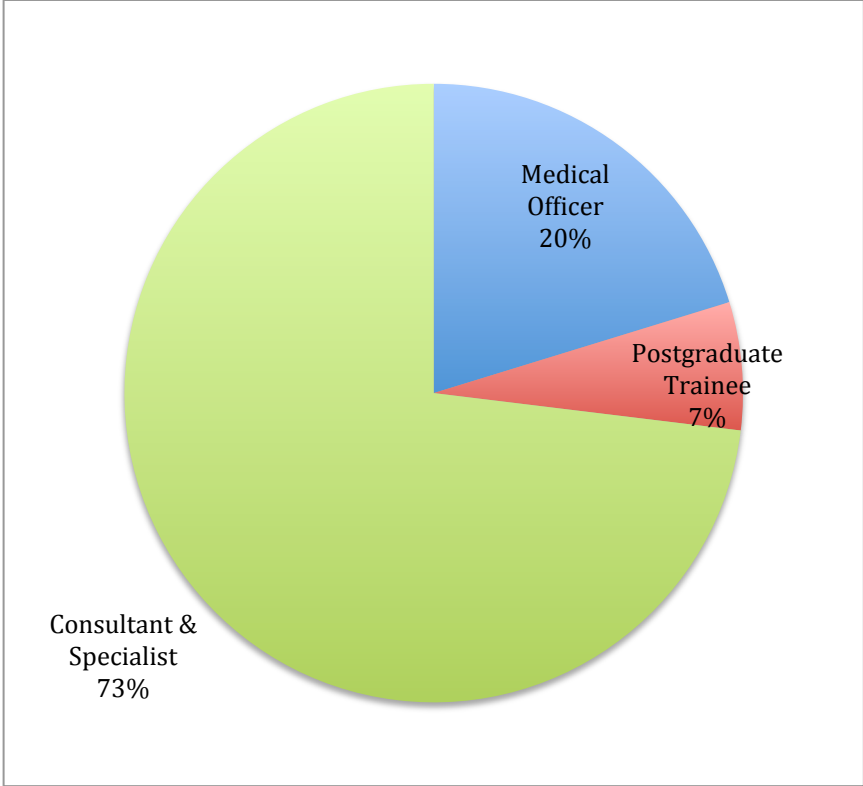


Chart 4 : Seniority of primary clinician during major airway events.

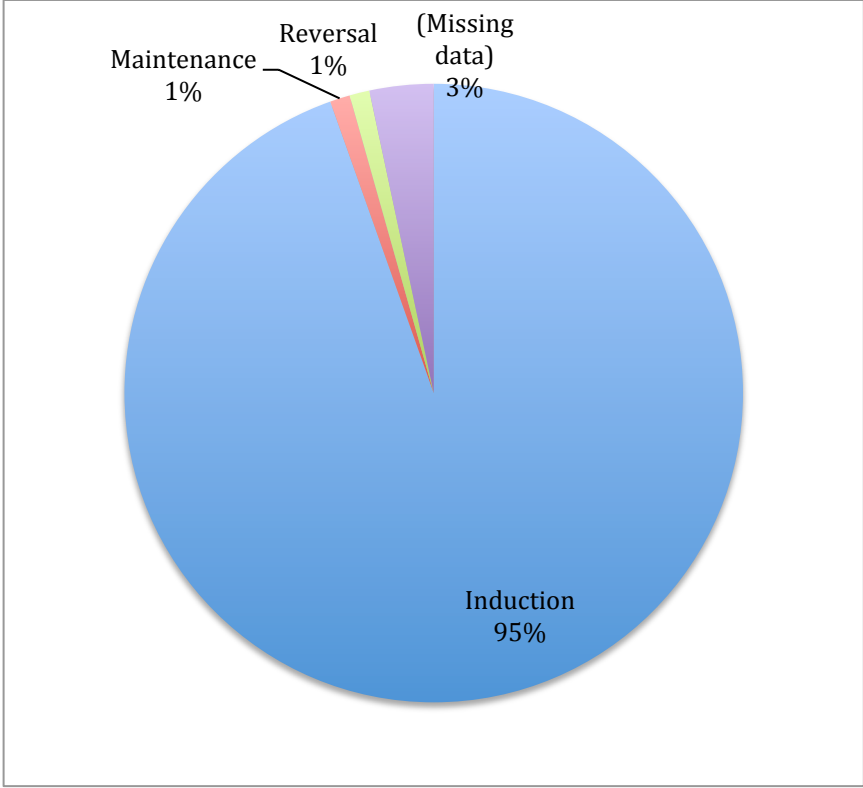


Chart 5 : Phase of anesthesia during major airway events.

Most of the major airway events occurred during the use of an endotracheal tube (96%) and during the induction phase (95%). Consultant and specialist anaesthetists (73%), anaesthetic medical officers (20%) and postgraduate anaesthetic trainees (7%) were present from the onset of the airway events.

3.4. Presence of predictors of difficult airway

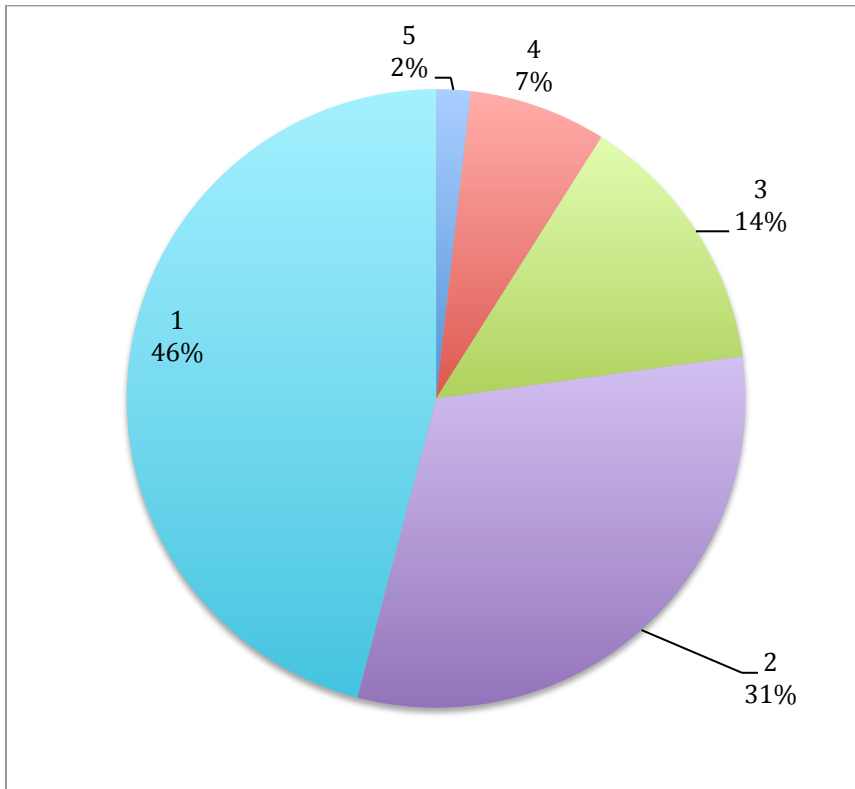


Chart 6 : Number of difficult airway predictors present in the case reports (n=390).

A total of 390 out of the 479 reported cases of airway complications had predictors of difficult airway. 46% cases demonstrated 1 predictor of a difficult airway while 31% had 2 predictors of a difficult airway.

	Predictor	Percentage present (n=390)
1.	History of difficult intubation	7.7%
2.	Mallampati 3	27.9%
3.	Mallampati 4	5.8%
4.	Thyromental distance < 3 fingerbreadths	24.9%
5.	Mouth opening < 2 fingerbreadths	24.9%
6.	Limited neck range of movement	19.5%
7.	Receding chin	26.2%

8.	Anatomical variation	22.1%
9.	Syndromes associated with difficult airway	4.6%
10.	Others	24.4%

Table 5 : Prevalence of predictors of difficult airway

Table 5 shows the prevalence of individual difficult airway predictors. It is evident that there was no single predictor that can be highlighted in our study.

The highest prevalence of reporting for difficult airway predictors was the Mallampati 3 score (27.9%) followed by receding chin (26.2%). History of difficult airway and syndromes associated with difficult airway had low prevalence of reporting at 7.7 % and 4.6% respectively. The predictors listed under the category “Others” (24.4%) included severe facial trauma, facial or inhalational burn, unstable cervical spine and dental factors e.g. loose teeth.

3.5. Preferred Airway Adjuncts During Major Airway Events

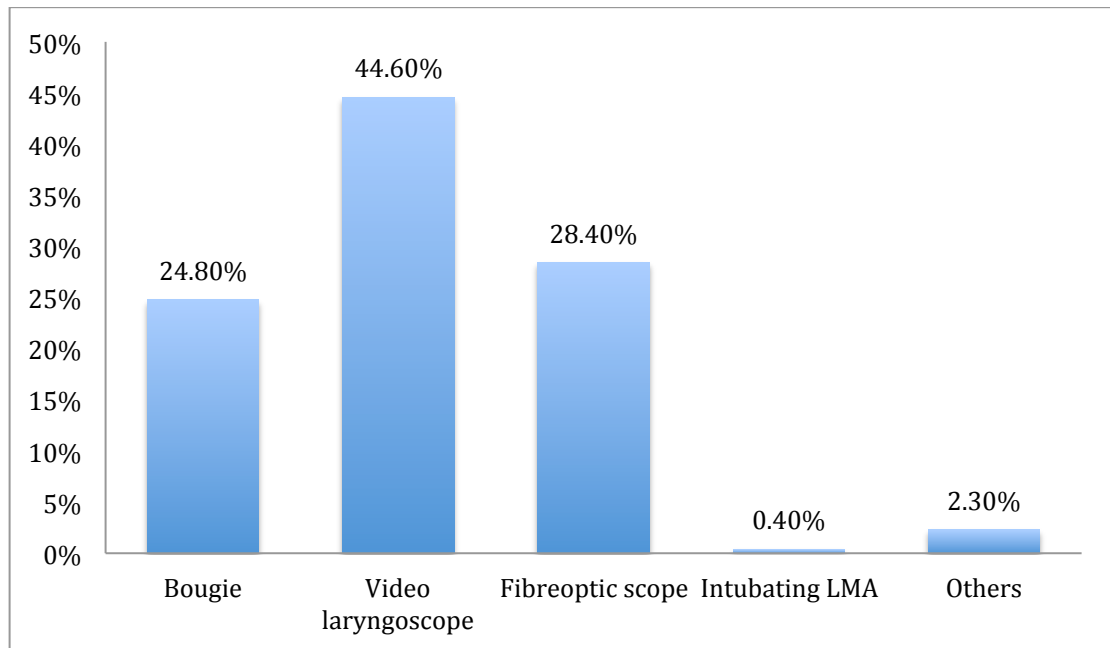


Chart 7 : Preferred airway adjunct during major airway events.

446 out of 479 major airway events reported the use of airway adjuncts for the management of difficult airway.

Video laryngoscope (44.6%) was the preferred adjunct of choice during an airway event, followed by the usage of the Bougie (24.8%) and fiberoptic scope (28.4%). McCoy laryngoscope, supraglottic airway devices and nasal endotracheal tube were included under 'Others'(2.3%). Further analysis showed that 7.85% used a combination of Bougie and Video laryngoscope to secure the airway.

DISCUSSION

Primary airway management technique

This audit shows that the endotracheal tube (70%) is still the mainstay of airway management technique in Malaysia followed by the supraglottic airway (25%).

These data suggest that the endotracheal tube is still the mainstay of airway management during general anesthesia in Malaysia. This practice differs significantly from practices at the United Kingdom (National census of airway management techniques for anaesthesia in the UK), where the mainstay of airway management were supraglottic airways².

This could be due to the fact that all the participating hospitals in our audit were secondary and tertiary referral centres that performed complex surgeries, which may necessitate the use of endotracheal tube. However, these findings may also just reflect the current practice in Malaysia where anaesthesiologists prefer the use of endotracheal tube to the supraglottic airway devices.

Supraglottic airway devices are widely available for usage in all the participating hospitals in our audit. Further analysis will need to look into the preference of intubating the trachea over the use of supraglottic airways. The reason(s) for the preferences in choosing the particular airway device was not included in this audit.

Utilization of facemask in 5% of the patients was comparable to the results from the NAP4². The practice in Malaysia is for the facemask to be used mainly for short and simple procedures.

Incidence of major airway complications

The overall incidence of major airway events (1054 per 100,000 general anaesthesia) in this audit is higher compared to the fourth National Audit Project of the Royal College of Anaesthetist and Difficult Airway Society (NAP4) (1 in

22,000)². These 2 audits are not comparable due to the differences in the inclusion criteria for our study. We included the criteria of anticipated and unanticipated difficult airway and desaturation which may have contributed to the higher incidence. Technically, these 2 criteria are not airway complications but were included as events to be reported in our study.

There were no deaths reported in this audit. The incidence of emergency surgical airway and unanticipated ICU admissions was approximately ten-fold to that of NAP4's². This may be attributed to the complexity of the patients and surgeries performed in the participating hospitals, and the lack of a single reliable difficult airway predictor as shown in our study.

Demography

From the 479 major airway events reported in the audit, higher proportion is seen in the following groups; male gender, ASA I and II physical status and also those who have undergone elective non-obstetric surgeries. Majority of the patients who developed complications were noted to be within a body mass index of 18.5 to 34.9, however, the actual relationship between body mass index and incidence of airway complications is uncertain. Our findings were probably not very different from that revealed by Brodsky et al⁶ who has demonstrated that absolute body weight and body mass index were not reliable in predicting difficult intubation. From the data obtained, obstetric patients did not vastly contribute to the number of patients developing airway complications. The most plausible explanation is that most of the obstetric surgeries i.e. Lower Segment Caesarean Section are routinely done under regional anaesthesia, hence the apparent lower incidence of airway complications.

Primary Clinician and Phase of Anaesthesia during Event

Consultants and specialists were present and managed up to 73% of the events when they occurred. As about two thirds (62.6%) of these events occurred during elective surgery, this reflects our practice of having a consultant supervised elective list. Furthermore, some cases would have already been identified as

candidates of difficult airway, necessitating the presence of the consultant or specialist prior to the event.

While most of the events in this audit occurred during the induction phase, there may still be a possibility of events occurring during the maintenance and reversal phase. The high incidence (95%) of the reported events during induction can be attributed to the airway manipulation performed during intubation.

Predictors of Difficult Airway

Predictors of difficult airway (refer to Table 5) were only found in 81% of the reported airway complications in this audit.

Our audit was not designed to investigate the sensitivity and specificity of difficult airway predictors. Analysis of this audit also shows that the presence of increased number of difficult airway predictors did not necessarily and accurately predicts a difficult airway. This corresponds to literature that suggests Mallampati score, thyromental distance and neck range of movement were of no significant value in predicting difficult airway^{7,8}. Alternative tests such as the upper lip bite test has since been proposed to be a more accurate predictor of difficult airway^{9,10}.

Preferred Airway Adjuncts during Airway Event

Video laryngoscope was the device of choice in the management of difficult airway in our audit. A total of 44.6% of difficult airway was successfully managed by using video laryngoscope. This practice is in accordance with the global practices in which video laryngoscopy has been adopted increasingly in such events². Till date, meta-analyses and systematic reviews have successfully demonstrated that in comparison with conventional direct laryngoscopy, video laryngoscopy was able to provide better glottis visualization and this was more pronounced in difficult intubations than routine intubations^{11, 12}. Hence, video laryngoscopy was proven to achieve better success in patients at a higher risk of difficult laryngoscopy¹³. With the mounting evidence of its success in managing

the difficult airway, video laryngoscopy has been included in the latest guidelines of American Society of Anesthesiologists Difficult Airway Algorithm. Its use has not only been highlighted as a rescue device but also as an initial equipment for intubation¹⁴. Although video laryngoscopy may act as a life-saving intubating device, its use is not free of complications. Among the common complications reported are palatopharyngeal, anterior tonsillar pillar or soft palate perforations caused by the tracheal tube, even without apparent force or difficulty during intubation. Fortunately, most of the reported complications recovered satisfactorily without any major disabilities^{15,16,17}. As blind advancement of an endotracheal tube has been identified as the most common factor leading to airway mucosal injuries, the tip of the endotracheal tube must be always kept in line of sight when it is advanced during the tracheal intubation¹⁸.

Limitations

1. While all attempts were made by the site investigator to ensure proper and timely reporting, over reporting or under reporting cannot be ruled out. This is especially true for events happening after office hours.
2. This audit only focused on airway management in the operating theaters, but not the Accident and Emergency Department and Intensive Care Unit where potential airway complications can commonly occur.

SUMMARY AND CONCLUSION

The overall incidence of major airway complications from this audit is 1054 per 100,000 general anaesthesia.

The endotracheal tube was the primary airway management technique of choice (70%) , followed by supraglottic airway (25%) and facemask (5%).

For management of difficult airway, video laryngoscope was the adjunct of choice (44.6%) followed by Bougie (24.8%) and Fibreoptic scope (28.4%). Other adjuncts (2.3%) included McCoy laryngoscope, other supraglottic airway devices and nasal endotracheal tube. It is worthy to note that 7.85% used a combination of Bougie and Video laryngoscope to secure the airway.

Of the 20 patients who were admitted into ICU, one developed “Brain damage” directly from the airway event, and another developed stroke and died (unrelated to the airway event) while the rest had full recovery.

RECOMMENDATIONS

Avoidance of airway complications requires institutional and individual preparedness, careful assessment, good planning and judgment, good communication and teamwork, knowledge and use of a range of techniques and devices, and a willingness to stop performing techniques when they are failing.

The following are the recommendations suggested by the committee:

1. It is necessary to have a “Difficult airway” trolley that is easily accessible during emergencies. The contents of the trolley will need regular checking and replacement of airway devices when deemed necessary. (Appendix 2)
2. Difficult airway algorithm charts should be made available in all designated areas dealing with airway management. (Appendix 3)
3. Introduction of an ‘equipment for intubation checklist’ for all areas where airway manipulation is performed.
4. Intubations must be confirmed with capnography.
5. It is encouraged that all anesthesia medical officers and anesthesiologists attend and participate regularly at ‘airway workshops’ to keep abreast with skills and latest developments in airway emergencies.
6. Trained anaesthetic assistants should be available during intubation.
7. Introduction of a ‘difficult intubation card’ should be made available to all patients who have a history of difficult intubation.
8. To create a National Registry for Difficult Airway.
9. Future airway study to include other sites such as Emergency and Trauma and Intensive Care Units.

Recommended List of Airway Devices for Ministry Of Health Hospitals

In Malaysia, anaesthetic services are provided by

- a) Minor hospitals without specialists
- b) Minor hospitals with specialists
- c) Major hospitals with specialists
- d) Tertiary or stand alone hospitals

In the ideal setting, appropriate and advanced airway equipment should be made available in all hospitals with anesthesia facilities. However at present, certain hospitals providing anaesthesia services may be limited by infrastructure, equipment and manpower.

The importance of appropriate equipment to manage the difficult airway has been highlighted by the publication of the Australian and New Zealand College of Anaesthetists (ANZCA) guidelines in 2012.

We have tabulated recommendations on airways devices that are appropriate and achievable for the current times. However, these recommendations need to be reviewed periodically and updated regularly in tandem with the continuous improvement of our resources. The following table summarizes the equipment that should be available in the various ranges of hospitals within Malaysia.

Recommended List of Airway Devices for MOH Hospitals

Type of Hospital	Airway Devices					
	Standard Laryngoscope and full range of blades+ McCoy blades	LMA (Standard, Disposable or Proseal)	Intubating LMA	Video Assisted Laryngoscopes (VAL)	Other difficult intubating devices (E.g. Bonfils)	Fiberoptic Intubation set
Minor hospitals without specialists	Must have	Must have	Optional	Optional	Not necessary	Not necessary
Minor hospitals with specialists	Must have	Must have	Must have	Must have one set	Not necessary	Should have
Major hospitals with specialist	Must have	Must have	Must have	At least one set per OT complex	Optional	Must have
Tertiary or stand alone hospitals	Must have	Must have	Must have	May have various types of VAL's	Optional	Must have

Other considerations:

1. Bougies must be made available in all anaesthetising locations and Intensive Care Units.

2. Hospitals with OT (Operating Theatre) complexes in separate buildings (e.g. Women and Child Block, Ambulatory Care Centre) will need to have at least one Video assisted Laryngoscope (VAL) set in each OT facility.
3. Remote anaesthesia services (e.g. CT scan, Angio suites or ECT rooms) must have bougies and a range of LMA's immediately available upon request.
4. Maternity OT must have Bougies, LMA's or video assisted laryngoscopes immediately available upon request.
5. Awake fiberoptic intubation can only be used by those already trained in this technique.

APPENDIX 1 – DATA COLLECTION FORM

NATIONAL AUDIT ON AIRWAY MANAGEMENT, MALAYSIA

Center :

Number :

Date :

Data Collection Form

1. Demography

(a)	Registration number				
(b)	Age				
(c)	Gender	(1) Male		(2) Female	
(d)	ASA Class				
(e)	BMI	(1) <18.5, (2) 18.5 – 22.9, (3) 23.0 – 27.4, (4) 27.5 – 34.9, (5) 35.0 – 39.9 (6) 40.0 – 54.9 (7) ≥ 55.0			
(f)	Obstetric patient?	(1) Yes		(2) No	
(g)	Surgical Discipline	(1)Surgery, (2)Orthopaedics, (3)Dental, (4)Plastic, (5)Neurosurgery, (6)Urology, (7)ENT, (8)Ophthalmology, (9)Radioangio Suite, (10)Remote, (11)Pediatrics Surgery, (12) Obstetrics & Gynaecology, (13) Cardiothoracic, (14) Others			
(h)	Elective / Emergency	(1) Elective		(2) Emergency	
(i)	Surgery				

2. Airway assessment

(a)	Were there predictor(s) of difficult airway?		(1)YES / (2)NO	
(b)	If 'YES', indicate which of the listed present (can be multiple).	(i)	History of difficult intubation	
(ii)		Mallampati 3		
(iii)		Mallampati 4		
(iv)		Thyromental distance < 3 FB		
(v)		Restricted mouth opening < 2FB		
(vi)		Limited range of neck movement		
(vii)		Receding chin		
(viii)		Anatomical variation (lumps, tumour)		
(ix)		Associated syndromes		
(x)		Others (please state):		

3. Trigger factor(s) for reporting that occurred (can be multiple) [Please tick]

	Complication	Yes (1)	No (2)
(a)	Death		
(b)	Anticipated / unanticipated difficult airway		
(c)	Unanticipated ICU, HDU or PACU admission		
(d)	Emergency surgical airway		
(e)	Significant trauma to the airway		
(f)	Desaturation < 94% due to difficult mask ventilation or difficult laryngoscopy.		

4. Anaesthesia and airway management [Choose the appropriate answer]

(a)	Level of anaesthetic training of the primary clinician. 1. Medical officer 2. Trainee 3. Specialist 4. Consultant 5. Assistant Medical Officer		
(b)	Phase of anaesthesia when complication occur 1. Induction 2. Maintenance 3. Reversal		
(c)	Primary airway management technique 1. Endotracheal tube 2. Facemask with NPA/ OPA 3. Facemask without NPA/ OPA 4. Supraglottic airway device with gastric access 5. Supraglottic airway device without gastric access		
(d)	If SAD was used, indicate type 1. LMA 2. LMA Proseal 3. LMA Supreme 4. Intubating LMA 5. Igel 7. Laryngeal tube 6. Others		
(e)	Any use of airway adjunct? 1. Yes 2. No		
(f)	Airway adjunct used that helped to secure the airway (can be multiple)		
	(i)	Bougie	
	(ii)	Glidescope	
	(iii)	C Mac	
	(iv)	Fibreoptic bronchoscope	
	(v)	McCoy Laryngoscope	
	(vi)	Intubating LMA	
	(vii)	Others (specify) :	

- **Primary clinician** – The most senior clinician who is present when the complication occurs.
- **Trainee** – Medical officers who are in the postgraduate anaesthesiology programme
- **NPA** – Nasopharygeal airway; **OPA** – Oropharyngeal airway

5. Outcome of the patient who is admitted to ICU, HDU or PACU at 1 month

	Outcome (choose one)	
(1)	Full recovery	
(2)	Brain damage	
(3)	Death	

APPENDIX 2 – DIFFICULT AIRWAY TROLLEY

Difficult Airway Trolley (DAT)

What does the ideal DAT look like?

- Top work surface and 4-5 drawers
- Mobile
- Robust
- Stocked in a logical sequence
- Clearly labelled
- Easily cleaned
- Attached documentation
 - DAS/modified local guidelines
 - Checklist for restocking
 - Logbook for daily checking
- Reproducible



Top of trolley

- Flexible intubating fibrescope
 - portable scope with battery light source
 - portable stack system
 - e.g. Storz Tele Pack
 - or single use fibrescope
 - e.g. Ambu aScope



Side of trolley

- Bougies – adult and paediatric
- Aintree Intubation Catheter
- Airway exchange catheter



Drawer 1 – Plan A

- Optimise head position
- Bougie
- Alternative laryngoscope



Contents

- Bougie (ideally on side of trolley)
- Short handle laryngoscope
- McCoy blade and/or straight blade
- Videolaryngoscope



Drawer 2 – Plan B

- LMA
- Followed by fiberoptic tracheal intubation through LMA



Contents

- LMA #3,4,5 &/or 2nd generation device #3,4,5
- Intubating LMA (iLMA) #3,4,5
- Aintree Intubating Catheter (ideally on side of trolley)
- Fiberoptic adjuncts*



Drawer 2 – Plan B

- Fiberoptic adjuncts*
 - Berman/Ovassapian airways
 - Mucosal atomisation devices
 - Fibrescope-compatible angle connector
 - Nasal sponge
 - 4% lignocaine
 - 10% lignocaine
 - Instillagel
 - Co-phenylcaine

(*Alternatively these can be stored in a separate storage box which accompanies the trolley)



Drawer 3 – Plan C

- Bag mask ventilation +/- airway adjuncts
- Supraglottic airway device



Contents

- Facemasks – various sizes
- Oropharyngeal airways – various sizes
- Nasopharyngeal airways – various sizes
- LMA/Proseal LMA - #3,4,5



Drawer 4 – Plan D

- Surgical cricothyroidotomy



Contents

- Large bore cannula device eg. Quicktrach I or II (VBM)
- Scalpel (No. 20 blade)
- Tracheal dilator or tracheal hook
- Bougie
- Cuffed tracheal tube #6 & 7



Drawer 5 – Plan D

- Cannula cricothyroidotomy



Contents

- Kink-resistant jet ventilation cannula e.g. Ravussin (VBM)
- High &/or low pressure ventilation system e.g. Manujet III (VBM)
- Ventrain (Ventinova)

















Miscellaneous

- DAS intubation guidelines (laminated)
- Or locally agreed algorithms
- Equipment checklist for re-stocking
- Logbook for daily checking procedures

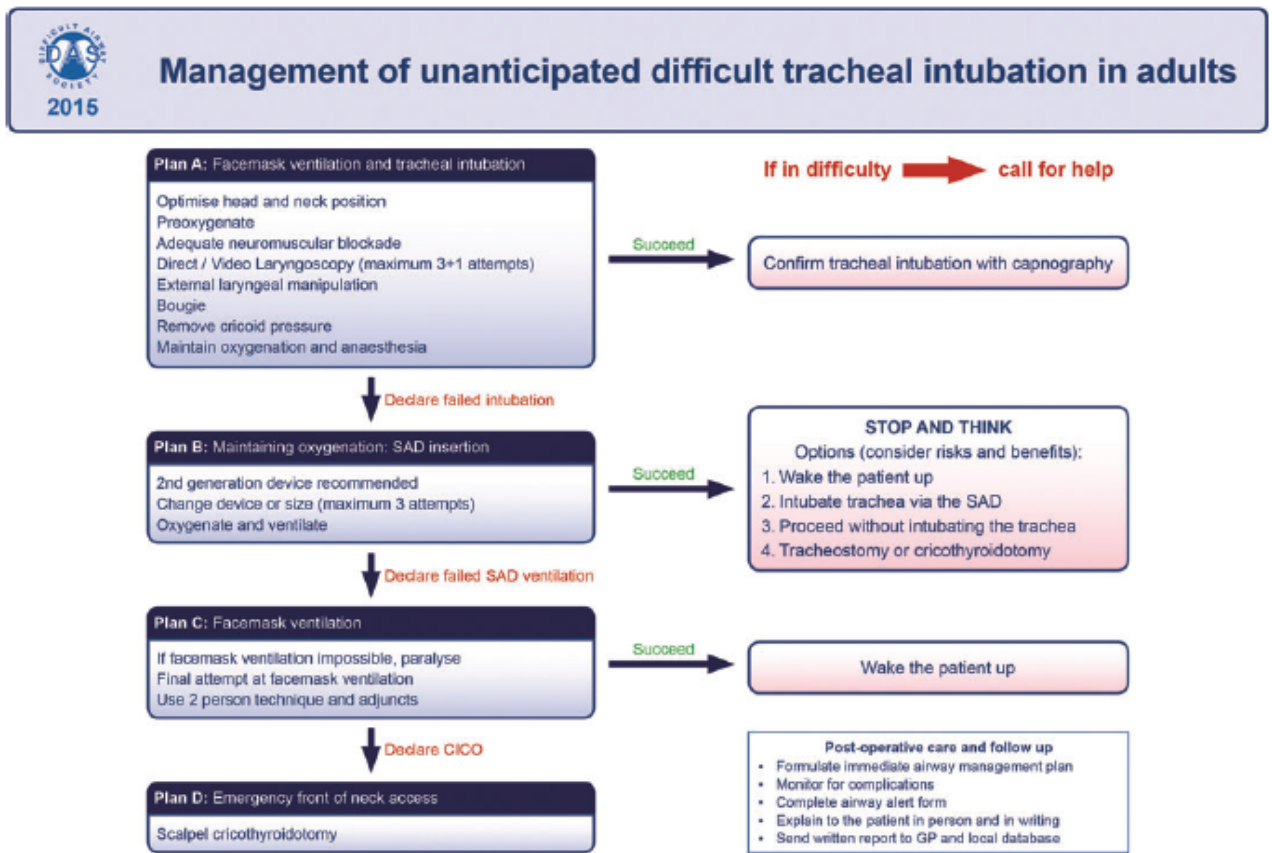
May also consider:

- Specific extubation aids/equipment
eg. Staged Extubation Set (Cook Medical)
- Extubation guidelines (laminated)

Suggestions for drawer labels

Plan A Initial intubation strategy	Optimise position	Bougie	Alternative laryngoscope
Remember to move on if not making progress			
Plan B Secondary intubation strategy	LMA device	Fibreoptic intubation	
Remember to move on if not making progress			
Plan C Maintain oxygenation	Facemask +/- airway adjunct	LMA device	
Postpone surgery Awaken patient			
Plan D Can't intubate, can't ventilate	Cannula cricothyroidotomy		
Remember to move on if not making progress			
Plan D Can't intubate, can't ventilate	Surgical cricothyroidotomy		
Remember to move on if not making progress			

APPENDIX 3 – DIFFICULT AIRWAY ALGORITHM



This flowchart forms part of the DAS Guidelines for unanticipated difficult intubation in adults 2015 and should be used in conjunction with the text.

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