

Can paramedics achieve core educational competencies through simulation alone?

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Introduction

The management of a patient's airway is the fundamental and primary consideration of every patient with emergency care needs. In clinical practice, failure to properly manage airway conditions remains a significant source of morbidity and mortality. To avoid or reduce errors and improve patient outcomes and safety, training airway management for ambulance clinicians is essential (Woolard and Furber 2010).

Within ambulance service and paramedic practice the skills and interventions required to ensure effective and appropriate airway management range from basic manoeuvres through to the use of advanced airway adjuncts.

Since the introduction of paramedics into UK ambulance services in the 1980's traditional training and education has involved a blended approach involving lectures, scenarios and time spent in clinical placements such as hospital theatres, emergency departments and with paramedic placement educators.

Endotracheal Intubation (ETI) is defined as the insertion of an emergency breathing tube into the trachea (windpipe) and is an important, high-profile procedure performed by paramedics (Wang 2012). Alvarado and Panakos (2022) describe ETI as an essential skill performed by multiple medical specialists to secure a patients airway as well as provide oxygenation and ventilation.

To achieve this core paramedic skill paramedic students have been required to complete hospital placements. This has been under the direct supervision of a consultant anaesthetist on patients undergoing pre-operative anaesthesia. The standard defined has traditionally been to achieve more than 25 intubations and been 'signed off' by a consultant anaesthetist (Deakin et al 2008).

Context

Many of the United Kingdom's (UK) ambulance services have withdrawn intubation from routine paramedic practice. The only ambulance services in the UK who retain ETI as a core skill are in Wales and Scotland. Each of the services who have withdrawn ETI now only 'permit' specialist roles to continue with the skill as long as they remain congruent with the College of Paramedics (2018) guidance.

The motivation for this decision to remove ETI has been varied but often consists of a desire to reduce the risk of unrecognised oesophageal intubation, concerns around frequency of undertaking the intervention and the challenge of developing

competency due to the difficulty of securing reliable theatre placement during pre-registration training. These factors have generated repeated discussion and debate as to whether the same recommendation to withdraw intubation from paramedics within Wales should also be progressed.

However, this decision is far from benign and if the decision was made to withdraw this intervention from paramedic practice, there remains a significant risk that a situation occurs where less invasive techniques (such as supraglottic airways) are not sufficient to secure a patient's airway.

There remains a paucity of evidence of benefit from paramedic out-of-hospital ETI (College of Paramedics 2018). The most recent study into the practice illustrated a less than clear outcome with no obvious benefit from the use of intubation against the insertion of a supraglottic airway (SGA). However, the publication also recognises that in a subset of patients, the insertion of an SGA will be insufficient to manage presenting condition. This finding is also supported in the description of the instances where pre-hospital intubation has been necessary (Benger et al 2018).

Whilst it is acknowledged that anecdote is low on the evidence hierarchy the frequency and consistency of anecdote, relating to this subset of patient, from prehospital care clinicians cannot be ignored. Furthermore, there is a requirement to ensure that attending paramedics feel suitably skilled and equipped to manage presentations such as this and are not left in a frustratingly pressured position where skills they once had are no longer supported.

It is clear that finding a solution to the ongoing challenge of ETI training and its complications requires greater consideration than simple withdrawal of the intervention. To do so has the potential to simply create another risk of attending clinicians not being able to secure a patients airway in a timely manner. Therefore, it is necessary to balance these two opposing risks against each other, to then determine which risk can be mitigated sufficiently to ensure adequate patient safety.

This paper aims to establish how confident paramedics are if the training for this core paramedic skill is delivered through simulation and not through deliberate practice under clinical supervision on human subjects.

Justification

In recent years, the topic of unrecognised oesophageal intubation has been the subject of several coronial investigations and subsequent Regulation 28 rulings, both in Wales and across the UK. Most notable amongst these is the sad case in East Midlands Ambulance Service. This case had significant ramifications for clinical practice in that through the Association of Ambulance Chief Executives (2014) there was a subsequent commitment from all the UK's ambulance services to ensure all paramedics maintained an ongoing log of airway management activities to ensure competency is maintained through clinical practice and simulation.

It should be noted that Welsh Ambulance Service NHS Trust (WAST) has also been the recipient of Regulation 28 orders, in relation to airway management incidents following Coronial investigations (Courts and Tribunal Judiciary 2016). Whilst the questions raised within this report are being addressed, it does resonate with the current circumstances that issues around the airway management and the ongoing competency of ambulance clinical is a very real and ongoing challenge.

Over several years, the introduction of new airway clinical equipment has seen the requirement for patients to require ETI has reduced significantly as other airway adjuncts are now used to maintain a patient's airway (in most clinical situations). The Covid 19 pandemic has also impacted the ability for paramedic students to complete clinical supervision in hospital placements to achieve the required standards.

Best practice statements from the College of Paramedics (2018), several serious incidents across the UK, Coronial Regulation 28 Prevention of Future Death Reports and published guidance had reinforced the need for all ambulance clinicians to have frequent reviews of their airway management training and education.

Many of the aspects within the College of Paramedics consensus statement have been addressed in the Welsh Ambulance Service NHS Trust (WAST) to implement a framework that supports recording of ETI in clinical practice or through simulation.

The subject of intubation by paramedics remains one which continues to generate controversy and repeated discussion. Undergraduate programmes provide students with the underpinning knowledge with regard to ETI, they also provide direction through supervised simulated practice but on graduating they are not permitted to undertake the core skill of intubation without undergoing supervised practice on human

subjects in the hospital environment. For example, over the last three years WAST have recruited 248 students through university and external recruitment who have not been through hospital placements so, are not currently permitted to undertake intubate patients in clinical practice.

Simulation

Health Education England undertook a systematic review of simulation in medical education and commented on the importance of simulation-based education (SBE): 'Access to SBE needs to be readily and equitably available to all staff, trainees and learners so that the future workforce is prepared for the delivery of safe, effective care. Central to this is the development of strong, active local and regional networks that can take advantage of economies of scale and best ensure a return on investment' (p.5).

Included in the review was a study by Wayne et al (2008) who concluded that the incorporation of simulation-based learning into resuscitation teaching programs, using realistic scenarios, is useful and offers the possibility of acquiring technical skills, but it also allows for the improvement of teamwork and the adoption of different roles and positive attitudes towards emotional stress.

Research studies provide a strong evidence base to help paramedics make robust clinical judgements and implement clinical management plans. Polit and Beck (2008) described research as a systemic inquiry to answer questions and problems encountered in clinical practice.

So (2019) describes simulation as a method or technique to produce an experience without going through the real event. Simulation has been used by a number of industries for many years, one of which are the aviation industries who have used simulation successfully for many years in their education and training programmes to drive improvements in safety. Skill training across many disciplines in healthcare (such as anaesthesia, nursing, surgery and medical curriculum). The introduction is comparatively recent which has been driven by patient safety and quality improvement.

Health Education and Improvement Wales (HEIW) undertook a Delphi study to get a consensus definition of simulation:

'is a learning tool that supports development through experiential learning by creating or replicating a particular set of conditions which resemble real life situations. It should

provide a safe environment where participants can learn from their mistakes without any danger to patients, allowing individuals to analyse and respond to these realistic situations, with the aim of developing or enhancing their knowledge, skills, behaviour and attitudes' (Hawker et al. 2022).

In 1966 a committee, chaired by Dr E L M Millar, reported to the Minister for Health on the equipment and training of staff in the NHS ambulance service. These reports were instrumental in both setting and improving standards in the training of ambulance staff. Before this in the post-war years all that was required of ambulance staff was a driving licence and an agreement to undertake a first aid certificate once in service.

Education in ambulance services has used some form of simulation models and learning approaches for a long time. In 1964, the first low-fidelity simulation educational study involving paramedics and lay people was conducted to investigate the acquisition of cardiopulmonary resuscitation skills using a resuscitation-Anne mannequin (Winchell & Safar, 1966).

Simulation is a term that refers to an artificial representation of a real scenario to achieve educational goals through experiential learning. This includes replicating clinical scenarios through simulation tools that serve an alternative to human subjects. Simulation allows the acquisition of clinical skills through deliberate practice rather than an apprentice style of learning. Simulation is a useful modality to supplement training that cannot be replicated from clinical practice (the major trauma patients who is entrapped in a vehicle for example).

Review of the literature.

Simulation-based training and education leverage the artificial representation of the human anatomy, thereby supporting the clinical experience and expertise in emergency intubation through experiential learning (Bienstock, Heuer and Zhang, 2022). Replication of clinical scenarios requiring ETI allows paramedics to master the emergency technique through the use of simulation tools (McClelland and Smith 2016; Panchal et al, 2020). However, simulation training models adopted within the contemporary healthcare sector hold critical implications for the quality-of-service provision and general health outcomes within modern society. Among emergency treatment, paramedics apply ETI placement skills to patients in dire need of airway

support, cardiopulmonary resuscitation (CPR), oxygenation or ventilations (Bienstock, Heuer, and Zhang, 2022). Although multiple techniques remain admissible for controlling a patient's airway the provision of rescue ventilation and ETI, paramedics rely on professional knowledge and experience gained from clinical supervision or simulation training on the process of intubation (Panchal et al, 2020, Wang and Bengner, 2020).

ETI remains identified as a critical skill among paramedics, considering the prevalent need for ventilation and breathing support among emergency care outpatients (Wang and Bengner, 2020). Paramedics implement the intubation procedure through the precise insertion of a medical tube through the nasal cavity, down to the blocked airways or trachea, for ventilation and delivery of oxygen across the patient's deprived system (Pilbery, 2018). Byars, Lo and Yates (2013) attained a 97.5% success rate for simulation-based training of paramedics in intubating Laryngeal Mask Airway in a medical program that simulated an extreme airway emergency requiring urgent ventilation and oxygenation following the repeated failure of the conventional ETI (95% CI, 87.1%-99.4%). Similarly, Warner et al (2010) and Sergeev et al (2012) received positive outcomes in the effectiveness of simulation training for paramedics intubating under challenging situations. However, contrary to the simulation training model adopted by Byars et al, (2013), Sergeev et al (2012) and Warner et al (2010) established the need for a minimum of 29 (over 3 years) and 30 manikin intubation simulations respectively, for a paramedic to gain firm professional skill and confidence in emergency care intubation.

Although Warner et al (2010) indicated a requirement minimum median of 29 simulated intubations for effective intubation among emergency care paramedics, the performance of 5 successful intubations within the hospital settings was enough to allow a paramedic to perform emergency care intubations. Consistent with the emergency care needs of patients, McClelland and Smith (2016) established that the competence and effectiveness of ETI among paramedics required at least 25-30 simulated intubations, whereas Panchal et al (2020) found 40 pre-hospital simulations were relevant for the acquisition of a reliable success rate.

Fundamentally, repeated success in the simulated intubation for emergency care patients elevated the professional experience and effective placement of breathing tubes during emergency care situations (Bienstock et al 2023; Jasper 2022; Warner et al 2010). Using a prospective and single-group approach, Byars et al (2013)

achieved 100% success after 1-year simulation training of 35 paramedics using mannequins for I-LMA intubation within the hospital settings (95% CI, 91.4%-100%). Evidence from the studies by Jasper (2022), Warner et al (2010) and Sergeev et al (2012), however, reflects the in-hospital simulation training for intubation, although it lacks the element of invariance and urgency, is in accordance with emergency health situations.

A scoping review by Wheeler and Dippenaar (2020) demonstrated the significant influence of simulation on emergency care, as the primary teaching modality for the education and training of paramedics. In agreement with the findings by Wheeler and Dippenaar (2020) and Bienstock et al (2023) argued the high invariance in emergency cases that require airway management, necessitating critical intubation skills and experimental experience among paramedics performing cardiopulmonary resuscitation or trauma management within out-of-hospital settings. While Beinstock et al (2023) reviewed the use of simulation-based learning for training intubation procedures for paramedics, the findings are consistent with the research outcomes of Balamurugan and Madhubala (2019) and Zamani et al (2020), where both supervised and unsupervised intubation improved the overall professional capacity of paramedics to perform ETI. Due to experiential learning and interactive intubation practice during the simulation process, simulation-based training was established to provide a resourceful platform for paramedics to gain extensive experience and clinical skills in different environments and techniques.

Both clinical and medical evidence indicates the capacity of simulation training to improve intubation skills for emergency care patients, where the active engagement of paramedics in simulation training modalities significantly improved the paramedics professional experience and endotracheal intubation ability, competence and success rates (Byars et al, 2013; Katzenell et al, 2013; McClelland and Smith, 2016; Zamani et al, 2020). However, inconsistencies within the medical evidence, research outcomes and simulation models account for the variation in simulation training for pre-hospital, in-hospital and emergency care paramedics. Supported by data from Johnston and Batt (2019) and Katzenell et al (2013), the review by Wheeler and Dippenaar (2020) asserts that minimal clinical and medical research explores the use of simulation-based learning for training pre-hospital paramedics. Further, Beinstock et al. (2023) included heterogeneous study designs that account for the variation in the outcomes among different qualitative, quantitative, retrospective and mixed-

methods projects. Bienstock (2023) indicated that the extent of skill retention among paramedics was not frequently and sufficiently reported in reviewed studies, after the engagement of paramedics in simulation on intubation. Further, the direct influence of simulated-based training (SBT) on patient outcomes, including mortality and length-of-stay, was not precisely documented among 25 reviewed studies on SBT for intubation procedures.

Within difficult airway intubation procedures, the effectiveness of simulation training was established by Panchal et al (2020) to be significantly low especially for pre-hospital paramedics, as compared to outcomes by Khalaf et al. (2019), where planned simulation training improved the self-efficacy of students showing that the participants revealed high self-efficacy levels. Contrary to simulation-based education (SBE) for pre-hospital paramedic students under training (Pilbery, 2018), only 14% paramedics managed to effectively ventilate difficult airways at a standard rate of 10-12 breaths/min, whereas continuous ventilation without interruptions (<30sec), occurred in 22% of simulations (Panchal et al, 2015). Additionally, paramedics with an average of 40 prehospital intubations throughout their careers were found to successfully and effectively perform airway placement at a rate of 63%. Although a critical review by Wheeler and Dippenaar (2020) demonstrated the significant impact of simulation-based learning modalities on intubation outcomes, Pilbery (2018) and Panchal et al (2015) established a volatile pattern in the effectiveness and success rate of endotracheal intubation (ETI). However, Pilbery (2018) adopted an inconsistent methodology that includes live experiences of ETI as opposed to Wheeler and Dippenaar (2020) and McClelland and Smith (2016), where primary simulations were adopted for training the skill of intubation.

The theme of confidence, satisfaction and competence are intertwined within the SBT process considering the participation of paramedics in experiential learning that requires physical and psychological engagement for improving the skill of intubation. Research by Kabi et al (2021) explains that simulation-based learning resulted in improved learner satisfaction and improved performance. The research relied on the use of a questionnaire to collect data. The findings of the study are congruent with the findings by Wheeler and Dippenaar (2020), who assert that simulation is effective in building paramedics skills and developing student competence in certain areas. Wheeler and Dippenaar (2020) further explain that simulation is effective in presenting paramedics with experiences and chances to learn in different environments by

making use of various techniques. In addition, this position is supported by Strachan (2019), who found that paramedics students in South Africa were satisfied with simulation training. The findings of Kabi et al (2021) and Wheeler and Dippenaar (2020) show correspondence with the findings of Sandy et al (2021) who describe simulation as an effective learning model that aids in improving the competency of paramedic trainees. Moreover, Sandy et al (2021) explain that simulation increases the satisfaction and self-confidence of paramedic students which in turn results in increased quality of care. However, the study by Sandy et al (2021) used the convenience sampling technique, thus, lacking the crucial element of randomisation.

Findings by Miles, Hansen and Mills (2020) regarding a paramedics training session, where the participants were expected to conduct the program on a nightshift, reported positive feedback from the students regarding the satisfaction of the event, a large number of the individuals found the activity exciting. Miles et al (2020) also reveal that the paramedic trainees raised their concerns about the need to include the experience in the standard undergraduate curriculum. However, although the participants were excited by their experience most of them were reluctant to agree on performing the same activity on the same day, which Miles et al (2020) attribute to general tiredness from their first night of the engagement. Similarly, the study by Miles et al (2020) also used the convenience sampling technique. Additionally, Miles's et al (2020) findings correspond with those of Nabecker et al (2021), who highlight that 329 participants of a high-fidelity simulation showed positive reactions after the experience and were motivated to engage, with most of them happy to recommend them to their colleagues. The participants also revealed an improvement in their self-efficacy and confidence to employ learned skills in further practice. Nabecker et al (2021) study adopted the convenience sampling technique.

Slabber and Henrico (2022) established the correlation between high-fidelity simulation and high student satisfaction levels. Slabber and Henrico (2022) explain that fidelity plays a key part in the satisfaction of emergency care providers with simulation. However, one of the major underlying limitations of the Slabber and Henrico (2022) study is the use of a convenience sampling technique, weakening the strength of the evidence. These findings are congruent with findings by Turatsinzea et al (2020), who highlight the significant role played by the simulation in improving the satisfaction levels of emergency care providers. Moreover, research by Jang, Kim and Kim (2020) reveals increased job satisfaction and decision-making capabilities after

the deployment of simulation learning of participants working in the emergency care department. Jang et al (2020) employed the use of convenience sampling which is also the case with Turatsinzea et al (2020). The improvement of occupation cues, such as satisfaction and decision-making capacity, greatly elevated the level of confidence of paramedics in the placement of treatment tubes during emergency care intubation.

Interactive and experiential learning encompassed within simulated-based training influences the skills and confidence of paramedics, shaping the outcomes of emergency intubation procedures and general patient outcomes (McClelland and Smith, 2016). Jasper (2022) attributes this to the relaxed working situations in simulation training as there is reduced pressure from their clinical supervisors, given that they are not interacting with live patients. These arguments remain consistent with findings by Ross et al (2023), who contend that simulation-based learning has shown significant developments in confidence, knowledge, teamwork and communication. Moreover, Ross et al (2023) and Jasper (2022) agree that simulation training provides a secure and conducive environment for paramedic training which is supported by findings from Alrazeeni, Younas and Parveen (2021).

However, according to Ross et al (2023), despite performance improvement, simulation in paramedics training reduces reaction time in difficult conditions due to the elevated confidence of practitioners in performing complicated procedures such as airway management. Ross et al (2023) advocate for multiple sessions of a relatively moderate length of ETI simulation training for improved performance of paramedics in emergencies. The findings of Jasper (2022) Ross et al (2023) and Alrazeeni et al (2021) concur with those of Kabi et al (2021). To expound on this, Mortimer (2018) highlights that there is a strong relationship between simulation and self-confidence, although any difficulties faced during interaction with the simulator can decrease its benefit, thus, compromising the learner's working environment.

Findings by Azizi et al (2022) complement those by Khalaf et al (2019) as they stress that simulation learning positively impacted the learner's self-efficacy skills and confidence during clinical activities, reflecting the potential applicability of simulated-based learning (SBT) for training paramedics who perform intubation. Confident paramedics are identified to have higher success rates in the endotracheal placement of tubes for emergency care patients with ventilation or blocked airway problems. Unlike Azizi et al (2022), who adopted the simple random sampling technique, the study by Khalaf et al (2019) who used the convenience sampling method, is gender

biased as they only focused on the female gender. Studies by both parties used questionnaires to collect data from the participants which included the demographic profile and self-efficacy level. Findings by Khalaf et al (2019) further noted a statistical variance regarding the age difference, which is a factor that reflects the medical experience of the paramedic learners. The studies used to determine the relationship between simulation training and self-efficacy in the current study also focus on nursing students, thus, limiting the specificity of the findings on paramedics who perform ETI.

A study conducted by Balamurugan and Madhubala (2019) establishes the relationship between simulation training and the confidence of participants. The study further explains that the training helped develop competency and knowledge, improving the level of practice of ETI. The findings complement those of Zamani et al (2020) who ascertain that learning the skill of tracheal intubation in simulated environments is necessary since the learners are exposed to less pressure and their self-confidence is not greatly undermined by mistakes. The findings of Zamani et al (2020) and Balamurugan and Madhubala (2019) concur with those of Lin et al (2019) who explain that the suction-assisted laryngoscopy-assisted decontamination simulation system can promote the performance of tracheal intubation, reducing the intubation time and improving the confidence of participants in performing endotracheal intubation. The findings of the study show a notable increase in confidence in endotracheal intubation, which increased from 22% to 97.6% after the training. However, despite the correspondence in their findings, studies by Zamani et al (2020), Balamurugan and Madhubala (2019) and Lin et al (2019) employed the use of convenience sampling and, thus, lacked a key aspect of randomisation which greatly compromises the strength of the evidence. The findings of Zamani et al (2019) and Lin et al (2019) are consistent with those of Alrazeeni et al (2021). Furthermore, Madsgaard et al (2022) support these findings by explaining that simulation learning in paramedics training has been identified as a vital aspect in not only enhancing the development of psychomotor skills but also promoting the acquisition of knowledge and confidence and self-efficacy among paramedic trainees.

Kaliyaperumal et al (2021) agree with Alalhareth and Howarth (2020) as they ascertain that simulation in medical education promotes the self-confidence of nursing learners before their real encounter with their respective patients. Kaliyaperumal et al (2021) further explain that confidence in nursing is a key component of professional caring that aids in enhancing trust and engagement between nurses and their patients.

Kaliyaperumal et al (2021) also contend that for a successful simulation program, a positive student perception is a major requirement. When reviewing the effectiveness and confidence in simulation training in the current research, the theme of self-confidence emerges as a key factor of consideration. Studies by Kaliyaperumal et al (2021) and Alqahtani and Ramiah (2021) adopted the convenience sampling technique and lacked the vital aspect of randomisation which may result in obtaining weak results. Findings by all the reviewed studies notably identify simulation-based learning as a major contributing factor to self-confidence among learners, which is a vital tool in healthcare provision.

Debriefing has also been discussed by various researchers as a crucial component of simulation especially in achieving its effectiveness. Naidoo (2021) ascertains that debriefing provides the opportunity for paramedic trainees to share their actions and experiences. Therefore, by expressing the emotions of learners, debriefers motivate the trainees to enhance their knowledge, participate in the learning and promote teamwork boosting their confidence to address their issues in the programs. With the use of simulation, real experiments can be performed through the deployment of simulation tools to enhance interactive and procedural intubation skills within emergency care settings (Jasper, 2022). Moreover, the deployment of simulation has helped paramedics trainees gain the advantage of rapid feedback. Such factors have been crucial in developing the confidence of paramedics, improving the quality of care.

Drawbacks of simulation based education

Simulation-based education (SBE) and training are subject to error despite the high-quality designs and modelling applied for learning emergency care. From a broader perspective, the use of simulation training suffers a scope of error and doubt on the re-creation of emergency care scenarios. Simulation in paramedic training has been faced with challenges such as the increased cost of technology and increased cost of the employment of staff (Miles et al 2020). The predominant drawback of simulation training is the costs and maintenance involved in the replication of real-world facets and environments, applied for interactive learning (Brown and Tortorella, 2020). The cost of conducting simulation practices has also been identified as a major challenge due to the heavy reliance on complex technologies and the cost incurred in paying trainers (Mortimer, 2018). Additionally, simulation often involves the participation of small populations in teaching which is relatively imbalanced when comparing the cost

attached to this activity. The maintenance of manikins, simulated models and digital simulations requires frequent updates for effective simulated learning. Technical design factors such as lack of change in the skin colour of manikins as observed in patients also undermine the effectiveness of simulation.

Furthermore, there is a lack of strong evidence to show if competence during simulation training is reflected in the actual setting. In comparison with other traditional research approaches, simulation is highly associated with validity challenges (Lamé and Dixon-Woods, 2020). Lamé and Dixon-Woods (2020) further highlight that for high internal validity in simulation, more efforts have to be put into standardisation. In terms of validity and effectiveness, another challenge facing simulation training is that most trainers involved in the program are full-time healthcare practitioners and offer training services part-time (Lateef, 2010). These individuals in certain circumstances may lack enough time to conduct regular teaching programs and are potentially at risk of losing their debriefing skills. On this basis, the implementation of simulation-based learning has resulted in changes regarding clinical supervision as fewer clinical supervisors are needed during the facilitation of the training. In essence, this has been identified as a key intervention in reducing the high costs incurred when conducting simulation training.

A significant number of studies reviewed used convenience sampling and a lack the crucial component of randomisation, weakening the strength of their evidence. Additionally, the review is language biased, as it only studies written in English. Despite the above limitations, the objective of the review was attained and adequate data were collected regarding the effectiveness and confidence of simulation in paramedic training for learning the skill of intubation. The comprehensive review of multiple research studies and clinical trials supports the heterogeneity of evidence and outcomes examined in understanding the effectiveness of simulation-based learning among paramedics who perform intubation procedures within emergency care settings. Different studies applied varying methodologies and measures, contributing to the evidence analysed for comprehending simulation training among intubating paramedics.

Aims of the study

To identify if simulation alone provides paramedics with the confidence to apply core airway management skills and meet the best practice guidance contained in airway management policies.

Objectives of Research Activity

1. To research and critically evaluate the latest evidence for simulated clinical practice.
2. To assess and analyse the confidence levels of paramedics who are using simulation to maintain core skills in airway management and identify patterns.
3. To critically analyse the data.
4. To reflect on the findings section and recommend learning for future action in WAST.

Methodology

Research philosophical paradigms are a set of beliefs and practices that regulate inquiry within a discipline by providing lenses, frames and processes through which study is carried out (Edwards, 2008). Costley, Elliott and Gibbs (2011) describe paradigms as a “deep rooted set of principles that include an ontological and epistemological position and a set of values for operating in the world” (p.83). Some paradigms are dominant but many exist together and give rise to competing beliefs, thoughts and world views which can either exist in harmony or, lead to disputes.

Guba and Lincoln (2000, quoted in Costley, Elliott and Gibbs 2011,p.84) describes five paradigms as:

1. *Positivism-treats reality as objective and knowable whose methodological approach is often quantitative and technical which aims to provide explanations and predictions based on measurable (often mathematical) outcomes.*
2. *Post-positivism-similar to positivism in that reality is objective but not all is 'knowable', the emphasis moves then to testing a hypothesis rather than attempting to prove or disprove a hypothesis.*
3. *Critical theory- social and cultural values shape reality over time, education and knowledge that challenges the status quo.*
4. *Constructivism-reality is socially and individually derived, knowledge as an individual construction.*

5. *Participatory- reality and knowledge of reality is co-created from mutual understanding form lived experience, research is a collaborative activity of enquiry which is facilitator led.*

Ontology, epistemology, methodology and methods are components of a methodological framework used when embarking on any research. Gray (2009) state “ontology as the study of being, the nature of existence, understanding *what is*” (p.17). This seems an all-encompassing philosophical view which would include individual beliefs about the nature of reality, assumptions made of how the world works and what we believe to be reality. Scotland (2012) describe ontology as a branch of philosophy concerned with the assumptions, we make in order to believe that something makes sense or is real, or the very nature or essence of the social phenomenon we are investigating. Two main ontological positions are objectivism (reality is objective and independent of other external/ social factors) and subjectivism (reality is subjective and cannot be considered independently of experience, viewpoints, social factors).

If we conclude that ontology is concerned with the study of what we say exists then epistemology is what we mean when we know something or as Gray (2009) states “epistemology tries to understand what it means to know” (p.17). Kivunja and Kuyini (2017) suggest that epistemology is concerned with the very basis of knowledge, its nature and forms and how it can be acquired. The two main epistemological positions are positivism (positive, objective reality that can be observed and measured) and interpretism (people and their institutions are fundamentally different from the natural sciences). For Crotty (1998) epistemology is a way of looking at the world, making sense of it by including knowledge and what knowledge entails.

A number of ontological, epistemological and axiological assumptions will be made during each stage of the research which will help to shape this research and how to interpret the findings. Grix (2004) go one step further, “people that who want to conduct clear, precise research and evaluate other’s research need to understand the philosophical underpinnings that inform their choice of research questions, methodology, methods and intentions” (p.57). When embarking on research it is important to firstly, understand your own values and beliefs. Even if one’s own values and beliefs do not fit perfectly into one paradigm it is important to determine your approach to the research before selecting a methodology. Scotland (2012) explains that every paradigm is based on its own ontological and epistemological assumptions

which underpin a particular research approach which is reflected in the methodology and methods.

Costley, Elliott and Gibbs (2011) state that “methodology consists of principles for acquiring knowledge or for creating change, or both” (p.86). Researchers will have their own assumptions and world views about the nature of knowledge and reality, based on their own beliefs and how that knowledge may be gained (methodology). Methodology addresses the how, why, what and which methods are best suited to collecting and analysing data. Gray (2009) suggest that a research design will explain the purpose of the study, collection of data, sample selection and methods of analysis.

Two of the main methodological approaches can be classified as quantitative and qualitative used to collect data. Quantitative methodology is concerned with quantifying, collecting and analysing numerical data. Gray (2009) describes as truth seeking as opposed to opinion or perspective seeking to produce objective results which are valid and replicable. Much more information about science and society has been recorded in number form which allows them to be manipulated using statistical analysis (Walliman 2016)

Paramedicine is an evolving area of research but there has to date been little experience of conducting large scale clinical trials in the prehospital setting, an area of clinical practice where knowledge gaps are significant (Snooks et al 2009). Over the last ten years there has been a growing evidence base of quantitative research (Perkins et al 2015) which has been implemented into clinical strategies for the improvement of measurable outcomes such as mortality and morbidity. There have been fewer qualitative studies understanding how and why humans interact with each other in the pre-hospital setting.

Gray (2009) suggests that a criticism of quantitative research is the disengagement of the researcher from the people they are researching. This view can be seen from two perspectives, the quantitative researchers may well see this as a positive but qualitative researchers point out that may see it as a failure to understand the social and cultural constructions.

Qualitative methodology is more concerned with the understanding and meaning so the data is more descriptive. Typical examples include literary texts, observation notes, interview transcripts or recordings and recollections. Because qualitative data cannot be dispassionately measured and analysed in a standard way means that they may be more susceptible to variation in how they are interpreted (Walliman, 2016).

The author struggled with separating methods, methodology, ontology and epistemology despite reading several texts to summarise and formulate the approach to the study. A video presentation by David James (2015) to doctoral centre students in Wales used the metaphor of an iceberg to explain how methods were what you ended up doing and just below the surface was the methodology, how you came to make decisions and analyse approaches to your method.

The author reviewed the different methodological approaches to the research and initially felt that the constructivist paradigm with multiple realities as opposed to positivism would be the correct approach to the study. Siriwardena et al (2022) explain that interpretivism and constructivism derive from individual experiences, perceptions and beliefs which create a version of reality that is their own. This paradigm fits well with the authors beliefs and values and can relate this to their own learning experiences. However, this changed after deliberating on which model to use for the research. Several methodologies were reviewed but a mixed method approach was finally decided upon. Cohen (2018) states that 'mixed method research has a major place in research and for many writers it has its own paradigm, its own foundational views on social reality and research, its own ontology and epistemology, its own axiologies and methodologies' (p.31). The researcher changed this approach after careful consideration to study participants and whether the two approaches would compliment and support each other in answering the research question.

Mixed methods research is an established methodological approach complementing the existing traditions of quantitative and qualitative movements. This development has been accompanied by a search for an appropriate paradigm to legitimise the use of mixed methods comparable to the paradigms that have been widely accepted as justifying the use of quantitative and qualitative methods separately. The term 'mixed methods' has come to be used to refer to the use of two or more methods in a research project yielding both qualitative and quantitative data (Teddlie & Tashakkori, 2009).

Rather than take a single approach to the research the author believes that approaching the research from the perspective that there are multiple views of the problem will have an increased probability of addressing the research question. Creswell and Plano Clark (2011) describe four paradigms, one of which is pragmatism where the researcher focusses on framing and answering the research question. Cohen (2018) suggests a mixed methods approach integrates numerical and narrative data to meet the needs of the research rather than meeting the preferences of the

researcher. As an alternative, most versions of mixed methods researchers prefer to concentrate on matching the research questions to a set of methods that can address that question in a meaningful way.

According to National Institutes of Health, mixed methods strategically integrates quantitative and qualitative research methods to draw on the strength of each. This approach allow researchers to use a number of methods, combining inductive and deductive thinking and by providing a complimentary approach reduces the risks of exclusivity.

The author reviewed several approaches to the study design, including:

Case studies

Denscombe (2010) state that “case studies focus on one (or just a few) instances of a particular phenomenon with a view to providing an in-depth account of events, relationships, experiences or processes occurring in that particular instance” (p.52).

Case studies tend to collect data and information from a smaller range of people and/or organisations but do so by exploring more themes and subjects than other methods such as surveys. Using a case study method is ideal when a ‘how’ or ‘why’ question is being asked about a contemporary set of events over which the researcher has no control (Gray 2009).

An example of this could be between ambulance service mergers where complexities such as different organisational cultures, clinical leadership, staff development, strategic vision, political support where the aim is to highlight general findings that would not immediately come to light through other methods such as surveys or experiments.

Critics of the case study methodology point out that the study of a small number of cases can offer no grounds for establishing reliability or general findings. Others feel that the intense exposure to study of the case can lead to biases the findings. Case studies have much potential in research areas, but it is somewhat problematic in principle and practice, especially from the point of view of the single case and wider use of such a study (McDonough and McDonough, 1997, p.203) for these reasons it was decided by the author that using case studies would not enable them to answer the research question.

Experiment

Denscombe (2009) defines an experiment as an “empirical investigation under controlled conditions designed to examine the properties of, and relationship between, specific factors” (p.65). Experiments are usually concerned with identifying the cause and effect of what is being studied by differentiating between independent and dependant variables, they usually include a large sample size.

An example is the study by Perkins et al (2018) who undertook a study into the use of a medical drug (epinephrine) as a treatment for out of hospital cardiac arrest. The trial took place across a number of ambulance services and recruited 8014 patients into a randomised, double-blind trial. Blinding is a control to ensure research participants and researchers are not aware of which group the participants have been assigned to in order to prevent any bias. Randomised control trials are regarded as the optimal research design for clinical trials involving medical drugs. Advantages of experiments are that they can be repeatable and inferences can be drawn about a population. Costley et al (2011) suggest that a disadvantage is that they are relatively inflexible and do not lend themselves to exploring depth of information. The research aim was to understand confidence in a population group, deep understanding of some of the reasoning and individual beliefs and values would be required to answer the research question which is largely based (not entirely) on a qualitative approach so this approach was not deemed to be consistent with the study design.

Action research

Gray (2009) state that “action research methodology symbolises much of what modern research is about, analysing the world but also trying to change it” (p.312). As well as improving knowledge and/or proving or disproving a hypothesis, action research also adds the element of ‘what can be done about it’. Action research is concerned with the aims and design of research without specifying any particular methods for collecting data and that change is an integral part of action research.

Action research has become used as a methodology for practitioner and collaborative research which mostly, follow a cycle of four changes (planning, acting, observing (or studying) and data gathering; reflection and decision making (Denscombe 2011).

In WAST quality improvement utilises plan-do-study-act cycle is seen and organised as a distinct quality improvement method as opposed to research. There are separate

teams leading research to those concerned with quality improvement and innovation, the lines between what is quality improvement and what is research are often blurred. Most of the practical, tangible changes that can be seen across professional practice are implemented through quality improvement. Research studies often tend to take a much longer time to affect any change in practice and in my experience of large research studies lead to recommendations for further research to take place before any noticeable change. However, when research findings do lead to a change in practice then those studies are (in the most part) generalisable and lead to change in practice across all ambulance services as opposed to local changes in practice.

Hirschhorn et al (2011) highlight the that implementers within organisations focus on quality improvements that address local problems and driving change for improvement and recommend a number of steps to bridge the gap between quality improvement and research. These include alignment between quality improvements and research to agree goals and objectives, beyond local improvements.

Participation is a distinct element of action research as opposed to conventional research where research design methodology, methods, data collection and analysis are usually segregated from the implementation of any change in practice. Denscombe (2011) address some of the advantages and disadvantages in undertaking action research which are shown in the table below:

Table 1.

Advantages	Disadvantages
Participation-can democratise the research process, greater appreciation of, and respect for practitioner knowledge	Scope and scale-within the workplace may affect the representativeness of the finding, participation may limit the scope
Professional development-personal benefits for the practitioner	Control-integration of research and limits the feasibility of exercising controls over factors of relevance.
Practical-addresses practical problems in a positive way	Ownership-may become contestable within the framework of partnership relationship.
Continuous-continuous cycle of development and change, on-site research in the workplace	Work load- extra burden of work for the practitioners
	Impartiality-the action researcher is unlikely to be detached and impartial on approach to the research

Methods

Two types of methods were used in the research:

Interview

Costley, Elliott and Gibbs (2011) describe interviews as being a widely used research technique that can be adapted to gain information about people's perceptions, experiences or preferences (p.93). Interviews can be flexible and tailored to what is being studied, they can be structured, semi-structured, open discussions and can be undertaken either face to face or remotely. Beck and Manuel (2008, p82) suggest that if you want to understand or explore shaded human issues, if your question seems best answered in prose rather than with numbers, and if you want to explore a trend or an experience looking for themes, then the interview is a good choice.

Once it has been decided that the best way forward is to undertake interviews, the next step is to decide what kind of structure will frame the interview. Structured interviews used the same set of pre-prepared questions and response descriptors for all interviewee's which lends itself to quantitative analysis. Semi-structured interviews allow the interviewer to ask further questions of the views and opinions interviewee. Gray (2009) suggest that this is semi-structured approach is vital when using a phenomenological approach to explore subjective meanings.

Denscombe (2011) identifies an important caution called the interviewer effect which can affect the way an interviewee responds. For example, when using interviews as a method the author would have to consider the effect their position as a senior clinician in the organisation may have on the interviewee such as influencing the amount and content of information or willingness to engage in the process. Other vital components that need careful planning before the interview such as the venue, interview technique and personal attributes like the ability to listen and to use prompts. To address these risks the author opted to undertake the interviews on Microsoft teams. The reason for this was it was felt that communicating through a teams meeting would make the interviewee feel more comfortable rather than it being undertaken in a trust meeting room or even face to face. All staff have direct access via their trust ipad devices so could choose a time and location that was suitable for them.

The population selected for interview was from a paramedic group who were in a new role in trust who provide mentorship, clinical supervision and leadership. This is

a smaller group of 38 staff who are responsible for the day-to-day clinical supervision of paramedics as well as delivering education preceptorship to newly qualified paramedics. The 38 staff (senior paramedics) are included in the population being surveyed as described below. This technique is described by Krombie and Davies (1996) as stratified sampling where methods of sampling are particularly suited to populations which fall naturally into a number of groups (p.96).

This smaller group of senior paramedics have a closed Microsoft teams channel. The author drafted an open invite to undertake an interview about the research question. Within the invite, which was uploaded by the team administrator, was the study introduction that was included on the survey. The invite was to all members of the group and participants could indicate if they consented by returning a confirmation response to the team administrator who would then arrange a mutual time for the interview. The participants were informed that they could withdraw their consent at any time up to the date of submission.

Consideration was also given to the impact an interview may have, especially with the author who has a senior position in the organisation. The author decided to wear civilian clothing for all the interviews in an effort to make people more relaxed as well as planning the first few minutes of the interview to 'meet and greet' and to inform the person on the authors role in the research and to explain to aims and objectives of the research. There were three, open ended questions in the semi-structured interviews so that the author could inject other questions and probe answers to better understand the situational reality experiences of the interviewee.

The author followed Davies (2007) "ten rules for running your interview" (p.158):

Q1. Tell me about experiences in the education and training for intubation

Q2. How can we improve the skill acquisition of intubation amongst our paramedic profession?

Q3. Do you think we need to continue with hospital placements and intubation on human subjects?

The author decided not to have the interview recorded to further put the person at ease, the author took written notes of the interview and referred to interviewee's as SP A-G. The handwritten notes were reviewed at a later date and colour coded to responses, this was collated and reported as main themes and less prominent findings in each of the three questions.

Questionnaires

Questionnaires are a widely used, important data gathering tools usually used to gather data from a large number of participants. Carefully developed questionnaires can also form part of surveys and case studies. They are a set of pre-determined questions asked in a particular order, importantly they remain the same questions, in the same order for all the participants. Costley, Elliott and Gibbs (2011) discuss the benefits of open and closed questions and suggest that closed questions limit the responses but are more straight forward to statistically analyse. Open questions (opinions, preferences, attitudes) require some qualitative analysis, a common way of planning questionnaires is to include mainly closed questions (factual information) but to include some open questions that probe experiences and opinions in more depth.

From the authors own experience, completing questionnaires for social research are too long and a personal lack of motivation in the subjects has led to some flippant, speedy responses. This has not been true for all, the NHS Wales staff survey has included a lengthy questionnaire covering a wide range of topics such as personal well-being, organisational culture, team working and learning and development which are all topics that are of interest to the author. There are mainly closed questions with some open that allow to expand on you experiences and opinions. The author was invested in the results cascading through the organisation to lead improvements and to better understand some of the experiences and feelings of colleagues so there is a motivating factor in completing the survey which historically has had a low response rate.

This may also be true for the paramedics completing the survey who want intubation and the current position to remain in WAST. This was taken into consideration when developing the questions for the survey as Gray (2009) suggests that the overall content, style and structure of the questionnaire must satisfy the respondent, each individual question must stand on its own merit. Careful explanation of the background information including, its purpose, privacy, confidentiality, expected impact on the participant to give any participant an understanding about the research, how their participation may support what is being researched (p.340).

The initial intent was to approach was to develop the questionnaire and issue the survey then analyse the responses before undertaking semi-structured interview, a

sequential approach so the semi-structured interview question could delve into the survey response in an effort to better understand some of the responses. As the population group was different to the survey group the approach was to undertake the research at the same time to merge concurrent quantitative and qualitative data to address study aims, this is known as a convergent approach (Cohen 2018).

Microsoft forms was used to reach the participants of the survey, this was chosen to get information at one point in time rather than a longitudinal approach. WAST has invested heavily in communications across a mobile workforce, working 24/7 365 days a year across urban and rural communities across Wales. Each member of operational staff use an individual issued iPad to access trust communications, emails, electronic patient clinical records as well as Microsoft teams so the researcher would be able to reach participants across Wales and they could complete the survey whilst in work.

The population selected to receive the survey were staff who were in frontline paramedic roles. As previously stated, there are 248 paramedics who have entered the trust via higher education or through external recruitment who are currently not utilising the skill of intubation. It was not possible to separate the two groups (248 non intubating paramedics and 701 paramedics who are intubating). By randomly emailing a sample of the total number the author believed that the findings could be reproduced across both groups.

Sample size was determined using the identified population (total number of frontline paramedics in WAST, $n=948$) and having a confidence level of 95% with a confidence interval of plus or minus 3%. The author utilised a table on sample size from Cohen (2018 p.206) to arrive at this calculation. This resulted in the requirement for a sample size of 516 which was deemed by the author to be unrealistic. Cohen (2018) provides further examples of sampling and explains that purposive sampling has four main types. The revelatory case sampling fits with the authors requirement to identify individuals within a particular group (frontline paramedics) which is known to be used in mixed methods research of a particular group. The author still required to provide a sample size which accurately samples the population of paramedics. The author used the formulae in found in the Survey Monkey (2023) website to correlate that a population of nearly 1000 paramedics

would require. A sample size of 88 paramedics was required to provide a 90% confidence level with a margin of error of 10%.

Constructing the questions was guided by Davies (2007) who identified twenty quality points to undertaking a successful survey. The first four questions were used to identify the route into the profession and confirm (or not) if they had any experience in hospital theatres.

The survey questions were decided as:

1. Please indicate your entry level of Paramedic education
2. Did you undertake supervised endotracheal intubation (ETI) practice within a hospital placement setting during your education?
3. If you were required to complete a hospital placement was there a minimum number of supervised intubations you had to complete
4. Did your training and education on endotracheal intubation include supervised simulated practice
5. Simulation scenarios were appropriate for the likely pre-hospital case mix you would encounter
6. The realism of the simulation was excellent
7. Intubating human subjects in hospital placements under clinical supervision is essential part of education
8. Interdisciplinary involvement in the simulation event had a positive impact
9. Using high fidelity manikins in multiple scenarios in intubation training is sufficient to transfer the skill of intubation into clinical practice (no human subjects or hospital placements)
10. A blended approach of multiple scenario simulation training with hospital placement is the best way of delivering training for intubation
11. The type of manikin used by the Welsh ambulance services is of sufficiently high quality
12. I would be confident to apply the skill of intubation without attending hospital placements to intubate human subjects
13. Please add any additional comments below

Ethics

Ethical considerations in research cover many areas and consist of important considerations that must be included during study design, they include informed consent, confidentiality, avoidance of selective, partisan and skewed data analysis plus a multitude of other areas.

Collins (2002) define ethics as “a moral principle or a set of moral values held by an individual or group” (p.315). The ethics of research concern the appropriateness of the researchers’ behaviour in relation to the study subjects or those affected by the study (Gray 2009). Most large organisations/institutes and professional bodies have developed ethical codes supported by policies and procedures to ensure as far as they can that any research undertaken includes responsibilities and ethical considerations to the subjects they are researching. Some of the considerations should include privacy, confidentiality, avoiding harm, informed consent and the avoidance of deception. Ethical considerations apply to any form of scientific research and Cohen (2018) describes a broader responsibility on researchers to take into account the effects of the research on participants and to act in a way that preserves their dignity as human beings.

The Welsh Ambulance Service NHS Trust has its own research and development department that supports the development of high quality research and ensure it is undertaken to a high scientific and ethical standard. Wales has a ‘route map’ for health and social research which includes guidance and resources provided by Health and Care Research Wales (2020). Ultimately, Welsh Government Research and Development division is responsible developing research ethics policies through the Governance Arrangements for Research Ethics Committee. Paramedic is a protected title and guided by the Health and Care Professions Councils (2020) Standards of conduct, performance and ethics.

Undertaking research within your own organisation can seem to be an attractive opportunity to undertake work-based research, the author has intimate knowledge of the organisation, understands the culture, the people and ‘how’ to break through some of the barriers that might affect an external researcher. It does however come with some cautions that need to be carefully planned for in the research design, there are also some key ethical issues that need consideration.

The author acknowledged their position in the organisation in relation to the research as it has important influences on how the research is constructed, designed and how the findings are interpreted. There are two important areas which need careful consideration before embarking on the research:

1. *The author has a senior position in WAST therefore a perceived authority figure which may influence the participants, either in a positive or negative way.*

One of the risks to insider research in my position are that it may introduce a risk due to my senior position in the organisation, other participants may see feel they are obliged to take part into any research. Fleming (2018) states “the perception of implicit coercion during recruitment must be addressed where any power relationship exists” (p.314). Informed consent, recruitment, following insider research protocols, avoidance of deception are all important aspects to be given careful consideration when undertaking insider research (Costley, Elliott and Gibbs 2011). To address this risk the author engaged with the communications team in WAST and asked them to randomly choose equal number of paramedics in each of the seven health board area in Wales to share the survey with, this was enabled via an email list of current paramedics in the trust. Greenfield (1996) suggest that using an existing list is adequate but maybe problematic with issues of coverage and selection probabilities, he goes further to say that some choices are imperfect. Cohen (2018) describes this as simple random sampling as the paramedic list would contain characteristics similar to the population. The survey was shared via a link on email to the paramedics in each area so there was no perceived pressure to undertake the survey due to the authors position in the organisation.

2. *Motivation for undertaking the research. The author is responsible for the clinical practice standards of clinicians in WAST and may influence the way the topic is designed.*

Careful consideration into how the research was designed as to not produce a bias towards the authors professional opinions on the subject and whether they thought the aim could be implemented in WAST. Additional points in the study design include:

- The research aims will be shared with participants and the researcher will inform everyone that the process is compliant with the trusts data protection policy as well as the Data Protection Act 2018. This will be written on the Microsoft forms with a consent box to be ticked prior to completion, the form will also inform participants that they can withdraw from the research.
- Verbal consent will be gained from participants in the interviews and they will be informed that their participation is voluntary and their details will be anonymised by using a code (Person A etc). They will also be informed that they can withdraw from the research at any stage of the study prior to submission.
- Participant details will be anonymised, responses to survey results will be anonymous, following the interview process responses will only be referred to by code (person A etc)
- The data will be stored on an Ambulance Trust provided laptop that is only accessible by the researcher, trust data protection procedures will be followed at all times.
- Transfer of data will be through the Microsoft platform provided by the Welsh Ambulance Service NHS Trust, all of which will comply with GDPR and Data Protection Act 2018 through the trusts DPIA principles.

Analysis of the data

The population for the study was 100 paramedics working in a frontline position in WAST. As previously stated, the WAST communication team randomly picked the email address of from an administration list which indicated paramedics working in each of the seven health board areas in Wales so the survey was as equally distributed across Wales (table 2).

The population was distributed to paramedics in:

Table 2.

Health Board	Number of paramedics
Aneurin Bevan University Health Board	15
Cardiff and Vale University Health Board	14
Cwm Taf Morgannwg University Health Board	14

Swansea Bay University Health Board	14
Hywel Dda University Health Board	14
Powys Teaching Health Board	14
Betsi Cadwaladr University Health Board	15

The two largest health boards had one more paramedic than the others for practical reasons.

The analysis determined measurements of central tendency (mean and median) as well as measures of dispersal (range and standard deviation).

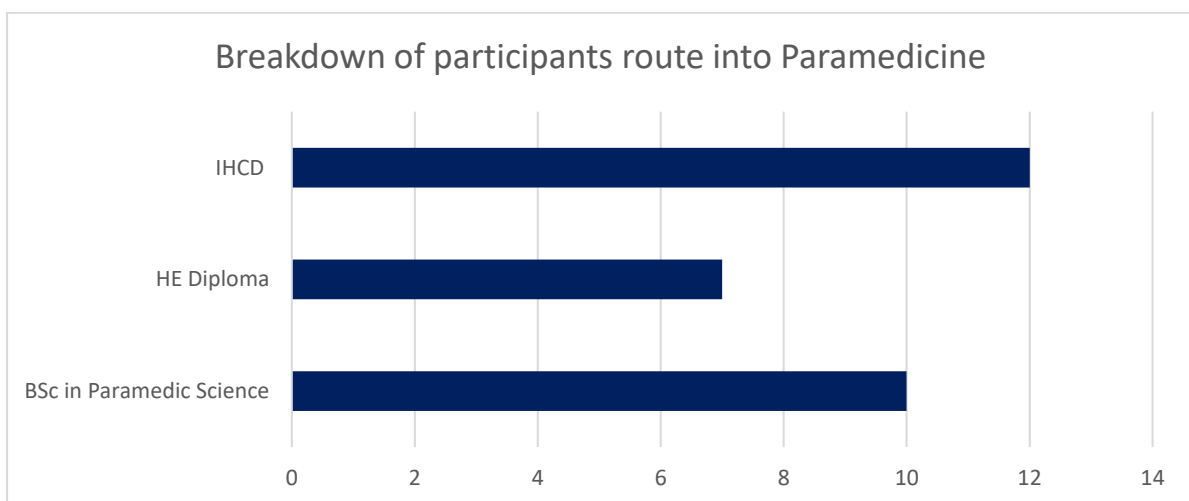
The response rate to the survey was 29% (n=29) when the survey was closed after being open for a two-month period.

The first four questions were analysed together using nominal data to provide an understanding of the participants route into paramedicine and whether their training had included hospital placements.

In question one, participants were able to indicate three levels of entry into the profession which would cover all the historical routes into the profession from the 1980's up until the current position.

The graph below (figure 1) indicates the response from the 29 participants. Institute of Health and Care Development (IHCD) paramedics accounted for 41.3% (n=12), BSc Paramedic Science accounted for 34.4% (n=10) and Higher Education Diploma participants accounted for 24.1% (n=7).

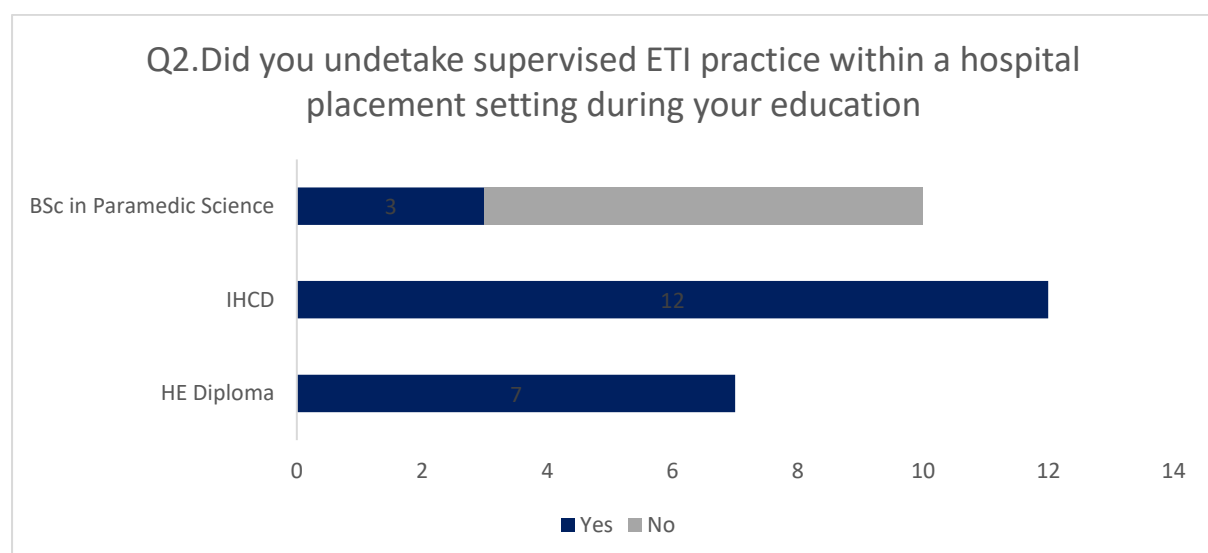
Figure 1.



Question 2. Did you undertake supervised endotracheal intubation (ETI) practice within a hospital placement setting during your education?

The second questions asked participants if they undertook supervised ETI in a hospital placement during their paramedic education. The number of participant responses that replied yes was 75.8% (n=22) and no was 24.1% (n=7). All of the participants who indicated an IHCD (12) or HE Diploma (n=7) route into practice answered yes. In the BSc group (n=10), the response was split with 70% (n=7) of the total BSc group indicated that they had not undertaken supervised ETI in a hospital placement and 30% (n=3) indicated they had.

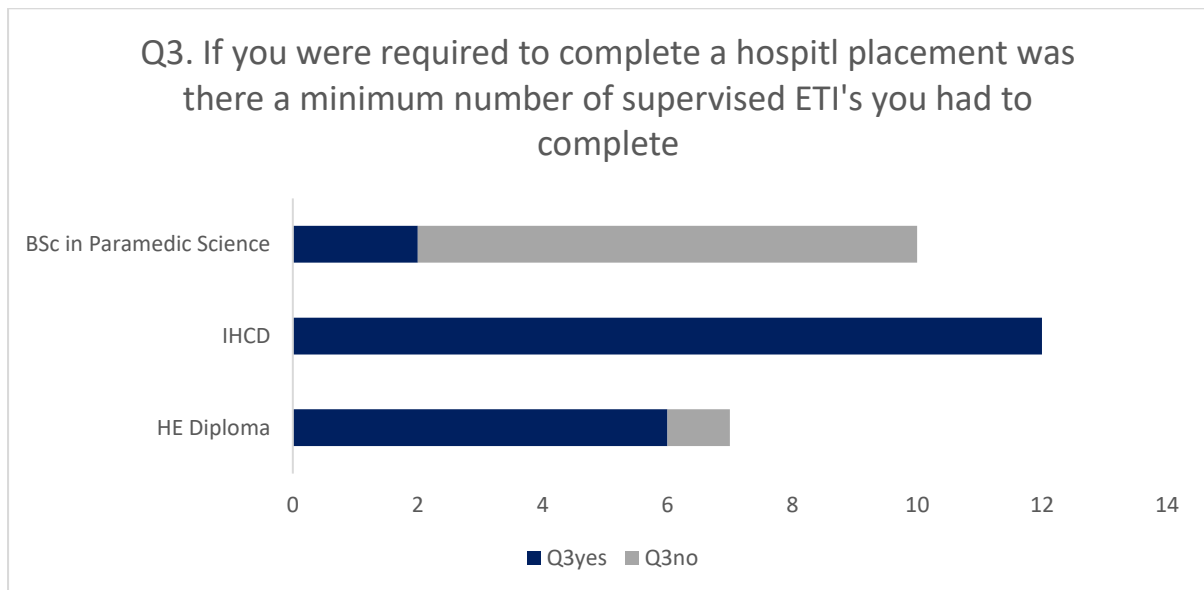
Figure 2.



Question 3. If you were required to complete a hospital placement was there a minimum number of supervised ETI's you had to complete

The percentage of participants who responded 'yes' was 68.9% (n=20) and 'no' was 31.1% (n=9). All of the IHCD participants responded yes (n=12). Six out of seven of the HE Diploma participants also responded yes. In the BSc group, two participants responded with yes and eight with no.

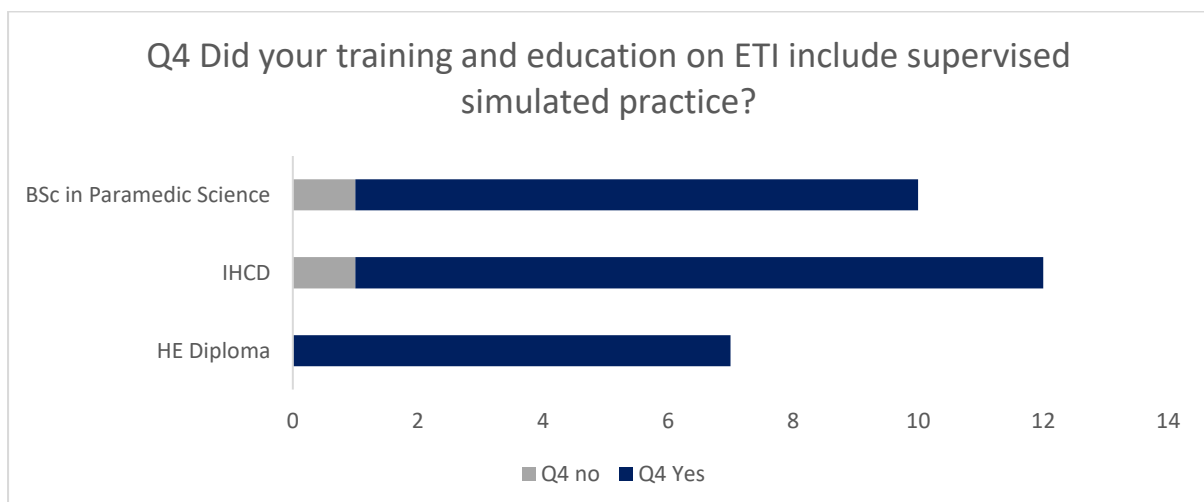
Figure 3.



Question 4. Did your training and education on endotracheal intubation include supervised simulated practice?

93.1% (n=27) of participants responded yes to this question and 6.9% (n=2) responded no. All of the HE Diploma participants responded yes (n=7). Nine out of ten of the BSc participants responded yes (n=9) and eleven out of twelve of the IHCD participants responded yes. The author was not expecting there to be any 'no' answers to this question as the undergraduate curriculum and the previous IHCD course contain vital elements of simulated practice for ETI. The author questioned if the inclusion of the word supervised may have been interpreted incorrectly as one of the reasons for answering this with a 'no'.

Figure 4.



Questions five through to twelve are the questions where a Likert scale were used. A Likert scale to indicate how much participants agree or disagree with the statement. Joshi et al (2015) states that a Likert scale “If the position of neutrality (neutral/don't know) lies exactly in between two extremes of strongly disagree to strongly agree, it provides independence to a participant to choose any response in a balanced and symmetric way in either direction. This construction is known as symmetric scale’ (p.397).

The range of answers provided ordinal data from five answers from strongly agree, agree, neither agree or disagree, disagree and strongly disagree. These responses were assigned a numerical value from one to five (appendix 1) to undertake further analysis. Microsoft excel was used to formulate tables, charts and descriptive statistics (table 3).

The total responses for these eight questions showed that 121 responses were either, strongly agree or agree. 44 responses indicated neither agree or disagree and 51 responses were disagree or strongly disagree.

The range can be seen across all questions as three or above, this was further checked using the formulae below (table 3) and a verbal interpretation assigned to each scale then checked against the mean in each question:

Table 3. Range and verbal interpretation

Scale	Range	Response	Verbal interpretation
1	1.00-1.80	Strongly disagree	very low
2	1.90-2.60	disagree	low
3	2.70-3.40	Neither	Neutral
4	3.50-4.20	Agree	high
5	4.30-5.00	Strongly agree	Very high
	5-1=4/5=0.8		

The range shows that all but two questions agreed with the questions at the scale of 4 which is interpreted as high, question eight and ten were neutral responses (both have a range of 3).

Question five and six asked about the case mix and realism that was used during simulation. The mean as described by Fisher (2004) is as a measure of central tendency that is usually advantageous unless there are extreme outliers which can distort the mean (p.181). The total mean reported in table 4 is 3.34 for question 5,

broken down into responses from IHCD/HE Diploma and BSc entry paramedics the mean and range are:

Table 4- Question5

Question 5	Mean	Range	Verbal interpretation	Total responses
IHCD	3.166	2.70-3.40	Neutral	12
HE Diploma	3.142	2.70-3.40	Neutral	7
BSc Paramedic Science	3.8	3.50-4.20	High	10

Standard deviation, a measure of normal distribution for question 5 is 1.142.

There were 16 responses (agree or strongly agree) and nine responses (disagree or strongly disagree) with four responses recording neither agree or disagree. Broken down to the three groups IHCD and HE Diploma entry paramedics responded with neutral responses and the BSc Paramedic Science group responded with 'high' as detailed in table 3.

Table 5- Question 6

Question 6	Mean	Range	Verbal interpretation	Total responses
IHCD	3	2.70-3.40	Neutral	12
HE Diploma	2.57	2.70-3.40	Low	7
BSc Paramedic Science	3.8	3.50-4.20	High	10

There were 16 responses (either agree or strongly agree), six neutral responses and 10 responses (either disagree or strongly disagree). The standard deviation reported in table 6 is 1.23. Fisher(2004) suggests standard deviation is a comprehensive measure of dispersion which identifies the average amount which values deviate from the mean. Interestingly the HE Diploma group had a mean of 2.57 which is interpreted as a low level of confidence that there was sufficient 'realism' in the simulation scenarios as opposed to the BSc Paramedic Science

paramedics who reported a mean of 3.8 which translates to a high level of confidence in the research question.

Questions seven and eight are being taken together as they both have similar themes about interdisciplinary teams working in hospital environments. Both IHCD and HE Diploma entry paramedics reported high confidence in the research question and the BSC group reported a neutral position. For both questions, participants responded on 35 occasions with a strongly agree or agree, 17 neutral responses and only six disagreed or strongly disagreed.

Table 6- Question 7&8

Question 7 & 8	Mean	Range	Verbal interpretation	Total responses
IHCD	4.1	3.50-4.20	High	12 to each question
HE Diploma	3.91	3.50-4.20	High	7 to each question
BSc Paramedic Science	3.3	2.70-3.40	Neutral	10 to each question

Question nine was a pivotal question for the research aim. Asking confidence levels of participants to indicate if they agree with the question on only using high fidelity mannikins for intubation training is sufficient to transfer the skill not clinical practice. Participants responded with agree or strongly agree on 17 occasions, four participants responded with a neutral response and eight responded with disagree or strongly disagree.

Table 8 reports a median and mode of 4 for question nine, when the three different groups are reviewed the IHCD group have a mean of three (HE Diploma- 3.85/BSc-3.7) which equal to a neutral response as opposed to the other two groups who responded their confidence more positively.

In question ten, participants were asked a question based on the best approach to ETI training with a blended approach and hospital placements. 79.3% of participants (n=23) responded with agree or strongly agree, five (17.2%) with a neutral response

(neither agree or disagree) only one response (3.4%) with a disagree or strongly disagree response.

Question 11 asked specifically is WAST's training and education equipment of a sufficient high quality. 58.6% (n=17) responded with agree or disagree, 27.5% (8) with disagree or strongly disagree and 13.7% (4) who neither agreed or disagreed. Question 12 asked if participants they would be confident to apply the skill of intubation without attending placements to intubate human subjects. 18 (62%) responded with agree or strongly agree, five (17.2%) with neither agree or disagree and 6 (20.6%) who disagreed or strongly disagreed.

Within this group the mean score response from the HE Diploma group was 3.8, the IHCD group 3.08 and the BSc group 4.3. The standard deviation is 1.22.

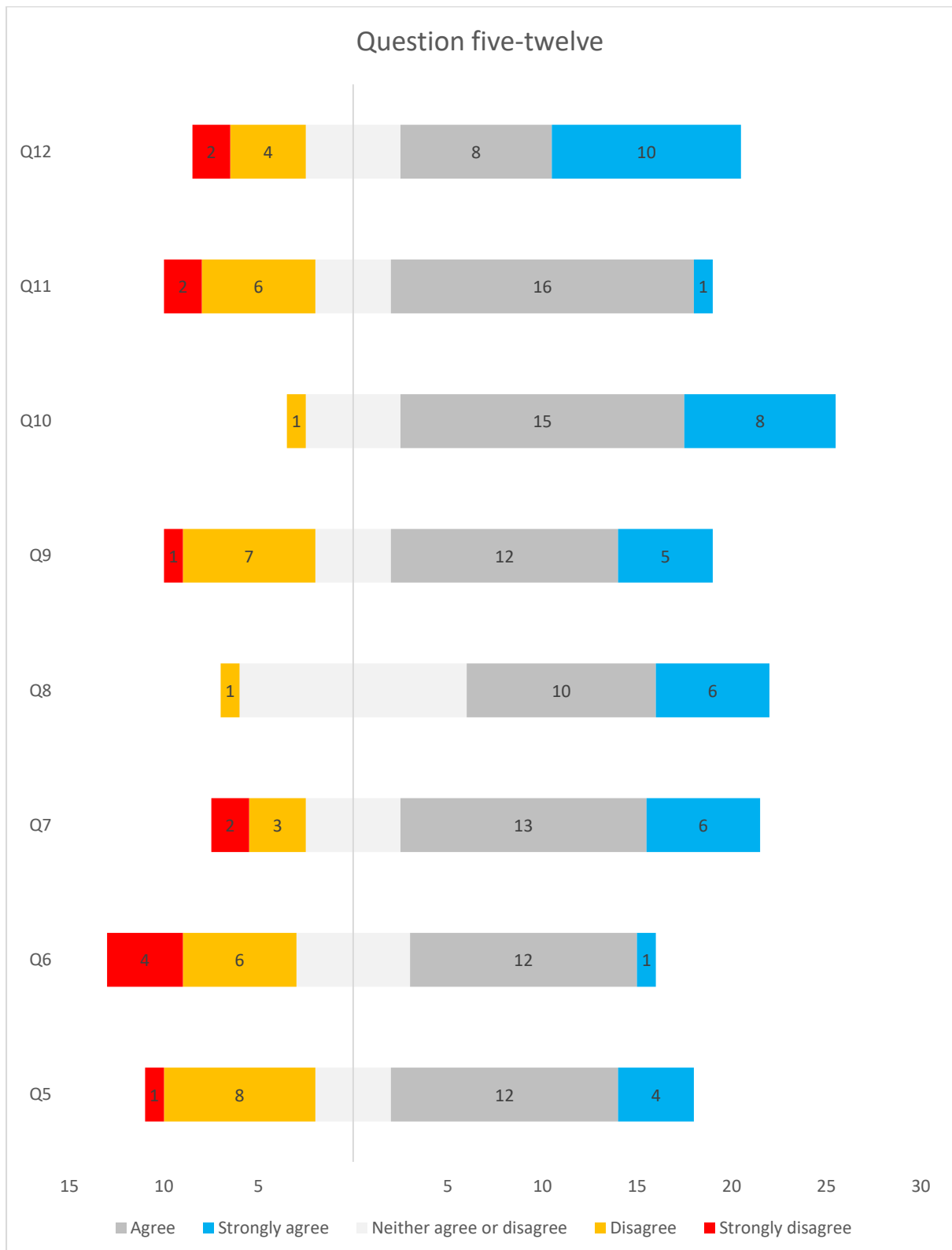
Table 7. Cumulative descriptive statistics for question 5-12

Cumulative descriptive data for questions 5-12	
Mean	3.689655
Standard Error	0.238548
Median	4
Mode	5
Standard Deviation	1.284619
Sample Variance	1.650246
Kurtosis	-0.62066
Skewness	-0.67155
Range	4
Minimum	1
Maximum	5
Sum	107
Count	29

Table 8-Descriptive statistics for individual questions

Descriptive statistic	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12
Mean	3.344	3	3.620	3.724	3.448	4.034	3.275	3.689
Standard Error	0.212	0.216	0.212	0.156	0.213	0.144	0.197	0.238
Median	4	3	4	4	4	4	4	4
Mode	4	4	4	3	4	4	4	5
Standard Deviation	1.142	1.1649	1.146	0.840	1.152	0.778	1.065	1.284
Sample Variance	1.305	1.357	1.315	0.706	1.327	0.605	1.135	1.650
Kurtosis	-1.046	-0.995	0.174	-0.862	0.914	0.243	0.507	0.620
Skewness	-0.282	-0.436	-0.852	0.192	0.391	0.549	0.790	0.671
Range	4	4	4	3	4	3	4	4
Minimum	1	1	1	2	1	2	1	1
Maximum	5	5	5	5	5	5	5	5
Sum	97	87	105	108	100	117	95	107
Count	29	29	29	29	29	29	29	29

Figure 6. Diverging stacked bar for question five to twelve



Five additional comments were returned as part of the survey:

Comment 1.

'There is merit in a 'blended' style of both hi fidelity sim alongside a short hospital placement. Hi Fidelity Sim can replicate a range of 'difficult' airways as encountered in practice, as my experience of hospital placement was that the Consultant would only allow Paramedic students to attempt ETTI on stable, uncomplicated patients with no anticipated challenges.'

Current WAST Airway Manikins not sufficient in replicating airway complications and the few we do have are not equally issued across Wales'.

Comment 2.

'Intubating human subjects who have suffered trauma or have an occluded airway due to vomitus or other requires a greater understanding of the anatomy of the human than a plastic doll can provide'.

Comment 3.

'simulation would allow a variety of scenario's to be undertaken alongside human subject intubation this would give a more rounded learning experience'.

Comment 4.

'This survey is based on previous experience, with appropriate senior clinical supervision (anaesthetics) and high fidelity manikins simulated practice could be more beneficial than placement in theatres where exposure is limited to straight forward intubations'.

Comment 5.

'The use of ETT has reduced in my practice since the introduction of the iGel. The supraglottic devices are excellent but not a complete replacement for intubation. I do feel confident with intubating a patient but have recognised that the number of times I use this is now far less. The manikins on station, for airway management scenario skills, are very beneficial but difficult to say with confidence that they should replace the theatre placements for our new staff. The placement taught me a lot from a team that use this skill frequently, but am aware supraglottic airway devices are replacing ETT in theatre also'.

Interview analysis

The response rate to the request amongst 38 senior paramedics was 7 (18.4%).

Q1. Tell me about your experiences in the education and training for endotracheal intubation:

The author noted three main themes that were raised in almost every interview in response to question one.

- An awareness of having what was described as a subject matter expert included in the training, this was in reference to hospital staff such as consultant anaesthetists and Operating Department Practitioners in a hospital environment with human subjects.
- The quality of education and equipment in Higher Education and Ambulance Trusts varied significantly, most simulation training took place with non interactive mannikins which only helped with the acquisition of psychomotor skills
- Participants felt prepared for routine ETI but not for complicated cases when they may encounter a difficult airway to manage (such as burns or major trauma) which were not encountered in the hospital setting as only stable patients who had undergone pre-op assessments were part of the learning experience across all groups. It was deemed to be to time critical for anyone other than experienced anaesthetists to manage peoples airways in the emergency department.

One less prominent theme also emerged:

- Some participants felt they were placed under too much pressure in the hospital environment and did not feel the experience was beneficial to their learning style.

Q2. How can we improve the skill acquisition of intubation amongst our paramedic profession.

The author noted two main themes that were raised in most of the interviews in response to question two:

- More time to develop the skill in training, both classroom and hospital placements. This would need to include high fidelity mannikins which could replicate the full case mix that would be encountered as well as simulating procedural failures such as blocked airways. Responses included the importance of being able to pause simulations at various points and discuss with subject matter experts as well being able to fully debrief the simulation.
- More clinical supervision post-graduation, especially until a certain number of intubations had been achieved. There wasn't a number given but respondents accepted that it might be different for each individual, they also

commented that as soon as they were qualified, they had minimal clinical supervision and often, their first intubation was a complex case where they were the senior clinician.

One less prominent theme was identified as:

- Hospital placements were largely seen as beneficial but placing a fixed number per student was not seen as being individual to each learner, some said they would have more opportunities whilst others said they could have spent less time in hospital placement.

Q3. Do you think we need to continue with hospital placements and intubation on human subjects:

The author noted two main themes that were raised in most of the interviews in response to question three:

- It was felt that having a blended approach which could include less time in a hospital placement would be of benefit with more advanced mannikins that are able to be used interactively and generate a more realistic scenario that paramedics are likely to face. Using simple technology may be used for gaining psychomotor skills for 'passing' a tube into the trachea but not for more complex cases (such as burns and major trauma).
- No one believed that removing the hospital placement element of the training would be a benefit, in fact, all said during the interviews that it was an essential component. It was also noted that the structure and support whilst on placement was different for everyone across multiple sites. Some paramedics who had experience of day surgery theatres were able to undertake multiple intubations in a day under the clinical supervision of one team, whilst others struggled to get the required number of ETI's,

Conclusion

It has been identified in this paper that the management of a patient's airway is a fundamental and primary consideration of every patient with emergency care needs and failure to manage airway conditions is a significant source of morbidity and mortality. To avoid or reduce errors and improve patients outcomes and safety, training airway management for ambulance clinicians is essential.

Several examples of patient harm and indeed death were given as a justification for the research study. Endotracheal intubation, as it currently stands is no longer a core skill for paramedics in many of the UK's ambulance services. Several factors have influenced these decisions: reducing frequency where it is required due to advancements in clinical equipment and the effect of the pandemic and reduced exposure to hospital placements (where students were signed off as competent). WAST are at the point where new paramedics entering the workforce no longer have ETI as a core skill. The aim of the study was to identify if simulation alone would provide paramedics with the confidence to apply core airway management skills.

A constructivist paradigm was initially decided upon which aligned to the authors values and beliefs but after moving to the method design it was felt a mixed method approach would be suited to answering the research question. After excluding other methods, a survey and questionnaire were decided upon.

One of main ethical considerations was insider research, the author has a senior position in WAST so the design of the study was carefully constructed in order to not influence the respondents in either taking part in the research or influencing how they answered the interview questions.

The effectiveness of simulation in paramedic training for learning the skill of endotracheal intubation, which is described as the standard of airway management has been discussed in the present study. Given the advantages of simulation such as rapid feedback and a conducive working environment, among others highlighted in the literature review.

When estimating the effectiveness of simulation in learning procedural skills such as that of intubation, the effectiveness and confidence of using simulation are reflected in the competence, satisfaction, skill retention and self-efficacy outcomes of the process which impact the quality-of-care provision in emergency situations.

The literature review established the nexus between self-confidence, competence, learner satisfaction and simulation-based learning. The review highlights some of the challenges that have hindered the effectiveness of simulation in paramedics training which include technological constraints and high costs. While the review provides resourceful insights regarding the effectiveness of simulation in paramedics training, literature gaps are also present in research concerning this field. Future research is recommended to explore the transfer of competence in simulation training into actual field activities. Furthermore, future research should investigate the success of simulation training on patient outcomes, including mortality and morbidity.

The response rate to the survey was low at 29% which means a nonresponse bias of 71% which affects the validity and reliability of the survey findings and that the findings could not be judged to be representative of the population. Survey data was analysed for measurements of central tendency (mean and median) as well as measures of dispersal (range and standard deviation). Question indicated that some participants did not have any experience of undertaking supervised practice which the author was not expecting, this was deemed to be a flaw in the question design. Question nine was a pivotal question for the research aim. Asking confidence levels of participants to indicate if they agree with the question on only using high fidelity mannikins for intubation training is sufficient to transfer the skill not clinical practice. Participants responded with agree or strongly agree on 17 occasions, four participants responded with a neutral response and eight responded with disagree or strongly disagree.

In question ten, participants were asked a question based on the best approach to ETI training with a blended approach and hospital placements. 79.3% of participants (n=23) responded with agree or strongly agree suggesting the participants agreed with this approach.

The comments entered into the section at the end of the Microsoft forms included helpful text on how WAST might approach further developments, acquisition of high fidelity mannikins to provide a range of complex scenarios where ETI which supported the responses to question nine.

The interviews revealed several themes across three questions, however the response rate was disappointing at 18.4% (n=7).

Hospital placements and training with subject matter experts were key across nearly all responses and no one wanted to not have placements included in the curriculums.

Participants also informed the author that training across a greater variety of pre-hospital case mixes with high fidelity mannikins would be beneficial to paramedics especially if there was improved clinical supervision during the first years of graduation.

This research has been extremely helpful for informing the next steps in WAST. The findings, experiences and participant responses will assist the author in proposing a direction for the future of ETI. The findings suggest that further research is required that account for simulated practice to translate into clinical practice and patient outcomes. The proposal would build on the findings to pilot a blended approach using simulated practice on high fidelity mannikins that incorporate complex cases delivered by subject matter experts. Hospital placements have been identified as an essential component but perhaps not to the extent they are now, with an individualised tailored to students leaning style and experience. An important element the author had not identified previously was the clinical supervision provided for new paramedics and for this to be customised to different areas of clinical practice.

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Appendices

Appendix 1- ETI data excel format



ETI Data ready for
analysis.xlsx

Appendix 2-Microsoft survey



Microsoft survey
form.pdf