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REPORTS OF ORIGINAL INVESTIGATIONS

Performance and impact of an airway management team launched during the COVID-19 pandemic

Performance et impact d'une équipe de prise en charge des voies aériennes lancée pendant la pandémie de COVID-19

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Abstract

Purpose *To determine the performance and impact of an airway management team (AMT) assembled during the COVID-19 pandemic.*

Methods *We conducted a retrospective cohort review of all adult patients who had received airway management services from the AMT (n = 269) and administered a survey questionnaire targeting physicians who had the option to activate the AMT (n = 77). The retrospective review determined the performance of the AMT, and the physicians' survey evaluated the impact of the AMT. The study was conducted at a large Canadian health centre (1,133 beds) from 28 March to 30 June 2020. We included patients in the cohort review who were ≥18 yr of age, whose chart showed that the AMT was activated, and whose airway was managed outside the operating room. We reviewed both electronic medical records and paper chart documentation. Outcomes included intubation success, number of intubation attempts, intubation time, team response time, patient contact time, intubation complications, and breaches of personal protective equipment (PPE) protocol. The physicians' survey evaluated the relevance, performance, reasonableness, and clinical utility of the AMT.*

Results *The AMT intubated 231 patients. Charts showed that 91% of intubations were accomplished on first attempt. The mean (standard deviation) intubation time was 2.1 (0.2) min. The complication rate was minimal. The incidence of breaching PPE protocol items was less than 6%. No AMT members reported COVID-19 symptoms. The response rate for the physician's survey was 36%. The consensus among the participants was that the AMT had considerable clinical utility during the COVID-19 pandemic.*

Conclusion *An AMT assembled during the COVID-19 pandemic showed high competency and effectiveness, and had favourable impact on the main responsible physicians who activated the team.*

Résumé

Objectif *Déterminer la performance et l'impact d'une équipe de prise en charge des voies aériennes (AMT - Airway Management Team) assemblée pendant la pandémie de COVID-19.*

Méthode *Nous avons réalisé une revue de cohorte rétrospective de tous les patients adultes qui avaient bénéficié des services de prise en charge des voies aériennes par l'AMT (n = 269) et avons soumis un questionnaire aux médecins qui avaient eu la possibilité de faire appel à l'AMT (n = 77). La revue rétrospective a permis de déterminer la performance de l'AMT, et le sondage auprès des médecins a évalué l'impact de cette équipe dédiée. L'étude a été réalisée dans un grand centre de santé canadien (1133 lits) du 28 mars au 30 juin 2020. Dans la revue de cohorte, nous avons inclus des patients âgés de ≥18 ans, dans le dossier médical desquels il était fait mention de l'activation de l'AMT et dont les voies aériennes avaient été prises en charge à l'extérieur de la salle d'opération. Nous avons passé en revue à la fois la documentation des dossiers médicaux informatisés et des dossiers papier. Les résultats mesurés comprenaient le succès de l'intubation, le nombre de tentatives d'intubation, le temps pour intubation, le temps de*

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réponse de l'équipe, le temps de contact avec le patient, les complications de l'intubation et les violations du protocole relatif aux équipements de protection individuelle (EPI). Le sondage auprès des médecins a évalué la pertinence, la performance, le caractère raisonnable et l'utilité clinique de l'AMT.

Résultats *L'AMT a intubé 231 patients. Les dossiers ont montré que 91 % des intubations ont réussi à la première tentative. Le temps moyen (écart type) d'intubation était de 2,1 (0,2) min. Le taux de complications était minime. L'incidence d'infractions aux articles du protocole pour les EPI était inférieure à 6 %. Aucun membre de l'AMT n'a rapporté de symptômes de COVID-19. Le taux de réponse au sondage auprès des médecins était de 36 %. Le consensus parmi les participants était que l'AMT était d'une utilité clinique considérable pendant la pandémie de COVID-19.*

Conclusion *Une équipe de prise en charge des voies aériennes assemblée pendant la pandémie de COVID-19 a démontré une compétence et une efficacité élevées et a eu un impact favorable sur les principaux médecins en charge qui ont fait appel à l'équipe.*

Keywords airway · intubation · survey · impact analysis · COVID-19

Airway teams were assembled in many medical centres after the initial outbreak of COVID-19 was reported in China in late 2019 and after the World Health Organization declared COVID-19 a pandemic on 12 March 2020.[1, 2] Airway teams were responsible for intubating SARS-CoV-2-positive patients and patients with suspected SARS-CoV-2 infection. These teams were assembled in anticipation of a surge of patients being admitted to the intensive care unit (ICU) and emergency department needing invasive mechanical ventilation because of hypoxemic respiratory failure. This expectation was enforced by early reports indicating high rates of invasive mechanical ventilation (between 42% and 88%) in patients admitted to the ICU with COVID-19 pneumonitis.[3–5]

Several published reports described the creation of such consultant-led intubation teams in response to the COVID-19 pandemic.[6–11] These publications explained the composition of the teams, and the supplies and equipment needed. For example, these teams typically consisted of an anesthesiologist or emergency medicine physician, a senior medical resident, a registered nurse (RN), and a respiratory therapist (RT). What was missing in these reports was a comprehensive determination of the performance and competency of these teams. Additionally, the impact of these airway teams on the main responsible physicians who constantly had to meet the challenges of managing critically ill patients of the pandemic was unknown.

Therefore, the aim of this study was to determine the performance of an airway management team (AMT) responsible for managing all urgent and emergent airway management requests outside the operating room and its impact on the main responsible physicians.

Methods

We retrospectively reviewed the charts of patients who had received airway management services from the AMT. Additionally, we administered a survey questionnaire to physicians who had the option to activate the AMT. Approval was obtained from the Trillium Health Partners Research Ethics Board on 16 September 2020 (ID#1015).

Chart review

The study was conducted at the Trillium Health Partners, a large tertiary medical centre located in Mississauga and greater Toronto area in the Province of Ontario, Canada. The conglomerate comprised two acute care hospitals—Credit Valley Hospital (CVH) with 382 beds and the Mississauga Hospital (MH) with 751 beds—as well as the Queensway Health Centre. The latter is a day surgery centre that also includes a long-term bed facility and surgical and medical clinics. Two AMTs were established to simultaneously serve the CVH and MH sites. The teams provided coverage 24 hours a day, 7 days a week. The AMTs evaluated in this study were led by fully certified consultant anesthesiologists who did all intubations and other airway management procedures. There were no residents or clinical fellows members in the AMTs. The teams consisted of 47 fully certified consultant anesthesiologists who have been in practice for at least three years, 35 ICU RNs, 28 RTs, and 38 safety officers. Safety officers were not RNs or RTs. They were hospital staff deployed mainly from the departments of occupational therapy, physiotherapy, and laboratory medicine. All safety officers were certified to perform the safety officer's duties by the hospital's Infection Prevention and Control division. Patient management protocols were standardized according to the Canadian Anesthesia Society guidelines for intubating COVID-19 patients. Detailed AMT records, protocols, and logbooks were designed for thorough documentation. Necessary airway management supplies and personal protective equipment (PPE) were stocked in a command centre room dedicated to the AMT. Several instructional meetings headed by the AMT working groups at MH and CVH were held for all

anesthesiologists to discuss the relevant protocols prior to implementation. In the first two weeks of AMT operation, about ten simulation sessions were conducted using high fidelity simulators to practice several scenarios. These sessions integrated all hospital teams dealing with urgent and emergent situations, i.e., Code Blue, and ICU and emergency room resuscitation.

The retrospective review aimed to determine the performance of the intubation team. The review included a cohort of patients whose airway was managed by the AMT in CVH and MH from 28 March to 30 June 2020. All the reviewed charts were identified using a secure database kept at the Department of Anesthesia. All charts included in the retrospective review showed that the AMTs were activated, patients were $\geq$ 18 yr of age, and that patients were managed outside the operating rooms. Patient charts were excluded if they did not have formal AMT records completed by the team, and showed that the airway procedure was not performed by the AMT anesthesiologist. Charts were reviewed by a research assistant using the relevant electronic medical record applications and paper chart documentations. Data were analyzed by an investigator not involved in the data collection. The chart review recorded all performed AMT services, including high-risk extubations, tube exchanges, and endotracheal intubations. Because most patients belonged to the endotracheal intubation group, we reviewed in detail the performance of the teams in response to requests for endotracheal intubations. The primary outcomes included intubation details (the success of intubation, number of intubation attempts, and technique of intubation), time intervals (response time, intubation time, and time of patient contact), complications of intubation, and breaches of PPE protocols. The time intervals were defined as follows: response time was the time from being paged to arriving at the patient location, intubation time was the time from start of drug injection to end-tidal carbon dioxide ($ETCO_2$) detection, and time of patient contact was the total time spent in the patient's room. The rationale for choosing these time intervals was to monitor and to continuously evaluate the performance of the AMTs. The team members also evaluated their own performance after every encounter. During such debriefing processes, the team's anesthesiologist initiated a discussion about the execution of the task assigned to the team including ways to improve the AMT practices particularly in implementing PPE protocols. The debriefing was an issue that has to be documented by the safety officer. Secondary outcomes included cohort demographics, patient vitals on arrival at the AMT, COVID-19 status at the time of intubation, location of intubation, pre-existing co-morbidities, primary indication of intubation, drugs used during intubation, and pre-intubation medications and O_2 therapy. In case of high-risk extubations and tube exchanges performed by the AMTs, the following variables were recorded: indication for the procedure, vital signs post procedure, and airway complications during and post procedure.

Physician survey

The physicians' survey questionnaire was designed to establish the impact of the AMTs. The questionnaire was e-mailed to 77 physicians who activated the intubation team or who had the option to activate the intubation team if necessary. The questionnaire comprised 11 questions exploring the demographics of the participants, and the clinical utility of the AMT, i.e., relevance, performance, reasonableness, and usefulness of the AMT program. The questionnaire used the GoEasy platform to post the questions (see Appendix A).

Statistical analysis

Continuous variables are expressed as means (standard deviations [SDs]). Categorical data are presented as frequencies, proportions, or percentages.

Results

Chart review

There were 269 charts eligible for review from 28 March to 30 June 2020. During this period, all elective cases at the Trillium Health Partners were cancelled because of the pandemic. All intubations were performed by the team anesthesiologist during the three-month study period. The AMTs were involved in all intubations during this period regardless of the patient characteristics. The review showed that the AMT intubated 231 patients at MH and CVH. The AMTs were also involved in 27 high-risk extubations, ten endotracheal/tracheostomy tube exchanges, and a single code pink for intubating a six-day-old neonate. The logbooks kept at the anesthesia department indicated that the intubation teams were activated 72 times without performing any airway management procedures. The chart review showed that 61/231 (26%) data sets were missing on intubating details and 81/231 (35%) data sets were missing on the complications of intubation (Table 2). Additionally, 70/231 (30%) charts did not include the patients' co-morbidities (Table 1). All data were available for the analysis of time intervals and breaches of PPE protocols (Table 2).

The cohort included 44/231 (19%) SARS-CoV-2-positive patients, 122/231 (53%) SARS-CoV-2-negative patients, and 65/231 (28%) patients with undetermined COVID-19 status when the intubation teams were activated

(Table 1). The patients' mean (SD) age was 64 (15) yr and 106/231 (46%) patients were female (Table 1). The indications for intubation in the cohort were respiratory failure in 144/231 (62%) patients, cardiac arrest in 50/231 (21%) patients, and severely decreased level of consciousness (Glasgow coma scale < 8) in 37/231 (16%) patients (Table 1). Most intubations were performed in the ICUs for 138/231 (60%) patients (Table 1). About 155/170 (90%) intubations were performed with videolaryngoscopy as a first-line approach (Table 2). Intubations done with videolaryngoscopy used the GlideScope® AVL video laryngoscope system (Verathon Medical [Canada] ULC, Burnaby, BC, Canada). Number 3 or 4 blades were used at the discretion of the anesthesiologist. Positive ventilation prior to intubation was highly discouraged; however, face mask and laryngeal mask ventilation were necessary in 5/231 (2%) and 2/231 (0.9%) patients, respectively.

The intubation teams showed high competency in intubating high-risk patients (Table 2). All available charts showed successful intubations in short time intervals with minimal upper airway complications. The response times and the durations of patient contact were kept to a minimum (Table 2 and Fig. 1). The mean (SD) intubation time measured from the start of drug injection to $ETCO_2$ detection was 2.1 (0.2) min (Table 2). Additionally, AMT anesthesiologists had comparable in-between intubating times as depicted from the box plots in Fig. 1. In fact, the interquartile range showed a tight distribution of intubating times without outliers. The team members adhered highly to PPE protocols. The incidence of breaching PPE protocol items were less than 6% except in one item pertaining to the number of unnecessary personnel present in the patient room (Table 2). None of the AMT members reported symptoms consistent with COVID-19 so testing was unnecessary.

To determine whether intubations during cardiopulmonary resuscitation (CPR) were different from intubations during non-CPR situations, we separately analyzed all intubations performed during Code Blue events ($n = 50$). The analysis showed no difference in the primary outcomes of the study between CPR and non-CPR intubations, i.e., intubation times, success rates, and complications were similar in both groups. This may have been the result of the frequent simulation sessions done to integrate the CPR and the AMT teams during cardiac arrest situations and the considerable experience of the anesthesiologists.

Physician survey

The physician survey was electronically distributed to eligible physicians three times two weeks apart. Eligible

Table 1 Demographics and characteristics of 231 patients intubated by the airway management team

Characteristic	
Age (yr), mean (SD)	64 (15)
Female, *n*/total *N* (%)	106/231 (46%)
BMI ($kg \cdot m^{-2}$) mean (SD)	28 (6)
BMI > 40 $kg \cdot m^{-2}$ *n*/total *N* (%)	25/231 (11%)
Vitals on arrival	
Heart rate (min^{-1})	104 (25)
Systolic BP (mm Hg)	137 (32)
Respiratory rate (min^{-1})	26 (19)
SpO_2[a], mean (SD)	94 (6)
Data unavailable, *n*/total *N* (%)	56/231 (24%)
Hemodynamic support on arrival[b], *n*/total *N* (%)	
Norepinephrine	98/231 (42%)
Dopamine	62/231 (27%)
Epinephrine	31/231 (13%)
SARS-CoV-2 status, *n*/total *N* (%)	
Positive	44/231 (19%)
Negative	122/231 (53%)
Undetermined	65/231 (28%)
Location of intubation, *n*/total *N* (%)	
ICU	138/231 (60%)
ER	77/231(33%)
Ward	16/231 (7%)
Pre-existing co-morbidity[c], *n*/total *N* (%)	
Essential hypertension	130/161 (81%)
Other cardiac	74/161 (46%)
Pulmonary	63/161 (39%)
Diabetes mellitus	56/161 (35%)
Renal	39/161 (24%)
Neurologic	13/161 (8%)
Immunocompromised	13/161 (8%)
Data unavailable	70/231 (30%)
Indication for intubation, *n*/total *N* (%)	
Code Blue	50/231 (21%)
Respiratory failure	144/231 (63%)
GCS < 8	37/231 (16%)
Drugs used during intubation[d], mean (SD)	
Propofol (mg)	93 (51)
Ketamine (mg)	53 (29)
Midazolam (mg)	1.7 (0.96)
Rocuronium (mg)	89 (19)
Phenylephrine (μg)	191 (161)
Epinephrine (μg)	147 (164)

[a] SpO_2 values were recorded with $F_iO_2 = 100\%$

[b] A single patient might have had more than one drug administered. All drugs were administered in the form of continuous intravenous infusions

[c] A single patient might have had more than one comorbidity

[d] A single patient might have had more than one drug administered. All intubated patients ($N = 231$) had complete records pertaining to intubating drugs administered

BMI = body mass index; BP = blood pressure; ER = emergency department; F_iO_2 = fraction of inspired oxygen; GCS = Glasgow coma scale; ICU = intensive care unit including coronary, medical, and surgical; SpO_2 = arterial oxygen saturation; SD = standard deviation

Table 2 Performance of the airway management team

Time intervals (min), mean (SD)[a]	
Response time (paging of team to arrival at location)	11.2 (6.1)
Intubation time (start of drug injection to $ETCO_2$ detection)	2.1 (0.2)
Time of patient contact (total time in patient's room)	15.9 (6.3)
Intubation details, *n*/total *N* (%)	
First attempt	155/170 (91%)
Second attempt	10/170 (6%)
Third attempt	5/170 (3%)
Fourth attempt	0/170 (0%)
Direct laryngoscopy	13/170 (8%)
Video laryngoscopy	155/170 (91%)
Awake intubation	2/170 (1%)
Unable to intubate	0/170 (0%)
Unavailable data	61/231 (26%)
Complications of intubation[b], *n*/total *N* (%)	
Hypotension (SBP < 80 mmHg)	61/150 (41%)
Desaturation ($< 90\%$)	46/150 (31%)
Oropharyngeal bleeding	5/150 (3%)
Dental damage	3/150 (2%)
Cardiac arrest	1/150 (0.7%)
Aspiration	2/150 (1%)
Esophageal intubation	2/150 (1%)
Unavailable data	81/231 (35%)
Breach of PPE protocols, *n*/total *N* (%)	
Donning	14/231 (6%)
Doffing	14/231 (6%)
Equipment deficiency	13/231 (5%)
Unnecessary extra personnel[c]	
≥ 1	84/231 (36%)
≥ 3	40/231 (17%)
≥ 5	12/231 (5%)
Deficient entry logbook	0/231 (0%)
Lack of post intubation debriefing	0/231 (0%)

[a] Time intervals were analyzed from data obtained from 231 intubated patients

[b] A single patient might have had more than one complication

[c] The maximum number of personnel was pre-defined to be the three members of the AMT (anesthesiologist, ICU RN, and respiratory therapist). In cardiopulmonary resuscitation (CPR) situations, the predefined maximum number of personnel was increased to 4 to include the individual performing chest compressions. All other members of the CPR team briefly exited the patient room during intubation.

AMT = airway management team; $ETCO_2$ = end-tidal carbon dioxide; ICU = intensive care unit; RN = registered nurse; PPE = professional protective equipment; SBP = systolic blood pressure

physicians were those who had the option of activating and mobilizing the AMT. The survey was distributed to 77 physicians. Twenty-eight physicians adequately responded (response rate, 36%). The survey responses indicated that the impact of the AMT was highly valued by most responding physicians (Fig. 2). There was consensus to highly appreciate the relevance and performance of the AMT during the COVID-19 crisis. As for the reasonableness of the AMT, most physicians witnessed satisfactory progress of the response time and availability of the team members. Nevertheless, about 50% of respondents did not recognize significant merit for the team's anesthesiologist to assist in taking decisions to intubate patients (question 4 [Q4] in Fig. 2). The clinical utility and usefulness of the AMTs were greatly appreciated. Nonetheless, more than 50% of respondents

did not recommend permanently establishing an AMT in our institution (Q9 in Fig. 2).

Discussion

This study reports the performance and impact of a specialized consultant-led airway management team assembled during the first wave of the COVID-19 pandemic. A retrospective review of 231 patients intubated by the AMT in a period of three months showed minimal team response time and team-to-patient contact times, with a mean intubating time of 2.1 min. There were no failed intubations, and 91% of patients were intubated after the first attempt. The rate of upper airway complications of intubation was minimal. The most common complication was oropharyngeal bleeding in 3% of intubations. There was no significant breach of PPE protocols except the presence of extra personnel in the patient room during intubation. None of the AMT members contracted COVID-19. The impact of the AMT on physicians was favourable pertaining to the teams' relevance, performance, reasonableness, and clinical usefulness. Nevertheless, more than 50% of physicians did not recommend establishing a permanent AMT. Also, more than 50% of physicians did not approve the notion that the AMT anesthesiologist would be involved in deciding whether to intubate patients.

As part of the preparedness plans at the Trillium Health Partners pertaining to the COVID-19 pandemic, the Department of Anesthesia took the initiative to assemble a highly specialized, consultant-led AMT. The initiative was based on the rationale that urgent airway management procedures should be considered high-risk practices during the COVID-19 pandemic, particularly in patients infected with SARS-CoV-2 or suspected of having COVID-19. Hence, intubations and other high-risk airway management procedures would have been best performed by experts in upper airway management to guarantee the highest probability of success in the shortest time possible. Furthermore, a dedicated, self-sufficient AMT would allow the attending physicians, i.e., intensivists, emergency physicians or hospitalist physicians to focus on other aspects of critical care management during the high-intensity situations of the pandemic.

Our study established and determined measurements of AMT competence and performance. Beside intubation details, these measures included specific time intervals during the intubation process and breaches of PPE protocols. Intubation success rates and complication rates were similar to previously published data.[12–14] Airway management team breaches of PPE protocols have not been

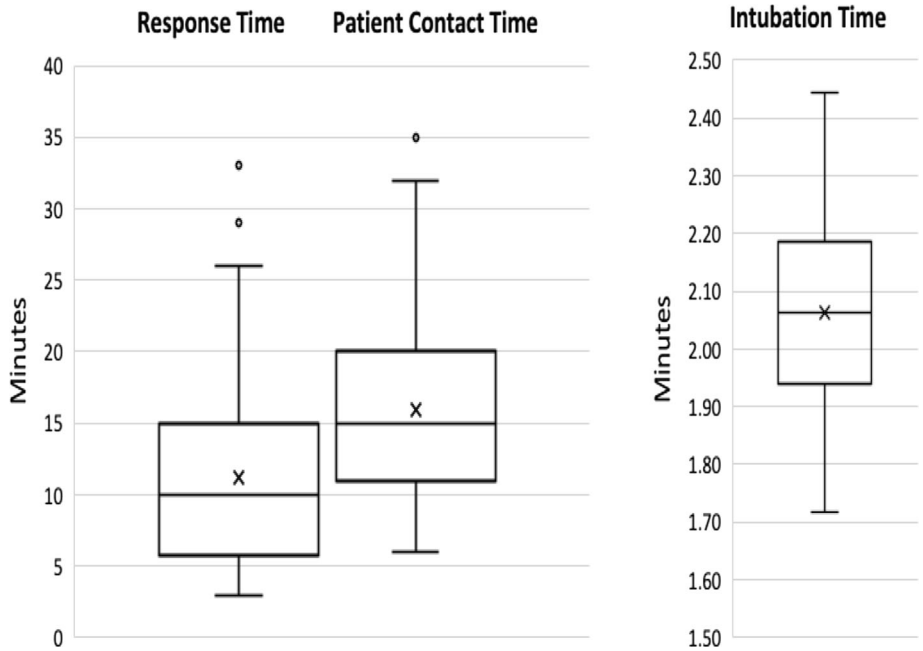

Fig. 1 Box plots showing the distribution of the response time, patient contact time, and intubation time in a cohort of 231 patients. Response time was defined as time from team activation to arrival at location, patient contact time as time from first member of team entering to last member of team leaving the patient's room, and intubation time as time from the start of intubating drugs injection to $ETCO_2$ detection. The upper and lower line of the box indicates the 75^{th} and 25^{th} quartile (Q75 and Q25), respectively. The horizontal line inside the box represents the median of the data set and the "x" indicates the mean. The positive and negative error bars represent Q75+(1.5*IQR) and Q25-(1.5*IQR) respectively. IQR indicates interquartile range. The open circles represent outliers.

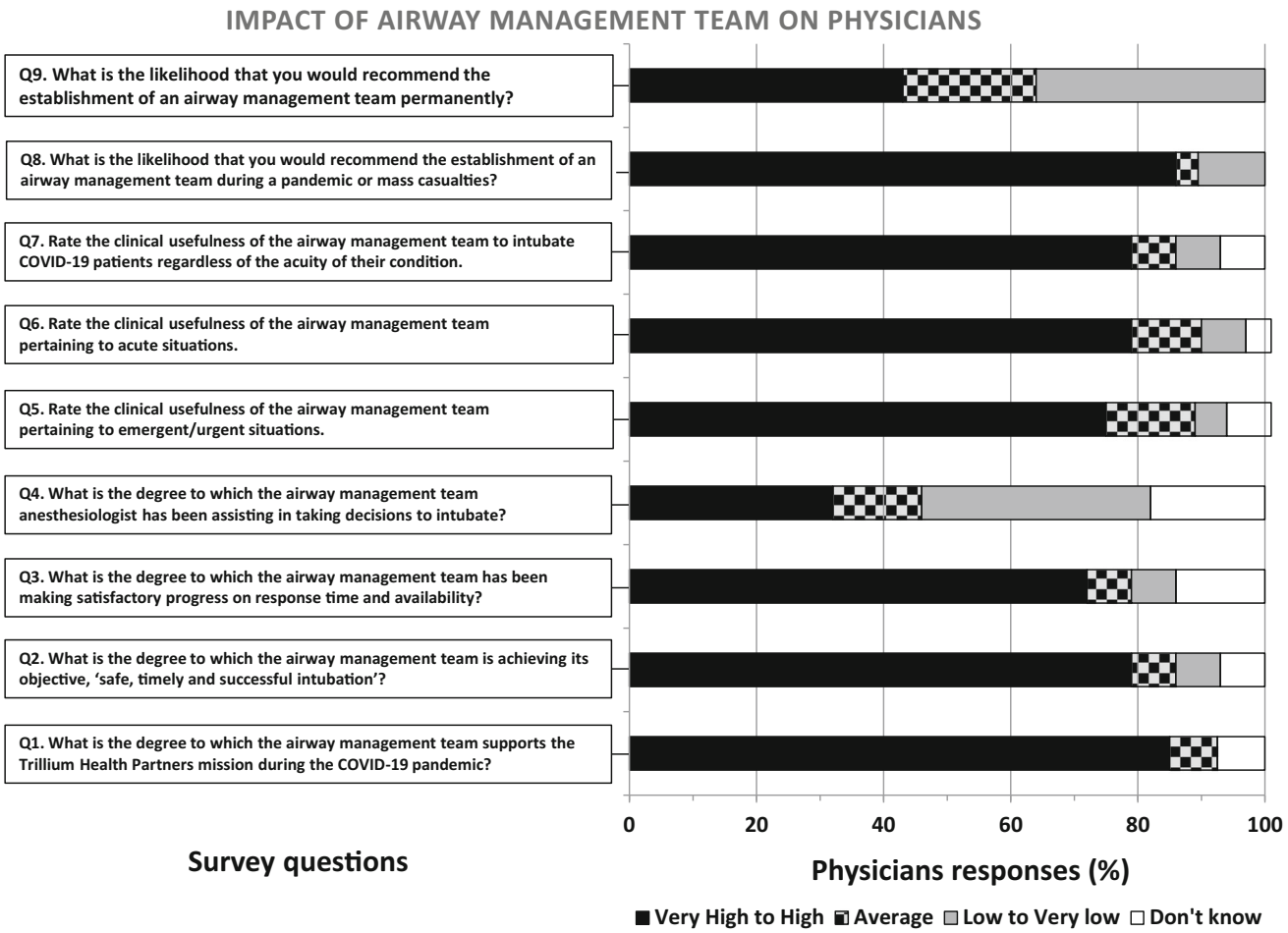

Fig. 2 Physicians' survey results. Left panel shows questions asked. Right panel shows a summary of the responses to every question as a percentage of participants. Very high and high answers, and low to very low answers were grouped together.

previously reported in detail. PPE protocol breaches were minimal in our study except for the presence of extra personnel in patients' rooms where intubations were performed (Table 2). As such, the present study showed high competency of the AMT.

The physicians' survey conducted to evaluate AMT impact was undertaken for formative purposes to improve or reorient the future mission of the AMT and for summative purposes to decide whether to continue, discontinue, or replicate the AMT program.[15] It was clear from the responses to the survey that the formation and clinical utility of the AMT was highly approved and accepted by the responding physicians. Nevertheless, it was necessary to reorient the duty of the team's anesthesiologist to focus on the patient's needs for a successful and expeditious intubation. It was determined that the team's anesthesiologist had to exhibit less emphasis on the feasibility and indication of intubating a particular patient. Accordingly, the team anesthesiologist had to consult the attending physician who requested the intubation regarding the indication of the procedure as part of the pre-procedure evaluation to choose the most appropriate course of action. The latter included preoxygenation, the choice of resuscitating and intubating drugs, and the selection of adequate tube sizes and intubating techniques.

Interestingly, about 50% of physicians did not recommend creating a permanent AMT led by a consultant anesthesiologist. One reason for this could be perceived reduced exposure for trainees to intubations. Other reasons included the high cost to support a permanent AMT, and the desire of ICU and emergency physicians to intubate patients under their care. Healthcare human resources could also prohibit the establishment of a permanent AMT as healthcare personnel have to be deployed from their "home" departments to support the team.

The survey showed that some of the challenges for the AMT have been dealt with appropriately. For example, the overwhelming number of responding physicians agreed

that the intubation team made significant progress in response time and availability. This success was thanks to locating the command centre room as close as possible to the ICU and emergency department and to minimizing the amount of supplies that had to be delivered to the intubating location. Also, communication between the central hospital paging system and team members was enhanced by creating a single code for paging the AMT and supplying the team members with a closed-loop phone system for within-team communication. Furthermore, physicians activating the AMT were encouraged to activate the team as soon as it became evident that intubation of a patient was unavoidable and refrain from last minute activation.

Overall, the survey responses summated the favourable impact of the AMT on our institution. In fact, during the re-surging of COVID-19 cases in January 2021, the AMT was reassembled and successfully deployed. This confirmed the notion indicated in the physicians' survey that the AMT program should not be permanently implemented but reassembled when needed.

The present study had a few limitations. First, the retrospective chart review may have missing data (Tables 1 and 2). This represented the recording practices of the AMT members. Nonetheless, missing data was reduced by the detailed intubating record designed specifically for the AMT, the detailed logbooks kept by the safety officer, and the detailed RN and RT notes, all of which decreased recording biases between the team members (Appendix B). Documentation could be improved by a dedicated recorder and by modifying the intubation record to include more check boxes for events or switching the documentation to exclusively electronic form. Secondly, most commonly in reports examining airway management, "time to intubation" was defined as the time recorded from the blade entering the mouth to removing the laryngoscope or detecting $ETCO_2$. In our study, the AMT intubation time was predetermined as the time taken from the start of drug injection to $ETCO_2$ detection. The definition was meant to be easily recorded by team members during a very challenging and turbulent situation. The difference between the intubation time in our study and the intubation time used in other reports was the time taken from the start of administering the intubating drugs to the insertion of the intubating blade in the patient's mouth. We could reasonably assume that such time difference would not significantly change the study conclusions since this "extra" time represents a common bias. Nevertheless, the intubation time in our study should be compared with caution with those in other reports. Thirdly, the response rate for the physicians' survey was 36%. Every effort was made to increase the response rate for better representation. Even so, the response rate was similar to other studies that surveyed physicians.[16] Lastly, the participants in the survey may have been better expanded to include RNs and RTs in the ICU and emergency department. For pragmatic reasons, we decided that the participants would only include the primary stakeholders in the impact evaluation to keep a relevant impact analysis focus. Further survey studies might expand the participatory approaches to ensure that all voices whose practices would be impacted by the AMT program are central to the findings.

In conclusion, a consultant-led AMT was highly competent, effective, and had a favourable impact on the principal responsible physicians providing care who activated the team. The present study provided evidence that assembling AMTs could be an important strategy to successfully manage airway emergencies under the extremely challenging situations of acute respiratory pandemics. It is recommended that medical centres should have comprehensive contingency plans and policies to assemble AMTs during times of mass casualties and uncontrolled patient surges.

Author contributions *Keziah Magor* contributed to the acquisition, analysis, and interpretation of data. *Tejinder Chhina* contributed to the conception and design of the study, interpretation of data, and drafting the article. *Ivan Cacic* and *Bill I. Wong* contributed to the conception and design of the study. *Hossam El Beheiry* contributed to all aspects of this study, including conception and design; acquisition, analysis, and interpretation of data; and drafting the article.

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Appendix A: Physician survey

The physician survey comprised of eleven questions as follows:

Demographics of the physician participant:

1. How would you describe your medical specialty?

A. Emergency medicine

B. Internal medicine

C. Intensive care medicine

D. Obstetrics and gynecology

E. Surgery

2. Have you activated the intubation team in the period 28 March to 30 June 2020?

A. Yes

B. No

Impact of the airway management team: (each question provided six answers: Very high, High, Average, Low, Very low, I don't know. Only one answer has to be chosen.)

Relevance of the intubation team:

3. What is the degree to which the intubation team supports the Trillium Health Partners mission during the COVID-19 pandemic?

Performance of the intubation team:

4. What is the degree to which the intubation team is achieving its initially stated objective, that is: "safe, timely and successful intubation"?

Reasonableness of the intubation team:

5. What is the degree to which the intubation team has been making satisfactory progress on response time and availability?

6. What is the degree to which the intubation team anesthesiologist has been assisting in taking the decision to intubate patients?

Usefelness of the intubation team:

7. Rate the clinical usefulness of the intubation team pertaining to emergent/urgent situations.

8. Rate the clinical usefulness of the intubation team pertaining to acute situations.

9. Rate the clinical usefulness of the intubation team pertaining to intubating COVID-19 patients regardless of the acuity of their medical condition.

10. What is the likelihood that you would recommend the establishment of an intubation team during a pandemic or mass casualty situation?

11. What is the likelihood that you would recommend the establishment of an intubation team permanently as a component of the acute care hospital team?

Appendix B: Intubation record

The intubation record shown below was filled by the team anesthesiologist. The intubation record was one of several tools used by the AMT to document the intubating event. These included a detailed logbook kept by the safety officer as well as the notes written by the RNs and the RTs.

Trillium Health Partners

AIRWAY TEAM RECORD

TEAM	
Intubator	
RT	
RN	
Safety Officer	
MRP	
Date (yy/mm/dd):	
Start Time:	End Time:

SETTING

Location: ☐ Ward ☐ ICU ☐ Emergency Dept ☐ Operating Room ☐ Other: _____

Timing: ☐ Elective ☐ Urgent ☐ Emergent

☐ Checklist Reviewed Negative Pressire Room ☐ Y ☐ N

PPE Used:
☐ Eye Protection ☐ Neck Protection ☐ N95 Mask ☐ Bonnet
☐ Surgical Gown ☐ Double Gloved

PATIENT DATA

Age:_____ **Gender:** ☐ **M** ☐ **F**

Ht (cm):_____ **Wt(kg):**_____ **BMI:**_____

Allergies:_____

Vitals on arrival:

HR_____ **BP**_____ **RR**_____ **SpO2**_____ **FiO2**_____

COVID Statues: ☐ **+ve** ☐ **-ve** ☐ **Suspected** ☐ **N/A**

Comorbidities:
☐ Hypertension ☐ T2DM ☐ CAD ☐ Smoker
☐ Renal Insufficiency ☐ Immunocompromised

☐ Other:_____

Indication:
☐ Resp Failure ☐ Cardiac Arrest
☐ Hemodynamic Instability ☐ Decreased LOC

☐ Other:_____

PROCEDURE

Preoxygenation: ☐ Face Mask ☐ Nasal Prongs ☐ Non-Rebreather ☐ Ambu-Bag

Induction: ☐ Intravenous ☐ RSI ☐ Cricoid Pressure

Vascular Access:

☐ IV:_____ ☐ CVC:_____ ☐ Arterial Line:_____

Induction Drugs:

1._____ _____ mg
2._____ _____ mg
3._____ _____ mg
4._____ _____ mg

Intubation: ☐ Easy ☐ Awkward ☐ Difficult

BMV: ☐ Performed ☐ Not Performed ☐ Easy ☐ Difficult

Oral Airway_____ Nasal Airway_____

☐ DL ☐ VL Blade ☐ 3 ☐ 4 ☐ Other_____
☐ FOB Intubating LMA ☐ LMA#_____ ☐ Bougie
FONA: ☐ Tracheostomy ☐ Cricothyroidotomy

View (Grade): ☐ 1 ☐ 2 ☐ 3 ☐ 4
Number of Attempts:_____ ☐ Atraumatic

ETT Size:_____ Depth_____cm ☐ Oral ☐ Nasal ☐ Cuffed
ETT Confirmation: ☐ Auscultation ☐ etCO2
ETT Secured: ☐ Taped ☐ AnchorFast

TRANSFER

Disposition: ☐ Emergency Department ☐ ICU ☐ PACU

☐ Other:_____

Ventilation: ☐ Manual ☐ Ventilator

Sedation:_____

Receiving MRP:_____

Vitals:

HR_____ BP_____ RR_____ SpO2_____ FiO2_____

COMMENTS

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