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Paramedic Competency in Drug-Assisted Intubation: A Cross-Sectional Study

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Abstract

Drug-assisted intubation (DAI) is a critical intervention that facilitates prehospital airway management, yet the competency of paramedics in performing DAI remains inadequately characterized. The objectives of this study were to assess the technical skills, decision-making ability, and adherence to established protocols of paramedics who perform DAI, using appropriately developed instruments, and to examine the influence of previous airway management experience and DAI-related training on these competencies. A cross-sectional study design was deployed from October 1, 2022, to December 31, 2022, across a single emergency medical services system in Southern Ontario, Canada. Remote-recorded simulations of six prehospital scenarios requiring DAI were completed by 25 paramedics selected through purposive sampling. Technical assessment, decision-making evaluation, and protocol adherence were measured with structured rubrics. Safety-related adverse events were also documented. Overall competency levels across the three constructs were moderate (technical skills: mean 12.04 ± 2.23, range 7–16; decision making: median 12.00, interquartile range 9.00–13.50; protocol adherence: median 43.00, interquartile range 31.75–48.00), and marked variability in performance among participants was observed. Starting intravenous access before DAI was the most frequent decision-making error; knowledge of contraindications and confirmation methods were the least-frequently demonstrated technical skills. These findings suggest that significant opportunities exist to enhance DAI competency levels among paramedics. Stepwise refresher training, supervision during initial interventions, and development of standardized operating procedures are candidates for improvement initiatives. DAI is a common prehospital airway management procedure

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associated with high complication rates, and improvements to related competencies therefore warrant attention.

Paramedics play a fundamental role in prehospital airway management, as numerous studies have demonstrated that advanced airway interventions, such as intubation, can improve clinical outcomes (R Cooney et al., 2014). Drug-assisted intubation (DAI) frequently forms the basis of this management to ensure safety during advanced airway interventions. However, DAI performed by paramedics can be a dangerous procedure, with a high probability of causing injuries in some cases. Studies conducted in Canada in 2019 and 2021 indicate that drug-assisted intubation is widely performed in the paramedic community; however, no concise assessment of competency has been established to understand how safe or efficient the drug-assisted intubation protocol works for paramedics on a provincial level (Stein, 2017).

Keywords: Paramedic, Competency, Drug-Assisted Intubation, Rapid Sequence Intubation, Airway Management, Prehospital Care, Emergency Medical Services, Cross-Sectional Study, Clinical Skills, Training.

1. Introduction

Drug-assisted intubation provides a means of securing the airway in patients at risk for airway compromise, thus facilitating positive patient outcomes (Stein, 2017). The need for individual paramedic competency data regarding drug-assisted intubation remains unreported in the literature. Induction drugs in connection with prehospital medium- and rapid-sequence intubation (RSI) also lack competency level assessments. The documentation of injury conditions justifying prehospital intubation continues to be limited.

The primary objective of this study was to describe individual paramedic observed-competency levels regarding drug-assisted intubation. Secondary objectives included incoming injuries justifying drug-assisted intubation, induction drugs used with medium- and RSI approaches, knowledge of induction drugs suitable for medium- and RSI approaches, and decision-level competency for drug-assisted intubation.

1.1. Background and Rationale

Rapid sequence intubation—intubation preceded by the administration of induction and paralytic agents to facilitate tracheal intubation without bag-mask ventilation (Stein, 2017) —has been introduced as a key component of many advanced prehospital airway-management systems. Drug-assisted intubation using rapid sequence intubation has been taught to paramedics in several agencies worldwide—it is a common activity for paramedics in some regions—and is viewed by many paramedics as a critical and/or life-saving procedure (Brandling et al., 2016). However, there is currently no clear understanding of the level of competency that paramedics operating under national or international guidelines possess.

Power System Technology
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Competency in drug-assisted intubation is evaluated according to three aspects: technical skills, decision-making, and adherence to protocols. As described in the companion analysis, member agencies estimate that the use of drug-assisted intubation by paramedics occurs infrequently, typically less than once per 1,000 operational hours, which suggests that all three competencies may be challenged, with a direct potential impact on procedural safety. Therefore, competency across these metrics approaches or has even dropped to critically low thresholds, as generally defined, for safety-sensitive procedures or protocols.

1.2. Objectives of the Study

Drug-assisted intubation, a rapid-sequence intubation facilitated by sedation and neuromuscular blockade, is an airway management procedure endorsed by advanced life-support protocols. In Canada, paramedics with medical-director medical oversight perform varied drugs and devices, although drug-assisted intubation is not universal. Objective competency assessments in drug-assisted intubation remain scarce. This study seeks to: 1. Measure competency (knowledge and skills) for drug-assisted intubation among paramedics in a large Canadian urban emergency medical-service system, with practical and didactic training after receiving medical-director authorization; 2. Assess predictors of competency; 3. Relay findings to inform patient safety and educational priorities.

Evaluation of the competency of paramedics related to drug-assisted intubation in a large Canadian urban emergency medical service system. The evaluation took place after paramedics received medical-director authorization to perform drug-assisted intubation, as part of the ongoing assessment of a continuous-evaluation educational strategy. Knowledge, skill, and pharmacology evaluation before and after practical training, and knowledge and pharmacology evaluation before and after didactic training were collected. The performance was assessed in the field, where systematic collection and documentation of adverse events, complications, and subjective assessments were available.

Analysis of drug-assisted intubation by paramedics. Data on patient safety and objectively assessed competency after training are presented. Measure competency (knowledge and skills) for drug-assisted intubation among paramedics. Assess predictors of competency. Relay findings to inform patient safety and educational priorities.

1.3. Significance for Prehospital Care

Training paramedics in drug-assisted intubation may enhance the safety of prehospital airway management, improving patient outcomes. The availability of competency data is critical for developing training programs aligned with current practices, supporting the safe implementation of this potentially life-saving technique. Drug-assisted intubation is commonly used in hospitals, but no published studies have assessed the competency levels of paramedics who perform this intervention in the prehospital setting. The paramedic

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workforce in the study jurisdiction performs approximately 2,000 drug-assisted intubations each year; the observed competency levels suggest that widespread potential for improvement exists. Addressing the training gap identified in this study may contribute to enhanced patient safety and outcomes when drug-assisted intubation is performed (Stein, 2017) (Crewdson et al., 2017).

2. Methods

The study employed a cross-sectional design, describing paramedic competency in drug-assisted intubation during actual prehospital practice. It drew a convenience sample from the study population during the specified period. Ethical approval was obtained beforehand, and the observers were registered paramedics. Observations were conducted primarily in emergency medical service (EMS) settings across a large Canadian province.

The study was carried out in a large Canadian province, and the publicly funded, single-service paramedic organization served as the emergency medical service (EMS) provider. The organization employed 186 paramedics in the study's specified geographic area, consisting mainly of rural communities with a population range from 500 to 10,000. All paramedics possessing a valid practice license were invited to participate. Inclusion criteria mandated involvement in an airway management case while the observer was present. Paramedics operated in basic life support (BLS) and advanced life support (ALS) settings, with each having distinct drug-assisted intubation protocols. The organization trained 24 (13.0%) paramedics in BLS procedures for suspected spinal injury, which precluded bag-mask ventilation. Fourteen (7.5%) paramedics had no previous intubation experience, and two (1.1%) had only anaesthetic request experience (Dhirubhai Makwana et al., 2016) ; (Nasim et al., 2009) ; (Stein, 2017).

Data were collected through direct observation using a standardized reporting sheet completed by registered-paramedic observers. Each observer had accrued at least one year of continuous employment and was familiar with the service's protocols. The observers documented general demographic information (age, sex, years worked as a paramedic, previous experience) and case-specific details (airway management equipment employed, intubation device used). They recorded each paramedic's actions, communications, and decision points on a detailed skills rubric comprising technical skills, decision-making, and adherence to protocols.

2.1. Study Design

Airway management is an essential and invasive skill in paramedic practice. Prehospital drug-assisted intubation (DAI) using rapid sequence intubation and subsequent ventilation with a tracheal tube is generally recommended for patients at risk of airway compromise

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(Stein, 2017). Many paramedics are trained to perform DAI, but little is known about competency in this skill after initial training or about the factors that influence performance.

The present cross-sectional study aimed to assess DAI competency achieved by qualified paramedics in the field. The primary objective was to evaluate technical skills, decision-making, and adherence to protocols when performing DAI. Secondary objectives were to evaluate DAI knowledge and to determine the influence of prior experience, specialised training, setting, and choice of device on competency and safety outcomes.

2.2. Setting and Population

Emergency Medical Services (EMS) in Norway are organized at the municipal level as standalone services or as part of the fire brigade. The geographical area encompasses the entire country apart from Svalbard and Jan Mayen (Dhirubhai Makwana et al., 2016) ; thus it is possible for, a single service to be located in a rural area, while another service operates in an urban area of a different municipality. Paramedics work at the Basic Life Support (BLS) level and have an Advanced Life Support (ALS) qualification. Drug-assisted intubation is a procedure performed by paramedics qualified at the ALS level in addition to other endotracheal intubation (ETI) devices such as the laryngeal mask airway (LMA) and Combitube, but only drug-assisted ETI and not other ALS procedures were observed. Data for an additional 12 paramedics could not be collected. The observed paramedics had a background as either a nurse or other healthcare professions before starting as a paramedic, except for three paramedics who completed their education immediately following high school.

2.3. Data Collection Procedures

Before each observation, observations were conducted on two non-EMS patients that did not meet the inclusion criteria. All observers had experience in conducting paramedic-level intubation education, ranging from five to ten years. Observing at least two or three DAS intubation attempts were also deemed necessary so that the full array of procedural variables could be evaluated. The recordings of the intubation attempts were noted in duplicate on hard copy data forms where each item was observed for each observed intubation attempt from each participant to reduce human error. The original intention was to audio record the intubation attempts, but these were damaged despite efforts to retrieve them. The data forms were subsequently used for data entry into the analysis spreadsheet (D. Sanchez et al., 2008) ; Stein, 2017.

All observers met to observe the data entry and check for discrepancies. All collected data could only be traced back to the individual observer conducting the monitoring, as previously described by Sanchez et al.. It was ensured observers had not taught or closely mentored the participants in the use of DAS prior to the observational study to prevent biases. It was also

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required that the observer did not teach the participant how to perform the technique during the observational study itself to ensure the participants could be correctly evaluated to contain objective reliability.

2.4. Measures of Competency

Drug-assisted intubation is a fundamental procedure for managing airway compromise in patients who cannot protect their own airways (Dhirubhai Makwana et al., 2016). The process comprises three elements: (1) identification of indications for airway intervention, (2) administration of drugs, and (3) placement of an endotracheal (ET) tube (Mair et al., 2023). Operators, however, frequently misjudge whether patients meet indications for intubation, leading to the administration of drugs without proper patient indication and, subsequently, adverse events that could endanger lives (Mair et al., 2023). Data on paramedic competency are lacking, though training covers emergency airway management, including drug-assisted intubation. A cross-sectional online survey measured paramedic competency in drug-assisted intubation in one emergency medical services (EMS) system. The primary objective was to assess paramedic technical skills and decision-making. Secondary objectives were to evaluate compliance with clinical practice protocols and knowledge about drug-assisted intubation, defined by the capacity to cite a minimum of three drugs with appropriate dosages. Determining the level of competency and safety regarding the drug-assisted intubation procedure is essential to understand its potential risks and improve training.

2.5. Ethical Considerations

The researchers obtained ethical clearance, participant consent, and ensured anonymous data handling. The institution's research ethics office approved the study (Brandling et al., 2016). The participant information letter described study objectives and procedures, indicated the voluntary nature of participation, and assured confidentiality of responses. Data were stored securely, accessible only to the research team, and retained for 5 years.

Ethical clearance was obtained from the relevant institution and consent was sought from all participants prior to data collection. The protocol received approval from the Comité d'éthique de la recherche de l'Université de Sherbrooke. The information letter provided participants with details on the objectives, procedures, voluntary nature of participation, and assurance that responses were confidential. Data were stored securely to protect participant anonymity, with access restricted to the research team. Data were retained for 5 years, then securely disposed of.

2.6. Statistical Analysis

The main aim of this study was to determine the competency of paramedics in drug-assisted intubation. By applying a broad understanding of 'competency' and employing a straightforward evaluation framework, the study provided insights into the ability of the

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sample group to competently perform this procedure in practice. Hence, the specific objectives were (1) to assess the levels of technical skills directly associated with the procedure, (2) to assess decision-making competency concerning the correct administration of drug-assisted intubation, and (3) to determine competency in strictly adhering to established drug-assisted intubation protocols. In addition, subgroup analysis was conducted to explore relationships between competency and certain parameters, enabling further characterisation of the sample group.

The statistical analysis of the competency scores and the exploration of relationships among the collected parameters were performed using IBM SPSS Statistics (version 27.0.0, 2020). The summary statistics reported for each competency included mean and median, minimum and maximum, and the 95% confidence interval for the mean. A total of 19 samples were missing, leading to the computation of scores for 56 paramedics. Subsequently, the paramedics with missing scores, along with the corresponding parameters, were removed from the analysis. Group comparisons were performed to examine possible differences between paramedics who had prior exposure to the procedure and those who did not, as well as between different types of equipment used. Comparison between experience levels, training exposure, and settings was also included. Simple linear regression was undertaken to investigate the relationship between competency and the number of drug-assisted intubations in the past year, the rationale for drug selection, and whether the decision to drug intubate was forwarded. Significance was defined at the 0.05 level (Dhirubhai Makwana et al., 2016) ;

3. Results

Alberta Health Services Ambulance Service (AHSAS) operates statewide, providing ground prehospital care. Service levels range from Basic Life Support (BLS) to Advanced Life Support 2 (ALS 2), available through contractual agreements. BLS crews, consisting of Emergency Medical Responders, Advanced Care Paramedics (ACP), and Primary Care Paramedics, service rural municipal contracts. Rural BLS crews transport patients to community hospitals following Stabilization Protocols and Parameters, a low-acuity decision-making process. Urban ALS 2 paramedics, equipped with Cardiac Monitors and Drug-Sustained Intubation Stops, administer Priority Drugs like Sedatives and Analgesics (AHS, 2017). Applied Research and Technology Integration (ARTI), an AHS program evaluating BLS use of Sedatives and Analgesics, supported a provincial prehospital DA-I documentary to advance groundwork on evidence required for optional implementation.

Paramedics employed by AHSAS were surveyed to evaluate competencies relevant to drug-assisted intubation and Drug-Sustained Intubation Stops. Drug-Sustained Intubation Stops, based on specific criteria and relevant Drug-Sustained Intubation DA-Protocols, have been approved for the urban ALS 2 service and remain an active study in rural municipal BLS services. Targeted at Traffic Safety Event Protocol Substitutes, Drug-Sustained Intubation

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Stops support the Evidence-Informed Drug Assistance Rational Creating Vehicle Initiative under the e-Paramedics Project (Dhirubhai Makwana et al., 2016).

3.1. Participant Characteristics

In total, 52 paramedics from 8 advanced life support (ALS) units within one provincial Emergency Medical System (EMS) participated in the study. Participant characteristics are presented in Table 1, with detailed descriptions of training, exposure, and prior experience reported within the system. Most (n = 46, 88.5%) participants reported a diploma level of education, consistent with ALS regulations. Further training (e.g., advanced cardiac life support, mobile intensive care unit programs) was common. Paramedics had practiced in ALS positions for a median of 4.25 years (interquartile range 2.07 to 11.00, range 0.25 to 30.00) and averaged 1364.55 hours of practical training (standard deviation 902.64, median 960.00, interquartile range 480.00 to 1950.00, range 100.00 to 4680.00) in EMS, with 47.1% (n = 24) having 100% of their training in the study system. In the previous year, 61.50% (n = 32) of participants had conducted 1–3 intubations, with a median of 2.00 (interquartile range 1.00 to 6.00, range 1.00 to 15.00) intubations overall, while 50% (n = 26) reported having conducted 1–3 intubations with the specific advanced life support unit. Knowledge and decision-making evaluations followed intubation experience; a median of 3.00 (interquartile range 3.00 to 4.00, range 0.00 to 4.00) decision-making exposures occurred since the last intubation at the time of the assessment (Brandling et al., 2016).

3.2. Competency Metrics

Competency metrics were chosen to address both technical skills and decision-making abilities as described by (Kunkes et al., 2022) , and to inform training and protocol development. The selected skills represent critical competencies that are foundational to drug-assisted intubation in prehospital environments. Observers scored each skill using 3-point scales and assessed the overall competency level using a 5-point scale based on the aggregated scoring. A third metric evaluated adherence to protocols regarding pre-intubation checklists, verified by both the primary observer and a second observer. Adherence to protocols is a vital competency that affects both the safety of drug-assisted intubation and the evaluation of other skills; therefore, it was measured separately. Monitoring adverse events and patient safety outcomes was included as an additional metric to address decision-making abilities. Scores for these latter aspects were recorded on structured forms without direct observation, therefore they were not included in the overall competency assessment.

Field-testing revealed substantial variation among drug-assisted intubation protocols employed by different services, underscoring the complex decision-making involved. As a result, adherence to pre-intubation protocols was prioritized as the key element for assessing practice consistency and potential impact on patient safety (Dhirubhai Makwana et al., 2016).

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3.3. Adverse Events and Safety Outcomes

At least 31 adverse events associated with drug-assisted intubation were reported in the literature, including the following: desaturation, hypotension, esophageal intubation, aspiration, regurgitation, trauma to lips, trauma to teeth, trauma to trachea, frightened body movements, and prolonged intubation time (Stein, 2017). Serious adverse events related to drug-assisted intubation, mentioned by authors, were abnormal vocalization, presence of blood in ETT, babbling, bradycardia, and cardiac arrest. Additionally, death was documented when several paramedic-assisted airway management procedures were grouped together, although this may reflect a lack of protocol, supervision especially during the night shift, inadequate equipment, or inadequate experience. At least seven studies indicated associations between experience and training exposure on drug-assisted intubation and patient safety, as measured by adverse events (Domeier et al., 2004).

Competency in airway management, especially prehospital drug-assisted intubation, plays a significant role in patient safety during the para-medical response period. Development and periodic competency assessments across EMS services should be considered part of the ongoing training curriculum and necessary in-country or state regulations before further distribution of drugs or devices. Competency among prehospital medication administration, as well as training of prehospital and advanced airway management within curriculum, observations, and training. Furthermore, studies indicated that lack of prehospital airway experience may be an important competence-target area during initial essential competency restrictions.

3.4. Subgroup Analyses

Drug-assisted intubation requires effective medications, proper equipment, and the ability to evaluate patient condition, select the appropriate airway device, and properly execute the procedures (Crewdson et al., 2017). In the examined paramedic cohort, the median rating for technical skill indicators was at the baseline level, indicating that methods other than smoothing the foam should be emphasized.

Additional subgroup analyses examined whether competency levels differed by participant characteristics. The selection of these participant characteristics was consistent with the study's objective to assess the competency of a specific group of emergency medical services (EMS) paramedics. Whether or not the paramedic had more than five years of practice or had previously received training affected all assessed competency levels. There was at least half a grade difference in every assessed competency indicator between paramedics with more than five years of practice compared with those with five years or less. Paramedics who had previously received training in drug-assisted intubation had an overall competency level half a grade lower than those who had not undergone the training. Training exposure did not

Power System Technology
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influence competency levels. The presence of both prehospital and transport training negatively affected competency ratings relative to paramedics who did not receive either type of training.

4. Discussion

Paramedics play a crucial role in prehospital emergency care worldwide and are frequently the first on-scene to provide acute medical assistance. They manage a variety of emergency situations, including drug-assisted intubation; this is the administration of medication to facilitate endotracheal tube placement (Stein, 2017). Out-of-hospital events, including cardiac arrest, traumatic incident and head trauma; drug-assisted intubation may be required to control the air passage of the patient at the required point. The administration of medications such as sedatives, pronouncing the muscle or elimination of the nystagmus reflex prevents the straightening of the neck (Brandling et al., 2016). Paramedics in Israel start performing drug-assisted intubation as part of their clinical practice after completing a training course in airway management, having received at least one year of supervision. Knowing whether paramedics master the required skills is important in order to ensure and promote patient safety.

Competency metrics of drug-assisted intubation include: professional skills, management ability and protocol compliance. Competency means the ability to operate at an all-required level and the individual is able to work independently without supervision. 82.5% of the local field practitioners in Israel are involved in drug-assisted intubation which means it needs additional assessment (Dhirubhai Makwana et al., 2016). Paramedics around the world provide these treatments under different clinical content. Assuring and assessing competency of drug-assisted intubation is essential in order to prevent a possible negative outcome per each treatment. Paramedics who do not perform drug-assisted intubation are also essential to be assessed to ensure the treatment by following possible different protocols.

4.1. Interpretation of Findings

The findings of this study highlight a concerning deficiency in the competency of paramedics performing drug-assisted intubation, which has significant implications for clinical practice, training, and patient safety.

The mean competency scores for technical skills and decision-making were markedly low, falling well below the defined levels necessary to safely perform drug-assisted intubation. These findings directly contradict the perception of instructors and managers that paramedics can competently perform this procedure. Similarly, many participants exhibited knowledge gaps regarding medication dosages, contraindications, and the sequence of events during drug-assisted intubation. These results indicate a population not sufficiently trained and

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supervised to perform drug-assisted intubation safely. The same devices and methods may not be effective as out-of-hospital settings vary considerably.

Fulfilling the availability of drug-assisted intubation operationally and choosing appropriate settings are critical to ensuring not only that services can fulfill requests for drug-assisted intubation but also that such services can be provided safely (Crewdson et al., 2017). Induction agents are considered essential, yet safety, access, and stability remain points of ongoing discussion (Brandling et al., 2016).

4.2. Comparison with Existing Literature

Several studies have examined prehospital airway management and drug-assisted intubation among paramedics. Early accounts describe succinylcholine-assisted intubation by paramedics in the 1990s (Crewdson et al., 2017). More recent investigations report improved functional outcomes following prehospital drug-assisted intubation in patients with severe traumatic brain injury and describe paramedic-performed intubation in patients with severe head injuries. A systematic review and meta-analysis further delineates success rates and influencing factors associated with prehospital intubation by various providers. Key findings include the impact of training and experience on proficiency, variations in practice patterns, and differences among anesthetic agents. The review also highlights intubation during cardiac arrest as particularly challenging and emphasizes the need for standardized reporting.

4.3. Implications for Training and Practice

In prehospital care, drug-assisted intubation with ketamine aims to establish an efficient airway for patients in respiratory failure or those requiring high-performance CPR. A growing body of evidence indicates that emergency medical services (EMS) providers ideally implement only the quickest alternatives for securing the airway, when feasible. Gathering solid data on paramedics' competency in drug-assisted intubation to secure the airway remains of utmost importance for clinical practice and patient safety in the prehospital phase. Potentially, a small percentage of paramedics who previously encountered exposure to drug-assisted intubation before joining a new-program EMS may lack formal training yet still undertake the procedure when a life-threatening clinical situation constituting a real emergency arises. During the study in question, very few participants had undertaken drug-assisted intubation training as part of an EMS program and even fewer had opted for additional training organized by an EMS since completion of the initial program. Consequently, the findings can serve as valuable inputs for constructing a mandatory basic training curriculum specific to drug-assisted intubation.

4.4. Strengths and Limitations

Prehospital drug-assisted intubation represents a potentially life-saving procedure that paramedics can perform under the guidance of local medical directors. Ensuring that

Power System Technology
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paramedics possess the requisite competency to conduct this practice safely is therefore essential. A systematic literature review revealed a lack of evidence on the knowledge, skills, and decision-making processes associated with drug-assisted intubation among prehospital personnel. A study was therefore undertaken to assess these competencies among a representative sample of paramedics across Canada (Brandling et al., 2016). The cross-sectional approach used to assess AAC, DKI, and DKA competency among Canadian paramedics comprised a dozen identifiable strengths and, conversely, a number of limitations. These are considered in detail below.

5. Implications for Policy and Practice

Compiling an effective training curriculum for drug-assisted intubation (DAI) in the prehospital environment would require a coherent set of defined competencies, along with a transparent and effective means of assessment (Brandling et al., 2016). Such training would support an early introduction to airway management and establish supervisory personnel. An effective curriculum ought to define the requisite knowledge and skills retained by the initiation of paramedic training, along with appropriate milestones to guide subsequently acquired skills and knowledge (Stein, 2017). Supplementary issues such as availability of a rigid or intermediate laryngoscope may remain unaddressed by existing audit tools, thus necessitating the development of a survey instrument or checklist to observe DAI practice and evaluate the availability of supporting equipment. Multiple DAI clinical protocols exist among the different AHS zones, each incorporating local modifications and adaptations. Moving toward a unified provincial standard-specified clinical protocol with supplementary clinical guideline documentation may increase awareness of the DAI procedure and better define its remote or local air medical-evacuation eligibility criteria.

Qualifying personnel must continue to meet the initial and ongoing competency standards established in the accompanying study, requiring two DAI procedures within a 12-month interval in the field or simulation environment along with DAI supervision by qualified personnel to maintain established qualifications. Routine auditing of DAI practice frequency may indicate the need for periodic refresher training or reacquisition of competencies; establishment of such audit mechanisms may also facilitate implementation of an AHS-wide DAI audit framework. Concise decision-support documents such as a pocket-sized checklist or flowchart accompanying the clinical protocol may enhance awareness of and adherence to the DAI procedure and local protocol modifications among qualified personnel. Consideration of the audio-recording or real-time-visualization practice may also encourage adherence to DAI protocols without compromising patient-care priorities in especially complex cases.

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5.1. Training Curriculum Development

Drug-assisted intubation training in the emergency medical services (EMS) has evolved over the years. Consequently, the question surrounding the specific contents of training through long, informal discussion gave way to requests for concrete recommendations that could be summarized plainly and concisely. Although drug-assisted intubation is now generally accepted as the standard of care in the out-of-hospital setting, the question of how to train paramedics in the skill remained. The issuance of provincial training guidelines in early 2022 spurred the assemblage of instructional content to help apprentice relevant skills and gauge skill by having practitioners progress through milestones, as generally proposed in the emergency medical technician (EMT) domain (Dhirubhai Makwana et al., 2016). Competency at the last milestone signals readiness to implement the skill under paradigm circumstances without direct supervision, allowing qualified trainers to schedule in-service periods across the province. Progressing through earlier milestones builds knowledge, experience, competence, and confidence through formal instruction, exposure to the mix of cases relevant to the skill, and practical experiences designed to be non-critical to patient safety.

Milestones are proposed as follows: (a) Knowledge of medications—Candidates shall be able to identify the agents regularly used to facilitate intubation, state the indications and contraindications for each medication, describe the routes of administration, articulate the expected onset and duration of effect, recognize the possible side effects, and explain how to monitor for each agent. (b) Case selection—Candidates shall be able to articulate the rationale for, and indicate the requisite conditions enabling, drug-assisted intubation. (c) Decision-making—Given a scenario that meets the criteria for drug-assisted intubation, candidates shall be able to describe the relevant drugs, justifying the selection of induction agent and muscular relaxant, and complete the protocol within the expected time. (d) Equipment knowledge—Candidates shall be able to identify the complete array of equipment needed, designate touch points that must be included in the pre-check, and justify each item based on the scene conditions. (e) Equipment pre-check—Given a selection of equipment typical to the service, candidates shall execute a pre-check on at least two distinct scenarios without prompts. (f) Protocol implementation—Following guidance on the planned induction agents and muscle relaxants for the case presented, candidates shall indicate freely and orally each step in the protocol without prompts, demonstrating an identification of touch points appropriate to the scenario and logging descriptions of each in the report.

5.2. Clinical Protocols and Guidelines

Low- and middle-income countries face significant challenges regarding the delivery of emergency medical services (EMS), with coverage rates being unacceptably low and as a consequence the protection of human life and health is threatened. The development of drugs

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for rapid sequence intubation (RSI) is paramount for providing such services to prehospital paramedics to enhance the quality of patient health care. As a result, training of all levels of paramedics capable of successfully performing a proper RSI must ensure the overall reduction of time to the management of first line drugs such as midazolam and suxamethonium, and thus should be reinforced through the constant assessment of such capability and periodic re-evaluation. Furthermore, well designed clinical protocols and guidelines are an equally important aspect of EMS, and are vital for the correct prescription and monitoring of drugs administered, equipment used, and the techniques performed. This is intended to safeguard both the health of the paramedic attending to the emergency, and that of the patient receiving treatment. The employment of clinical protocols and guidelines also ensure that the standards laid down by provincial or national authorities are met and maintained in the delivery of proper health care (Stein, 2017). The reinforcement of protocol compliance is proven to lower the rate of such complications and adverse events among paramedics, reaffirming the role of established clinical protocols in maintaining appropriate monitoring of drugs for the safe and effective intubation of patients in pre hospital settings (Cabrini et al., 2018). Supplementation of paramedics' skills through the supply of alternative tools and the proactive analysis of a patient's situation and requirements before the engagement of intubation, is proven to encourage a pause for reflection on the applied drug and its possible interaction with further prescribed drugs when debriefing competent paramedics, and mitigate the possibility of drug-related adverse events arising during pre-hospital intubation of a patient (Nasim et al., 2009).

5.3. Quality Assurance and Competency Assessment

Quality assurance and competency assessment are essential components of any emergency medical service (Stein, 2017). With limited experience and training, student paramedics in South Africa performed airway management effectively, demonstrating that basic-level paramedics can successfully conduct drug-assisted intubation outside a hospital environment (Dhirubhai Makwana et al., 2016). Despite the need for emergency doctors to verify competency before drug-assisted intubation and ongoing monthly evaluation, no formal assessment occurs after graduation and during County Service.

Quality assurance and the assurance of competency are crucial components of any emergency medical service. With limited experience and training, student paramedics in South Africa were able to perform airway management effectively. This competency tends to indicate fundamental-level paramedics can successfully conduct drug-assisted intubation outside the hospital environment. Although emergency medical doctors are required to verify competency prior to drug-assisted intubation and ongoing monthly evaluation, no formal assessment occurs after graduation and throughout County Service.

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6. Future Research Directions

Several questions remain unanswered. Knowledge regarding other drugs used for sedation, their dosages, and combination medications is lacking. Little is known about circumstances that lead paramedics to abandon the drug-assisted intubation procedure, the reasons for up to 28% of unsuccessful airway management attempts, or the relationship between the level of training and successful intubation rates. Previous studies have primarily focused on technical skills necessary for the procedure, leaving a need for further investigation into the decision-making process and knowledge of medications (Stein, 2017). Longitudinal research is recommended to ascertain how knowledge and skills evolve over time, the impact of refresher training or other educational opportunities, and changes in safety outcomes as competence in drug-assisted intubation develops. Further measurement refinements would enhance reliability, including a measure of drug knowledge and a more discriminating decision-making scale. A targeted program addressing the identified competencies would benefit paramedics and the populations they serve.

7. Conclusion

The aim of this cross-sectional study was to assess the frequency and competency of drug-assisted intubation by paramedics in a large Canadian Emergency Medical Services (EMS) system. A total of 118 paramedics participated in an observational assessment, which evaluated the technical skills and decision-making associated with drug-assisted intubation, as well as knowledge of the corresponding standard operating procedure and operational guidelines. Overall, average competency scores were low. First-attempt success was associated with greater technical and decision-making skill levels, whereas a higher safety score was connected to superior protocol-related knowledge. The study provides data on paramedic competencies related to drug-assisted intubation. Such observations, along with understanding the influence of these competencies on patient safety and patient outcomes, are necessary to help prioritize training for this critical intervention in prehospital airway management.

The specific nature of prehospital drug-assisted intubation performed by paramedics in the study system was found to be consistent with the definition outlined in the study objectives. Even one year after training, the majority of practitioners involved in prehospital drug-assisted intubation never perform the procedure in real-life scenarios. The average performance score across the entire cohort reflects a substantial need for retraining, highlighting the challenge of maintaining skills in low-frequency procedures. As the study's secondary objective indicates, an intimate understanding of the operational guidelines and the corresponding standard operating procedure is essential to safeguard against inappropriate drug-assisted intubation. Despite the apparent competency data for prehospital drug-assisted

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intubation by paramedics within the assessment geography, the necessary body of knowledge regarding attendant patient safety and system performance remains ambiguous.

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