NAMIBIA UNIVERSITY
OF SCIENCE AND TECHNOLOGY

DEVELOPING A QUALITY ASSURANCE SYSTEM FOR EMERGENCY MEDICAL CARE SERVICE DELIVERY IN NAMIBIA

By

Mr Brandon Diergaardt

217126650

"Thesis presented in fulfilment of the requirements for the degree of Master of Health Sciences"

in the Faculty of Health and Applied Sciences

Supervisor: Ms Nadine Seymour

Co-supervisor(s): Prof. Omotayo Awofolu; Ms Himeesora Kaimu

July 2020

Declaration

I, Brandon Adrian Diergaardt hereby declare that the work contained in the thesis entitled "**Developing a Quality Assurance System for Emergency Medical Care Service Delivery in Namibia**" is my own original work and that I have not previously in its entirety or in part submitted it at any university or other higher education institution for the award of a degree.

Signature: Date: 11/07/2020

Retention and Use of Thesis

I, Brandon Adrian Diergaardt being a candidate for the degree of Master of Health Sciences accept the requirements of the Namibia University of Science and Technology relating to the retention and use of theses deposited in the Library and Information Services.

In terms of these conditions, I agree that the original of my thesis deposited in the Library and Information Services will be accessible for purposes of study and research, in accordance with the normal conditions established by the Librarian for the care, loan or reproduction of theses.

Signature: Date: 11/07/2020

Acknowledgements

I wish to thank:

- Ms Nadine Seymour for her continued support, guidance, patience and motivation, without whom I would not have been able to complete this research.
- Prof Omotayo Awofolu, whose oversight as always been invaluable to this research, and for his motivation throughout this thesis.
- Ms Himeesora Kaimu for her support and guidance from a quality assurance point of view.
- My wife, Azaria Diergaardt and family whom has always supported and motivated me when I felt like giving up. Your prayers and encouragement have kept me going.
- All individuals that participated in this study and provided their input and motivation. You are all appreciated.

The financial assistance of the Motor Vehicle Accident Fund towards this research is acknowledged. Opinions expressed in this thesis and the conclusions arrived at, are those of the author, and are not necessarily to be attributed to the funding organisation.

ABSTRACT

Prehospital emergency care is an ever-evolving profession that requires constant review and improvement of services delivered. The evaluation of quality service delivery in the Namibian EMS setting has never been studied before. With the current changes in the international medical sphere, the measurement of quality delivery has become ever more so pertinent in the prehospital field. The aim of the study was to develop a quality assurance system for Namibian EMS service delivery.

A comparative analysis was conducted on international quality assurance systems to identify quality indicators for the Namibian EMS industry. Furthermore, a three iteration Delphi study was conducted to get consensus from a group of experts on the proposed quality indicators. Finally, the investigator conducted a pilot study, following a cross-sectional quantitative design to evaluate the quality indicators to the current emergency services operation at two emergency services within Windhoek.

The comparative analysis yielded *n*=67 quality indicators used by first world countries. The non-clinical domain (*n*=39) consisted of *n*=18 structure, *n*=18 process and *n*=0 outcome indicators; the clinical domain (*n*=28) consisted of *n*=0 structure, *n*=26 process, and *n*=2 outcome indicators. Experts reached consensus on *n*=42 quality indicators following the three iteration Delphi study (iteration 1: *n*=13, iteration 2: *n*=12, iteration 3: *n*=17). In the pilot study, company X had 50% (*n*=21) compliance on indicators, *n*=8 non-clinical, and *n*=13 clinical indicators. Variation was 50% (*n*=21), *n*=12 non-clinical, *n*=9 clinical indicators. Company Y had 36% (*n*=15) compliance on indicators, *n*=5 non-clinical, *n*=10 clinical. Variation was 64% (*n*=27), *n*=15 non-clinical, and *n*=12 clinical respectively.

The study assisted in the extrapolation of quality indicators for the Namibian EMS service delivery quality assurance system. The pilot study has shown some compliance with the proposed quality indicators however, requires further evidence-based investigation to improve patient outcomes.

Table of Contents

List of Tables

List of Figures

Definition of Abbreviations

ALS:	Advanced Life Support
ATLS:	Advanced Trauma Life Support
AHPCNA:	Allied Health Professions Council of Namibia
BLS:	Basic Life Support
CQI:	Continuous Quality Improvement
EMC:	Emergency Medical Care
ECP:	Emergency Care Practitioner
EMS:	Emergency Medical Services
EM:	Emergency Medicine
ILS:	Intermediate Life Support
IOM:	Institute of Medicine
MoHSS:	Ministry of Health and Social Services
QA:	Quality Assurance
QI:	Quality Indicator
SA:	South Africa

CHAPTER 1: INTRODUCTION

1.1 Background Information

Prehospital emergency care is considered a fast-growing sector in the healthcare industry. It has been evolving since the beginning of the Second World War and is considered an honourable profession today (Howel, 2007). However, Emergency Medical Services (EMS) has been under scrutiny for the care delivered in the prehospital field. The "Golden Hour" has been initiated after it was found that patients suffer increased risk of dying when the prehospital time exceeds one (1) hour. These results forced governing bodies to assess the response times and on-scene times of ambulance crews. In the present day, the assessment of EMS is part of the day-to-day operation and focuses to improve overall performance of services delivered (Macfarlane and Benn, 2003).

Emergency Medical Services is defined by Al-Shaqsi (2010) as a *"comprehensive system which provides the arrangements of personnel, facilities and equipment for the effective, coordinated and timely delivery of health and safety services to victims of sudden illness or injury"* (p.320). Globally, EMS focuses on the components of accessing emergency care, providing care in the community, providing care during transportation and continuation of care at a definitive facility. This cycle of care is delivered by Emergency Care Practitioners (ECPs) on different tiers of qualifications depending on the seriousness of the patient's condition. Nowadays, the care provided to any patient by Emergency Care Practitioners (ECPs) is reliant on either good Basic Life Support (BLS); Intermediate Life Support (ILS) and or Advanced Life Support (ALS) practitioners to intervene when the patient requires more advanced levels of treatment.

EMS and Emergency Medicine (EM) is an ever-evolving profession. The continuous evolution of technology and modern-day medicine guides patient management and treatment in the direction of evidence-based practice for better patient outcomes. EMS plays a fundamental role in the chain of survival of the critically ill and injured and therefore, needs constant review and evaluation to stay abreast with current changes. Each component of the EMS system requires Quality Assurance (QA) in order for it to be effective, co-ordinated and to ensure that timely and proper health care is being delivered to the sick and injured. The modern-day healthcare system has been engulfed with a stigma of value-based care worldwide and to ensure that a system does not deteriorate in service delivery, constant review and measurements should be put in place. According to Lighter (2014) the statement: *"You can`t manage what you don`t measure"* (p.7) has become the main attribute to quality improvement. It is arguable that to adequately manage any healthcare delivery you need a robust system with easily measured variables. According to Aaronson, Marsh, Guha, Schuur & Rouhani (2015), high-income countries enjoy the benefit of well-developed QA systems that are complimented

by the development of quality indicators that uplift the standard of emergency care. Stelfox & Straus (2013), mentions that one cannot improve quality of care unless it is measured, and for it to be measured it requires well-defined and developed indicators. Contrary to first-world countries` well-developed quality assurance systems and quality improvement, third-world countries are therefore burdened with the problem that the EMS system does not improve and grow parallel to the advancement of research in the medical field. This also means treatment modalities does not expedite patient survival rates in correlation of continuing improving health research as a result of out-dated treatment regimens and systems. The results of such a system can be multifocal on the healthcare system.

1.2 Emergency Medical Services and Quality Assurance

The enhancement of modern-day healthcare allows practitioners to have the opportunity to become responsible for the care they provide to patients. Quality Assurance forms part of the modern-day EMS system and the development and implementation of it is seen as a necessity for any healthcare system (Maritz, Hodkinson & Wallis, 2010). In most parts of the world, EMS services have migrated the practice of paramedicine from standard protocols to Clinical Practice Guidelines (CPGs). This evidence-based approach to patient treatment requires a well-functioning system to be constantly up to date with the current evidence. El Sayed (2011) mentions that the constantly expanding scope of practice of EMS providers are scrutinized at the same time for the value that it has in the prehospital setting. This requires that EMS organisations implement quality assurance systems for better coordination of the interventions performed to reduce the cost and the possibility of litigation. Internationally, most EMS industries have reached consensus that QA should form part of EMS systems, even though it might not necessarily be identical (Moore, 1999)

There are a number of different definitions for the term quality assurance. Brown, Franco, Rafeh and Hatzell (2000) views quality assurance as *"that set of activities that are carried out to set standards and to monitor and improve performance so that the care provided is as effective and as safe as possible"* (p.12). Quality Assurance is aimed to warrant that the EMS system improves and achieves quality service delivery. It is arguable that QA therefore requires indicators that guide the process of improvement. Mains (2003) defines Quality Indicators (QI) as measurement tools that guide, monitor and evaluate quality of patient care, organizational function and clinical support services. The fundamental role of QA in EMS is to assess the true value of the functioning system (El Sayed, 2012).

According to Islam, Rahman, Halim, Eriksson, Rahman & Dalal (2015), the EMS of some African and developed countries suffer inadequacies in healthcare from a lack of QA due to poor system and staff

performance. Quality Assurance is therefore, a widely accepted norm within EMS systems in developed countries and its implementation is recognised as an important method to achieve quality improvement (Haughland, Rehn, Klepstad & Kruger, 2017). Ambulance services in most developed countries implemented QA systems to measure their performance. However, the enormous variation in prehospital emergency care between countries made it difficult to develop a standardized quality assurance system. These variations include the availability of resources, education of healthcare providers, planning, geographical location, population density and cultural diversity; all of which need to be considered when setting up a quality assurance system (Macfarlane and Benn, 2003). According to Rahman, Tanaka, Shin, Yih Ng, Piyasuwankul, Lin and Hock Ong (2015) different countries deliver EMS differently because each one is at a different developmental phase of maturity.

Howel (2007) affirms that the State of Ohio mandates that all EMS organisations should implement continuous peer review and QA programmes for the purpose of delivering quality care to the public. They identified poor performing indicators and implemented their QA systems on those indicators to improve the quality of service delivered. Islam et al. (2015) in their study revealed that there are several indicators that function as barriers to quality of care in the health facilities where they work. Quality improvement indicators should be measurable and specific tools must be created to measure the indicators that can be benchmarked with performance of national and international EMS systems and standards (Moore, 1999).

The absence of a quality assurance system can be compared to Reason`s Swiss Cheese Model where the defences (the quality indicators) against failures are stacked in front of each other like slices of Swiss cheese with holes that represent weaknesses in the system. In a perfect or flawless system, there would be impenetrable barriers. However, should these failures align, catastrophic events are possible (Kelly, Thallner, Broida, Cheung, Meisl, Hamedani, Klauer and Beach, 2010). One can say that catastrophic events can occur in an emergency medical service if the performance of the system and its professionals are not measured to ensure that good quality healthcare is provided and that there is continuous improvement. It appears that the lack of quality indicators can lead to potentially catastrophic events in any EMS structure.

The importance of having a QA system in place has been stressed extensively however, most systems are anecdotal and mostly based on emotional and surrogate quality indicators (Howard, Cameron, Wallis, Castren, Lindstrom, 2018). Therefore, current systems need more in-depth studies of quality indicators used to develop QA systems. According to Howel (2007), QA ensures that local protocols are adhered to. In the State of Ohio, a lack of poor service delivery has been identified as a result of ECPs not adhering to set protocols. It was recommended by the Regional Physicians Advisory Board

that the development and implementation of a QA system would ensure adherence to protocols and the continuous improvement of such a system. It is arguable that quality indicators therefore form the bases on which the performance of an EMS system is measured and should be carefully identified.

1.2 The Donabedian Framework

Quality improvement and measurement in healthcare was first published in 1980 by Avedis Donabedian, a Lebanese physician and researcher at the University of Michigan`s School of Public Health. Donabedian was credited with the initiation of the framework for measuring performance in healthcare, known as the Donabedian Framework Model. The Donabedian Framework segregates healthcare services into three main categories namely Structure, Process and Outcomes. This framework became the most used system as nearly every quality measure can be characterized into one of these classifications (Lighter, 2014). By using this framework, quality can easily be measured by examining the EMS structure, the process of delivering care to patients, and the outcomes that both structure and process has on quality (Kelly et al., 2010).

The structural dimension of the Donabedian model refers to the setting where the care is provided and includes the organisational structure, facilities, equipment, assets, knowledge base of the providers and the human resources. El Sayed (2012), sees it as the infrastructure of the healthcare system whereas process dimension refers to the encounter between the pre-hospital provider and the patient and gives a proper measurement of quality care delivered. Howard et al. (2018) identifies it as the different steps that form the health care process. The outcome dimension is the impact or result of a specific intervention performed and gives an indication of the overall delivery of care in an organisation. The overall perspective of the Donabedian model emanates that structures affect organisational processes and that it in turn affects the outcome. It is thought that the Donabedian Framework is an acceptable method to build a quality assurance system for any EMS system. The development of the quality assurance system for Namibian EMS will therefore be based on the Donabedian Framework.

1.4 Delphi Technique

The Delphi technique is a method used to reach consensus on a particular topic by using a panel of experts in a specific field of interest. In the last few decades, this method has become more prevalent in healthcare research especially where there is lack of evidence or anecdotal issues pertaining to development of quality indicators specifically where the available evidence is not sufficient or where controversy exists (Boulkedid, Abdoul, Loustau, Sibony, Alberti, 2011). The Delphi technique has been

used since the 1950`s by the RAND Corporation and has shown its worth in decision making, in policy development, direct healthcare practices, and gives a heuristic picture of individual expert judgement and collectively identifies a broader knowledge base in the subject matter researched (Brady, 2015; De Viliers and De Villiers, 2005).

This is however, not an isolated method of study. According to Tottossy (2005), there are a number of different Delphi studies, which are known by different names such as the “Modified Delphi”, “Policy Delphi”, “Real-time Delphi”. However, they all fall under the broad spectrum of a Classical Delphi characterised by five common features namely: anonymity, iterations, constructed for controlled feedback, statistical group replies and stability in responses from a panel with broad expertise in a specific field. The main objective of the Delphi is to obtain consensus through a process of iterations or rounds (Tottossy, 2005). According to De Villiers and De Villiers (2005), most researchers apply three rounds which has shown to be sufficient to gain consensus on a particular topic. Few adjustments are required between the first and second round, and an overall consensus as high as 97% have been recorded in the last round.

A group of experts are purposively chosen to be part of the research and then information is subjected to each expert in multiple rounds. Each expert then rates the questionnaires or statements based on their individual experiences and knowledge and provides feedback to the researcher. The researcher then reviews the feedback and identifies consensus on the information provided by the experts. Non-consensus information and newly suggested information is resubmitted to the experts in the subsequent rounds until consensus is reached (De Villiers and De Villiers, 2005; Boulkedid et al., 2011; Brady, 2015; Fattah, Johnsen, Sollid, Wisborg and Rehn, 2016).

The Delphi technique is beneficial in a number of ways. Firstly, it can be used as a mixed methods study with both qualitative and quantitative data sources. Secondly, the Delphi is an inexpensive method to obtain information from participants using open ended to structured questions easily disseminated via an electronic medium. Thirdly, it uses a purposive sample of individuals with experience in a particular field rather than a complex sample size. Fourthly, the anonymity allows each individual to express his/her true knowledge instead of being pressurized with opinions of individuals with a higher status in a particular group (Brady, 2015). The Delphi technique has been shown to be beneficial in array of different contexts, more so in the development and implementation of policy. Given the usual employment of the Delphi study in the healthcare setting, one can argue that utilizing the Delphi technique to obtain consensus on quality indicators to develop a Namibian quality assurance system is a feasible method.

1.5 Emergency Medical Services in Namibia

Namibia as seen in Fig 1 below, is a country situated in the South-western part of the African continent. It is deemed a third world developing country and has a population size of 2,324,388 according to the latest consensus conducted in 2016 (Namibia Statistics Agency, 2017). Namibia is well-known for its vast landscapes and distances between towns which is also one of its greatest challenges when it comes to providing emergency care and rescue services.

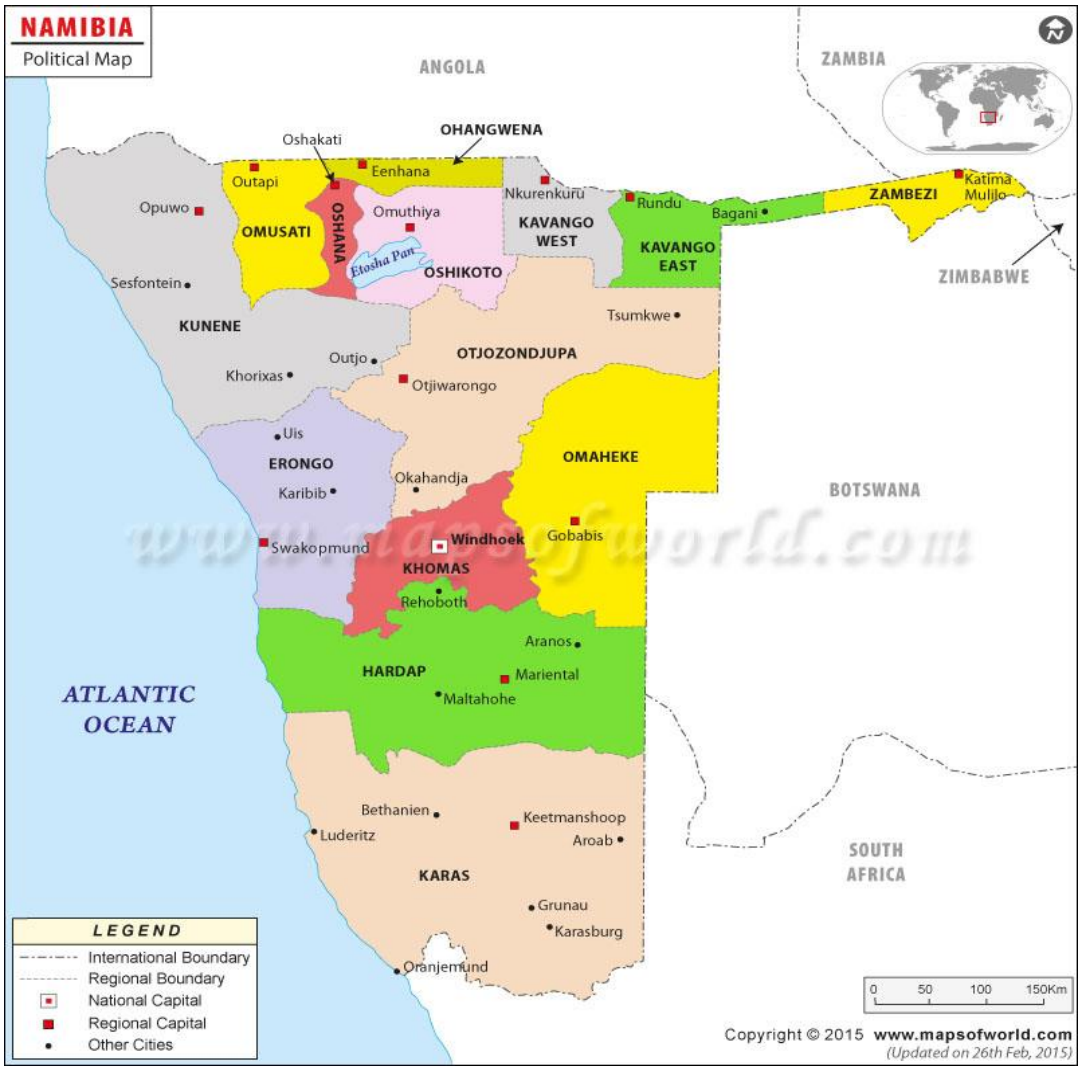


Figure 1: Map of Namibia (Source: https://www.mapsofworld.com/namibia/namibia-political-map.html)

The Emergency Medical Services (EMS) in Namibia is primarily run by three sectors: public, private and parastatal services. Each sector has its own communications centre, emergency crews and fleet. The private sector is mostly manned by the Basic Life Support (BLS), Intermediate Life Support (ILS), Emergency Care Technicians (ECT) and a few Advanced Life Support (ALS) practitioners. Some private entities also provide aeromedical evacuations with fixed wing aircrafts modified as air-ambulances.

Helicopter Emergency Medical Services (HEMS) is available for search and rescue missions by the Namibian Police Air Wing, however, this is subject to availability. The biggest sector of EMS in Namibia is run by the Ministry of Health and Social Services (MOHSS) which covers all the 14 regions of Namibia. They provide emergency response to motor vehicle accidents (MVAs), other trauma, medical cases and interfacility transfers from district to intermediate hospitals. The majority of the regions are provided with more than one ambulance, and manned by either BLS, ILS or ECT personnel. However, some district ambulances are only deployed with a driver and a nurse (Tesser, 2017).

In Namibia, all ambulance personnel must be registered with the Allied Health Professions Council of Namibia (AHPCNA). Basic Life Support (BLS) and Intermediate Life Support (ILS) ambulance personnel are registered as Emergency Care Practitioners (ECP), for example ECP-B represents an Emergency Care Practitioner with a Basic level qualification, ECP-I represents an Emergency Care Practitioner with an Intermediate qualification. Emergency Care Technicians (ECTs) and Advanced Life Support (ALS) Paramedics are the only qualifications registered according to the qualification name i.e. Emergency Care Technician is registered as ECT, and ALS as paramedic. This is different from ambulance personnel in South Africa where ECP represents an ALS paramedic with a four-year Bachelor Degree.

The EMS system is a small but rapidly growing part of the Health sector in Namibia. However, the problem of not having a QA system in place may seriously affect efficient healthcare service delivery. Absence of scrutiny of the value and effectiveness of services provided in EMS may affect the quality of healthcare (Graff, Stevens & Spaite 2002). In Namibia, the general quality management activities in the health sector only focuses on in-patient management activities and do not take into account pre-hospital Emergency Medical Care (MoHSS, 2014). Preliminary discussions with key professionals within the AHPCNA and Directors of Ambulance Services in the Ministry of Health and Social Services (MoHSS) acknowledged the absence of a QA system and argue that the absence of such system poses a number of challenges such as a dysfunctional operational system, delayed response times, poor treatment of ambulance crews and potential medico-legal litigation. It is therefore imperative for the Namibian Emergency Medical Services to develop processes of service quality improvement.

1.6 Significance of Research

Research that is focusing on the relationship between EMS and Quality Management Systems (QMS) in the Namibian context is generally non-existent. This research topic will be a first of its kind in Namibia and conducting this research has the potential to encourage further research in the same area. This study also has the potential to encourage the private and government EMS sectors to adopt and implement the proposed quality assurance system which will enhance not only the profession but

the industry and ultimately patient management. The importance of implementing a QA policy plays a fundamental twofold role in EMS, that for practitioner improvement of quality of care, professionalism, innovation and creativity, and improvement of the core components of EMS delivery. Additionally, this research puts Namibian EMS on the map to allow for benchmarking with other EMS states allowing for internationally recognized standards of quality assurance.

1.7 Purpose of Research

The study aimed at developing a quality assurance system for Namibian EMS through comparative analysis of currently used procedures in developed countries. The focus will be through the identification and extrapolation of Quality Indicators (QI) that are developed and currently used by selected developed countries. The aim of the study will be achieved through the following research objectives:

1. Establish QA service delivery indicators through a comparative analysis of selected international QA systems.
2. Apply a Delphi technique for consensus on applicable international quality indicators to develop a QA system for Namibia.
3. Conduct a pilot study for the developed QA system.

CHAPTER 2: LITERATURE REVIEW

Quality healthcare is becoming more popular around emergency medical service systems. According to Lighter (2015) a new era of value-based care has consumed the health care industry around the world. However, what is known throughout the healthcare industry is that policies of quality assurance and the practice of quality improvement is significantly different across different EMS agencies (Lincoln, Reed-Schrader & Jarvis, 2019). No set standard for quality in EMS is in existence and a one-fit-all implementation will not reap the same benefit for EMS systems of different countries. This is attributed to variations in clinical practice and protocols between different geographical regions. Instead, benchmarks are done on quality assurance and quality improvements and tailored to the needs of the EMS system (McLean, Maio, Spaite & Garrison, 2002). According to McLean et al. (2002) many prehospital interventions and system processes are not evidence-based and therefore calls for the need of evaluation of effectiveness. This increase for value-based care shows that the healthcare industry as well as the general public is demanding constant and continuing better care. Therefore, emergency services has to stay abreast with ensuring that improved care is delivered to everyone.

The industry has also seen a continual increase of healthcare cost and medical insurance organizations are questioning the evidence behind the interventions performed by EMS to ascertain that what they are paying for benefits the patients (McLean et al., 2002). There is a general misconception that quality can only be implemented and maintained by high-income countries, and may appear to be a luxury beyond the budgetary limits of most low-income/developing health systems. It is however the position of Brown et al. (2000) that having a quality assurance system in place and ensuring improvement of quality of care often does not cost, it pays. Maphumulo and Bhengu (2019) highlights the issue of litigation because of avoidable errors by healthcare providers faced by the South African Department of Health which has put enormous strain on the health budget. Maphumulo and Bhengu (2019) further mentions that a report outlining the medico-legal costs paid by the government in 2015 totals R498 964 916.72. It is arguable that the financial costs of a healthcare system that lacks a proper implemented quality assurance system is more weight-baring than one with a proper quality assurance system in place with the execution of quality improvement. This again highlights the need for quality assurance and continual quality improvement to be in place.

Tozija and Jankulovski (2013) conducted an assessment and identified that EMS in Macedonia is in dire need of extensive quality change and improvement. If emergency care quality is not improved the end result will be irreversible and severe health harm and even death. The quality of EMS was subsequently improved by a three-stage process which includes: assessment and recommendations

for quality healthcare, development of innovative evidence-based programs and quality healthcare policy implementation. Across the world EMS is considered an essential service and not merely a means of transportation to hospital. Instead, trained emergency medical personnel provide on-scene and in-transport care to acutely-ill, or critically injured persons to the most appropriate hospital. The German federal state of Baden-Wurttemberg for this reason deemed it necessary to develop a quality assurance project to determine the impact of emergency medical care for future development. Messelken, Kehrberger, Dirks and Fischer (2010) mentions that this initiative saw a significant improvement in not only patient status but also relieved the financial burden on the healthcare system as a whole. Additional benefits outlined include an 80% participation in quality of emergency personnel, which means collaboration and less resistance to change, and interpretation of local results assists senior management with decision making in their future quality management.

According to Brown et al. (2002) the 21st century has seen an explosion in the interest of quality assurance. The success of quality management approaches in Japan, Europe and USA has inspired other organizations to set up similar quality assurance systems. Their approaches yielded improved quality healthcare and efficiency within five years of implementation. A worthwhile approach is to start improving the effectiveness and efficiency of the current resources at hand, thus no significant burden is placed on the healthcare costs. It should be focused towards meeting the needs of patients and the public, focus on the systems and processes of EMS structures and encourage a team approach to solving problems. This same approach will ensure that quality service delivery is achieved in the Namibian EMS setting and therefore addresses the prevailing lacuna of quality healthcare.

2.1 General Overview of Quality Indicator Selection

Haughland, Rehn, Klepstad & Kruger (2017) emphasises that quality indicators play an instrumental role in achieving improvements in healthcare and has identified the development of quality indicators as a high priority of prehospital research. Similarly, Murphy, Wakai, Walsh, Cummings, and O`Sullivan (2016) re-emphasises that the highest priority currently in prehospital research is the development of key performance indicators to measure quality. However, despite the emergence of research on quality indicators, evidence-based research on pre-hospital quality indicators are still a scarcity and mostly rely on the opinions of experts within the EMS domain. In the past, assessments on EMS service delivery has largely been done on anecdotal and non-clinical endpoints, such as response time intervals or customer satisfaction surveys, because they are relatively easily and readily understood making them the primary indicators to assess quality of the EMS system. However, these indicators

do not reflect a true representation of quality care delivered by the EMS providers as they can only be applied to specific cases (Howard et al., 2018).

Pap, Lockwood, Stephenson & Simpson (2017) states that quality indicators are used to make judgments about quality and are based on evidence or consensus that the indicator can be used to evaluate quality of health care. Similarly, Aaronson, Marsh, Guha, Schuur & Rouhani (2015) agrees that the development of well-defined quality indicators can have a positive impact on the standard of quality care provided. This can be seen from high-income countries where QA systems are functioning well. It was noted by Poulsen, Jepsen & Christensen (2019) that there is an increase in the interest to study quality in prehospital care, however the need for validating the current indicators still exit. According to Christensen, Berlac, Nielsen & Christiansen (2016), only a few standard quality indicators exist across different countries and EMS organisations. Most quality indicators are therefore dependant on input from expert opinion well orientated in a specific country and environment where evidence is lacking. Christensen et al. (2016), further mentioned that the identification of quality indicators reaps maximum benefit when consensus is reached amongst such a panel of experts.

In a study conducted by Broccoli, Moresky, Dixon, Maya, Taubman, Wallis and Hynes (2017) it was mentioned that the increase in the need for emergency care in low-middle income countries is not inclusive of the measurement of quality care and the impact that it has on patients. Currently there is no standardised and agreed to set of quality indicators by health regulators and providers in the African setting. To develop a set of indicators the authors conducted an analysis of literature on available quality indicators, filtered through the data to contextualize it for the African continent and forwarded it to a panel for review and consensus. The authors removed duplicates and synchronized indicators that had the same meaning but were plotted differently. The identification of quality indicators for this study was extrapolated from current evidence but also those relevant to the African context which enhance the care provided by healthcare providers and will allow for international comparison and benchmarking in the near future (Broccoli et al., 2017).

The Australian Prehospital Care Quality Indicator Project through their study identified evidence-based quality indicators through a literature search to use the indicators to improve ways to measure prehospital quality. According to Tesser (2018), quality indicators used today are primarily based on anecdotal end points which do not provide a holistic and comprehensive outcome to measure quality. Through a multinational scoping review, the authors identified indicators used in quality assurance and quality improvement programmes internationally. The identified indicators were then circulated through a panel of experts to review the indicators and reach a consensus on the most appropriate indicators for the Australian ambulance services. Throughout the consensus process the panel also

introduced new quality indicators that will form part of future studies. This process will be useful in validating the newly identified indicators to measure prehospital care (Tesser, 2018).

As research is conducted on a continual basis the EMS profession globally has witnessed a continuous increase in their scope of practice. This has led to the development of evidence-informed quality indicators in certain first world countries (Howard et al., 2018). Haughland et al. (2017) cites that it is of utmost importance that there should be an integration of evidence-based research with clinical expertise to provide a quantitative basis to identify performance trends. Similarly, El Sayed (2012) mentions that the Institute of Medicine (IOM) recommends the development of: *"evidence-based performance indicators that can be nationally standardized so that state-wide and national comparisons can be made"* (p.1). Even though EMS systems differ, a national comparison and benchmark of QI will increase the level of accountability and will aid strategic planning to improve the overall performance of any EMS system (El Sayed, 2012).

Interestingly, MacFarlane and Benn (2003), states that prehospital care is accepted as an internationally uniform entity and therefore falls under the assumption that one set of rules applies to all. Although there are a few similarities, this however is not an appropriate philosophy. Each prehospital entity is different in its capacity and setting, and in developing indicators to assess EMS delivery one needs to consider a number of different factors such as geography, resources, medical and social cultures, the type of prehospital system and emergency department in collaboration as the one cannot be assessed in isolation (MacFarlane and Benn, 2003). The Namibian EMS setting is different from that of the first world countries. It is therefore arguable that the identification of quality indicators be based on evidenced-based indicators from the first world countries that will suit the Namibian prehospital setting.

2.2 The use of the Donabedian Framework in Quality Indictor Development

As mentioned by Lighter (2015), the Donabedian Framework model was first published in the 1980`s. Since then, the model has provided the framework for healthcare services to adequately measure quality. Lighter (2015), further cites that any type of healthcare quality indicator can be classified into this framework. By using the Donabedian Framework QI can be classified under one of three types of categories of structure, process or outcome. The SMART – Specific, Measurable, Achievable, Relevant and Time specific acronym forms the basis on which the Donabedian Framework is bedded as many professional organizations apply it to their daily measure for quality (Lighter, 2015). According to Mitchell, Ferketich and Jennings (1998), the Donabedian Framework has been used over three decades in the United States to evaluate and compare quality care. In a scoping review conducted by

Pap et al. (2017), the authors acknowledge that the Donabedian Framework is the most widely used framework to categorise indicators when quality is being measured. Although the authors noticed other ways of indicator classification, the Donabedian Framework is preferred in a multitude of studies.

Stelfox and Straus (2013), cites that before the development of QIs, an important step one has to follow is to identify a framework into which the indicators can be articulated. This will be beneficial in validating the measurement of the indicators for quality measurement and to identify areas where improvement is needed. The two most commonly used and inter-related frameworks in modern day healthcare quality research is the Donabedian Framework and the IOM. It is the view of Stelfox and Straus (2013) that these frameworks are helpful and even though they are simplistic, assists researchers to focus on the needed data to classify indicators. This classification system is widely used as narrated by Howard et al. (2018) in his scoping review on the evaluation of quality indicators in the prehospital setting. Howard further noticed that a great number of the studies used the Donabedian Framework classification to measure healthcare quality.

Those studies which did not utilize the Donabedian Framework were then classified under one of the three categories by the authors of the study. Broccoli et al. (2017) conducted a study in which the authors aimed to define the quality indicators from an expert consensus panel for low-middle income countries. After an exhaustive literature review the authors similarly mapped all the indicators in the three categories of the Donabedian Framework of structure, process and outcome.

Haughland et al. (2017) used the Donabedian Framework to conceptualize their study framework in developing quality indicators for a physician-staffed emergency medical service in Europe. Stelfox, Bobranska-Artiuch, Nathens and Straus (2010) classified their quality indicators of trauma care into the Donabedian Framework which helped them to have a better measurement of the care provided. Similarly, El Sayed (2012) also utilized the Donabedian Framework to classify specific indicators in his review of clinical performance indicators to measure quality in emergency medical services. Hung & Jerng (2014) from Taiwan make reference to the commonly used categories of structure, process and outcome which is the basis of the Donabedian model. In their study they emphasize the need for a paradigm shift of professionals to improve service performance and by using the three categories of the Donabedian Framework they were able to have a clear structure to measure how well their service is delivered.

Ameh, Gomez-Olive, Kahn, Tollmann & Klipstein-Grobusch (2017) applied the Donabedian Framework theory to assess the quality systems in a South African primary healthcare system by identifying the relationship between the Donabedian Framework metrics. The authors stated that *“there are*

relationships between structure, process and outcome constructs based on the idea that good structure should promote good process and good process should in turn promote good outcome." The authors were able to pinpoint the need for improved services in the primary healthcare setting after the implementation of the Donabedian Framework and emphasized the usefulness of this method in evaluating the quality in the healthcare sector.

A study conducted in Brazil saw the authors, Dantas, Torres, Salvetti, Dantas, Elza and Mendonca. (2015), considering two, (structure and process), of the three categories of the Donabedian Framework for evaluating the healthcare system. The Brazilian healthcare system is identified as poor and studies on prehospital quality care is non-existent as there are no systems of validation for healthcare delivery. By using the structure and process indicators, a proper analysis can be done as the healthcare professionals working in the respective fields can give valuable feedback on the quality of care. Although outcome indicators could not be measured in this study, the initiation of the evaluation of the first two metrics provide valuable data for continuation and measurement of outcome-based indicators in the near future (Dantas et al., 2015).

The Donabedian Framework is viewed by Murphy et al. (2016) as a reliable method to implement performance measures for improving the quality of prehospital care. Murphy used the Donabedian Framework to categorize 101 key performance indicators into the three metrics – structure, process and outcome. The majority of key performance indicators, 74 of 101, were classified as process indicators, 7 were classified as structure indicators and the remaining 20 were outcome indicators. The authors postulate that the identification and classification of the key performance indicators will contribute to a safer and improved prehospital care (Murphy et al., 2016).

Aaronson *et al.* (2015) in their study screened 1705 articles to identify quality indicators for a resource-limited ED. The authors identified 180 QI's which were then categorized into the Donabedian Framework of process (57%), structure (27%) and outcome (16%). The authors also classified the QI's into one of the six quality domains of the Institute of Medicine (IOM). The authors concluded that when QI are developed for resource-limited countries, consideration should be made to develop comprehensive indicators that are locally applicable. The author further states that these indicators should be reported to initiate global standards of quality measurement in emergency care. This highlights the importance of developing indicators that are practical to the local setting.

The researcher noticed that a multitude of studies interlink the three categories of the Donabedian model with the six quality dimensions of the Institute of Medicine (IOM). The six dimensions are safety, timelines, efficiency, equity, effectiveness and patient centred and is also known by some as the STEEP acronym. These dimensions are also internationally recognised, acknowledged and feature in policies

worldwide (Beattie, Shepherd & Howieson, 2013; Haughland et al. 2017). The use of these dimensions in quality benchmarks have become a common practice in all sectors of healthcare (Ayanian & Markel, 2016). The IOM plays an important role in the development of evidence-based quality indicators for EMS. In one of its reports called "*Emergency Medical Services at the Crossroads*" the IOM advocates for the development of standardized indicators to be used for global benchmarks. The development of such indicators would enhance the accountability of EMS organisations and improve their performance as they would have adequate data to measure their performance and to have strategic quality improvement planning (El Sayed, 2012; Rahman et al., 2015). El Sayed (2012), further mentions that the IOM's theory entails a multidisciplinary system which includes personnel, equipment and functions. When the six dimensions of the IOM are applied it ensures effective and coordinated high quality healthcare delivery.

A study conducted by Haughland *et al.* (2017) to develop quality indicators for physician-staffed emergency medical service, emphasized that the six dimensions, as classified by the IOM, should be appraised whenever quality is being measured. The identification of the QI's should encompass a combination of a thorough systematic review of literature as well as the use of an expert panel. The study further mentions that the development of QI's should cover one of the six quality dimensions to the furthest extent. The study emanates a relationship between the application of web-based searches to identify QI's, making use of a panel of experts to reach consensus on the QI's, categorizing the QI's into the Donabedian Framework and ensuring that it links to the IOM quality dimensions. By reviewing studies that focus on measuring quality in healthcare one can argue that the Donabedian Framework is a well-known method in current research across the globe as it surfaces with a multitude of studies measuring quality or with the aim of measuring performance of delivery.

2.3 The use of the Delphi Technique in Healthcare Research

A Delphi study was conducted by Van de Glind, Berben, Zeegers, Poppen, Hoogeveen, Bolt, van Grunsven and Vloet (2016), in the Netherlands to set up a research agenda for prehospital emergency medical care. The study consisted of a four-round Delphi survey with an overall response rate of 95%. Through the consensus process the suggested topics to be researched decreased from 48 in iteration I, to 12 topics in iteration III, with similar agreement in iteration IV however the final consensus came to 9 topics. The Delphi technique proved to be beneficial for this study as communication on the input between the panel members was easily distributed and feedback could be provided immediately. The study also provided both qualitative and quantitative data on the research topics. Similarly, De Villiers and De Villiers (2005) mentions that the Delphi is becoming more popular in the quantitative and

qualitative realms of research. Van de Glind et al. (2016) further encourages other researchers to utilize the Delphi technique especially when collecting qualitative data. According to Brady (2015) although the Delphi method is primarily used in quantitative studies it can also be used in qualitative or mixed methods studies.

Howard *et al.* (2018), in his scoping review, noted that the Delphi presented as one of the most common methodologies employed in the development of QI's to measure quality of prehospital emergency care. It is apparent from this article that the majority of studies that developed or measured quality indicators followed the process of identifying a panel of experts, and that the experts had to reach consensus on a subject matter. In study a conducted in Denmark a Danish working group of experts was formulated to aid in the development of the Danish quality database for emergency medical services. The database was established to analyse, monitor and improve prehospital emergency medical care and patient outcomes (Christensen, Berlac, Nielsen & Christiansen, 2016).

Boulkedid *et al.* (2011) conducted a systematic review that focused on using the Delphi method for selecting healthcare indicators. The study yielded 80 published articles most of which were using the modified Delphi method. Interestingly, Boulkedid *et al*. (2011) highlights that there are no universally agreed and accepted standard for the Delphi method on the definition of group consensus, number of rounds and expert selection. Another limitation highlighted by Boulkedid is that when a Delphi is not properly described the credibility of consensus can be affected. De Villiers and De Villiers (2005) cites that the factors that are critical to the validity of the Delphi method is the definition of consensus, selection of the expert panel, data analysis and the interpretation of non-consensus. Boulkedid *et al.* (2011) however reveals that the Delphi method is broadly accepted for the development of quality indicators in the healthcare system. These indicators also have high face validity when selected through a consensus process of experts.

Another critical factor when applying a Delphi study outlined by the authors is the selection of and the number of experts (Boulkedid *et al.*, 2011) and De Villiers and De Villiers (2005). According to De Villiers and De Villiers (2005), it is acceptable that a Delphi panel can consist of 15 to 30 participants, however the number can vary depending on the purpose of the study and its complexity. The higher the number of experts the better the results. The authors further identify an expert as defined in the literature as: *"someone who possesses the relevant knowledge and experience and whose opinions are respected by fellow workers in their field"* (p.640). In healthcare research these panel members usually consist of specialists in the field of anaesthesiology, emergency medicine, internal medicine, critical care and advanced life support paramedics with clinical experience in the field.

It is noticeable that the Delphi method is widely used across the healthcare sector and is feasible within the Emergency Medical Services (EMS), Emergency Departments (ED) and the Helicopter Emergency Medical Services (HEMS). Venter and Stassen (2016) conducted a Delphi study to get consensus on the capabilities and scope-of-practice of advanced life support practitioners to undertake critical care transfers in South Africa. Their Delphi consisted of an expert panel of 2 paramedics, a paediatrician, intensivist, anaesthesiologist and an emergency physician; however due to time constraints the third iteration of iterations had to be terminated. Regardless of the termination of the third iteration the authors were still able to achieve consensus on most of the proposed indicators.

In a study to identify performance indicators for emergency medicine, Beattie and Mackway-Jones (2004) utilized a Delphi method with a panel of 33 experts employed within the ED to reach a consensus on 36 indicators from a proposed list of 224 extrapolated from literature. The 36 indicators were then implemented to measure the quality of care within the ED. As mentioned by Beattie and Mackway-Jones (2004) the Delphi technique was a useful tool in their research as the expert panel was able to express their views anonymously without prejudice and feeling pressured by fellow experts. It has assisted the authors to identify areas where further improvements are required within their ED.

Twycross *et al.* (2013) applied a two round Delphi method to identify indicators of poorly managed pain for paediatric postoperative and procedural pain. The study requested participation from 122 carefully selected experts in the field of paediatric pain management and quality improvement, however only 59 returned responses in iteration one and 49 in iteration two respectively. Despite the drop in participation of respondents, most of the indicators received a consensus rate of 70% and above. The authors cite that this is a step in the right direction for mismanaged pain to be considered an adverse event (Twycross *et al*., 2013).

In most Delphi studies as with any other sampling methods the possibility of participants not responding to invitations are very likely as in the case of Fatta *et al.* (2016) who invited 29 participants with only 17 experts participating in the study. Venter and Stassen (2016) approached 12 identified experts with only seven agreeing to participate, Beattie and Mackway-Jones (2004) experienced a slightly better outcome with 30 out of 33 invited participants responding. Daudelin, Kulick, D`Amore, Lutz, Barrientos and Foell (2013), experienced a 100% participation rate of a 15-member expert panel throughout the duration of their study. Murphy *et al.* (2016) had participation of 112 expert panellist to identify quality indicators for prehospital emergency care.

According to De Villiers and De Villiers (2005) an acceptable agreement percentage for consensus is 70%. Authors of other studies opted for similar or higher consensus percentage, as with Murphy *et al.* (2016) and Twycross *et al.* (2013) whom set their consensus rate at 70% of respondents selecting "agree", Venter and Stassen (2016) set their consensus rate at 80%; Beattie and Mackway-Jones (2004) at 80%. Boulkedid *et al.* (2011) in their systematic review cites that the definition of consensus varies between studies however researchers should decide and agree on what the consensus rate will be set at and where the cut off will be.

It is noticeable that in a multitude of studies where quality is being researched or performance of healthcare is being measured the combination of using the Donabedian Framework and the Delphi Technique is particularly forth coming, especially in the prehospital field where research is lacking. It is arguable that using both the methodologies to identify QI and to measure the quality of EMS is feasible. Namibia`s EMS has been deprived of a robust QA system for far too long. The Delphi method is a widely accepted and valuable technique for achieving consensus on quality indicators where none is existent.

CHAPTER 3: METHODOLOGY

3.1 Comparative Analysis of International Quality Indicators

3.1.1 Design

In this study, the focus is to conduct a comparative analysis of international EMS quality assurance systems to identify quality/performance indicators that will be presented to a panel of experts to reach consensus on the identified QI's. A methodical strategy, using advanced searches was used to identify relevant studies that reported on EMS quality assurance systems that are related to evaluation or the measurement of EMS quality assurance and/or quality indicators. A qualitative desktop electronic database search was conducted to identify relevant publications via Google Scholar (2000 – May 2018), Medline (2000 – May 2018), Mendeley (2000 – May 2018), and HINARI (2000 – May 2018).

The primary search in the databases include a combination of the following terms with the use of Boolean searches: "emergency medical services", "pre-hospital emergency care", "quality assurance", "quality indicators", "performance indicators", "measurement", and/or "evaluation". The search strings included: "quality assurance systems AND quality indicators in emergency medical services OR pre-hospital emergency care", "performance indicators OR quality indicators for pre-hospital emergency care", "pre-hospital quality indicators OR performance indicators", "measurement OR evaluation of emergency medical services performance indicators", "evaluation of pre-hospital emergency care", "pre-hospital evaluation of quality service delivery" measuring quality in pre-hospital care". The search was not limited to a specific continent, country or state. However, only English articles or English translated articles were considered.

3.1.2 Study Sample

No specific study sample was set out for this objective. The investigator attempted to identify as many studies addressing the theme as possible. In addition to the studies identified through the data bases, efforts to identify other relevant publications were made by cross-referencing the reference lists of articles addressing the themes. The identification process and number of articles included in the comparative analysis can be found in Figure 2.

3.1.2.1 Inclusion Criteria

The inclusion criteria for the comparative analysis of QI were studies addressing the identified themes. These include articles that analyse, evaluate, discuss or promote the development of quality indicators in the EMS/pre-hospital field. The identified or selected indicators were those included in the articles and those that the primary researcher felt would contribute to the improvement of service delivery in the Namibian EMS setting. In addition, peer-reviewed publications and EMS/ambulance service policy documents based on primary or secondary research on quality assurance and quality indicators were also included. The inclusion criteria of articles were purposefully kept low to allow a greater number of identified QI's. The definition of a QI for this study is set as: a measurement tool that can be used in an emergency medical service to aid in the evaluation and improvement of organizational processes and service delivery to patients.

3.1.2.2 Exclusion Criteria

Some studies were excluded from the comparative analysis if they did not address the themes of the quality assurance, quality indicators or performance indicators specifically related to EMS/prehospital emergency care. Also excluded were abstracts of which full text articles could not be accessed after an exhaustive search by the researcher himself and by the assistance of the university librarian. Non-English articles were also excluded.

3.1.3 Data Collection and Management

The primary researcher solely collected and held access to the data. After extrapolation the data was transferred onto an electronic data sheet (Microsoft Word® MSO, version 16.0.4266.1001) and was stored on a password protected laptop and additionally stored on a password protected USB external device. The data was only made available to the primary researcher and the supervisors when and if required. The articles were reviewed for eligibility for inclusion by reading the titles and abstracts. Quality indicators were extrapolated from the studies, synthesized and tabulated. The researcher then further divided the indicators into "Clinical" and "Non-Clinical Indicators", designated each indicator according to the Donabedian framework of process, structure and outcome, and finally with one of the six quality dimension from the IOM if it had not already been categorized under any of the Donabedian Framework or the IOM in the articles.

3.2 Delphi Technique for Consensus on Applicable International Quality Indicators

3.2.1 Design

A cross-sectional quantitative study was carried out for the purpose of data collection for this objective. However, the data collection process was based on the use of the Delphi technique. The Delphi technique is a process whereby data is collected from a group of experts in iterations on a specific given subject with the aim of reaching consensus (Fattah *et al.*, 2016). This method has been previously applied in a related quality assurance development system (Hanafin, 2004). Boulkedid *et al.* (2011) viewed the technique as an acceptable method to reach consensus on QI's after conducting a systematic review of 80 studies that used the Delphi Method to select quality indicators.

For this objective, the study used the pragmatist paradigm to extrapolate quantitative data on quality indicators from a group of experts within and related to the EMS field by using a three-iteration Delphi technique. The Delphi was applied to generate ideas on quality indicators that were reconsidered and rated by the experts in the subsequent rounds for consensus. Participants had to group the indicators under the three categories of the Donabedian Framework of structure, process and outcome (Haughland *et al.*, 2017). The study was conducted over a period of three months from August 2019 to October 2019. This design revealed suitability for this study as it captured collective opinions from a group of experts based on culminating a pool of intelligence and knowledge over a series of rounds. The data collected was converted into numerical form and from that statistical calculations were made and conclusions drawn.

3.2.2 Study Sample

The study population was comprised of a specific group of experts which included emergency care practitioners with relevant clinical experience, educators, researchers and policy advisors within the EMS management/supervisory positions and/or relevant positions related in the Emergency Medicine and Rescue Professions. The experts identified for the study correlates with the definition of an expert as cited by De Villiers and De Villiers (2005) as *"Someone who possesses the relevant knowledge and experience and whose opinions are respected by fellow workers in their field"* (p.640).The importance of selecting a panel of experts with relevant knowledge and experience is multifactorial in reaching consensus on the proposed quality indicators. This can be seen from the definition of a Delphi method as derived from Brady (2015) and the definition of an expert as defined by De Villiers and De Villiers (2005). In this study, a purposive sampling technique was adopted in selecting the participants. These participants must have at least 5 years' relevant experience in the pre-hospital, emergency rescue

and/or emergency medicine field and should either be operational or functioning in the managerial/supervisory domain. Other experts will include those that work directly with QA policy development and management. The study participants were identified via the Namibia Emergency Care Practitioners Association (NECPA) and on recommendations of other experts.

3.2.2.1 Inclusion Criteria

- Pre-hospital care providers (BLS, ILS, ECT & ALS), in-hospital emergency care physicians and registrars, and fire and rescue providers'/policy advisors with supervising and/or managerial experience.
- Pre-hospital and in-hospital care providers and fire and rescue providers with more than five years' operational experience without supervising/managerial positions/experience.
- People working directly with QA systems regulation, policy development and management.

3.2.2.2 Exclusion Criteria

- Operational pre-hospital practitioners (BLS, ILS, ECT & ALS) with no supervising or managerial exposure with less than five years' experience.
- In-hospital care providers with no experience and knowledge of the pre-hospital field.

3.2.3 Data Collection and Management

The data was collected from participants through the use of an internet-based survey and questionnaire tool Survey Monkey (www.surveymonkey.com). The initial questionnaire was validated by the project supervisor, and piloted by 11 local emergency care practitioners that did not participate in the study to verify user understanding and the possible need for amendment to the questionnaire. After validation of the questionnaire, it was sent to the experts for completion. The experts were informed that should they continue with the survey; it is done on a completely voluntary basis. To ensure consent to voluntary participation the survey tool was designed to prohibit participants access to the survey without clicking the "OK" button. The same questionnaire was sent to all participating candidates provided they met the inclusion criteria.

The questionnaire was comprised of three iterations with a three-point Likert Scale that included a compilation of statements indicating potential quality indicators extrapolated from the comparative analysis of international QA systems. The participants rated their views on the proposed indicators and classification of the indicators by the Donabedian Framework and IOM quality dimensions by

selecting the number scale that represented their views. The scale was numbered as follows 1=Agree, 2=Disagree and 3=Undecided. Participants were provided with a definition of the Donabedian Framework triad, structure, process and outcome; and the definitions of the IOM six quality dimensions. Participants were also explained how the survey works and how they should rate each statement.

In iteration one, the questionnaire contained enquiries such as demographic information, the QI extrapolated and categorized by the primary investigator and a comments section at the bottom of each statement for participants to suggest new indicators or make comments. After collation of iteration one responses, consensus was sought on the proposed indicators. For this study, consensus was defined as 80% or more of expert`s agreement on the QI. Non-consensual indicators were restructured as per expert suggestions and resent in iteration two and three respectively to further explore experts` opinion to reach common understanding. Quality indicators that did not reach a consensus of 80% after iteration three was excluded from the study.

3.3 Pilot study for the identified quality indicators

The final objective of the research study was to conduct a pilot study on the identified quality indicators after receiving the third Delphi consensus. The pilot study aimed to test the feasibility of developing a quality assurance system for Namibian EMS service delivery by using quality indicators selected by the group of experts. Four emergency services within Windhoek were approached to conduct the pilot study.

3.3.1 Study Design

As with objective two, this study also followed a cross-sectional study design to collect quantitative data. However, this study used a questionnaire where ECPs had to answer a few questions and statements on the identified quality indicators by selecting either *YES* or *NO*, whichever represented their opinion. The participants were also allowed to add a comment on how the quality of the specific indicator could be improved at their respective company.

3.3.2 Study Sample

The participants of this pilot study were ECPs working at the respective companies and/or supervising team members. A random sampling technique was applied to identify the participants. Permission from all the emergency services were sought and granted to conduct the pilot study. They were

informed that no participant name or the company name will be disclosed when collecting and interpreting the data. Five participants of each emergency service were asked to voluntarily complete a questionnaire relating to the quality indicators and its implementation.

3.3.3 Inclusion Criteria

- The inclusion criteria for the pilot study were ECP-Intermediates with at least 2 years' clinical experience, ECT and ALS paramedics. ECP-Intermediates were included as they might have an acceptable level of understanding to answer all the questions.

3.3.4 Exclusion Criteria

- Emergency Care Practitioners – Basic were excluded from the study simply because of the level of the questions and statements in the Clinical domain.
- Non-Emergency staff members of the companies were also excluded.

3.4 Ethical Considerations

Potential ethical risks that this study contained was those of confidentiality and anonymity on data collected from EMS experts. To alleviate the possibility of breach of confidentiality and anonymity, correspondence was sent to the private mail of participants only. Collected data was stored on the password protected Survey Monkey database that was only accessible by the researcher himself. To consent to participation, participants had to click "OK" to be allowed into the survey. For the pilot study, no participant names were requested, similarly the company at which the survey was conducted was allocated with a number and the company name excluded from the study.

CHAPTER 4: RESULTS

4.1 Comparative Analysis of International Quality Indicators

Through an extensive web-based search of the search engines and medical databases, 1186 articles were identified to be reviewed for potential inclusion. However, after scanning the titles and abstracts of the 1186 potential articles, 1108 were excluded as they did not address the main theme of the research study and were not related to the EMS profession. This left a number of 78 articles for full text review. In addition, 39 articles were then included for full text review after being identified from a review of the reference lists of the identified articles. Furthermore, 105 full text articles were excluded following review. The articles were excluded because they did not address the study theme of analysing, evaluating or promoting QI in the EMS setting, and the majority of the articles were inaccessible despite the assistance from the university librarian and were therefore excluded. Duplications of articles were also excluded from the study. Finally, a total of 12 full text articles remained and were included to conduct the comparative analysis, identify and extrapolate QI's from. Figure 2 below outlines the process followed to identify the relevant articles.

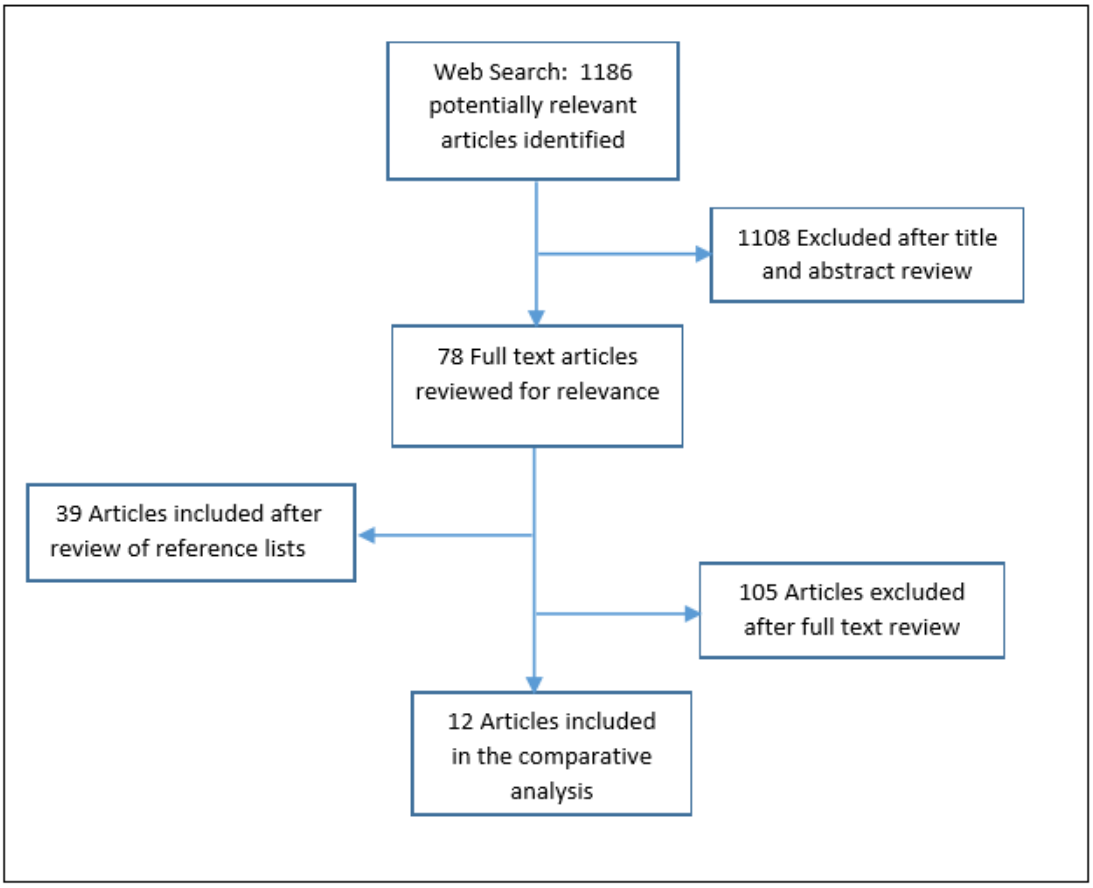


Figure 2: Identification of articles for Comparative Analysis

The 12 publications all addressed and identified different QI's used in different country's EMS systems and different states respectively. The majority of the articles reported indicators used in the United States of America (USA), followed by Australia, South Africa, Asia, Qatar, United Kingdom, Scandinavia and Korea. The articles were further reviewed for common themes of QI's to be extrapolated and those that would be relevant and beneficial to the EMS system in Namibia. Duplications of QI's were excluded and only those that assessed different outcomes were included.

The indicators were extrapolated, tabulated and compared with other countries EMS systems. The QI's were further categorized into the Donabedian Framework of structure, process and outcome if it had not already been done in the article. A total of 67 quality indicators were identified by the primary researcher which were designated as follows: Non-Clinical: 18 structure indicators, 18 process indicators and 3 outcome indicators; and Clinical: 0 structure indicators, 26 process indicators and 2 outcome indicators. The focus of the comparative analysis was to identify differences and similarities of QI's used, and then extrapolate the ones relevant to the Namibian setting. The indicators were then tabulated according to the author, country and year of publication (Appendix B and C) similar to that done by Howard *et al.* (2018). These indicators were included in the first iteration of the Delphi survey for experts to reach consensus and to share their suggestions/comments.

4.2 Iteration One

4.2.1 Demographic Information

The initial extrapolated QI's were sent to 141 participants from different EMS agencies across Namibia. Only 50 participants agreed to complete the survey by clicking the consent disclaimer. However, only 47 participants completed the demographic section of the survey. Under the non-clinical domain 8 participants skipped without completing, and 10 skipped the clinical domain without completing. *n*=31 (66%) of the 47 participants were males between the ages of 30 and 44 years and the remaining *n*=16 (34%) were female. The majority of the participants were qualified as ALS practitioners – *n*=21 (45%), followed by *n*=12 (26%) ILS, *n*=7 (15%) ECTs, *n*=6 (13%) BLS, and *n*=1 (2%) medical doctor. The chart below gives a segregation of the qualifications of the participants.

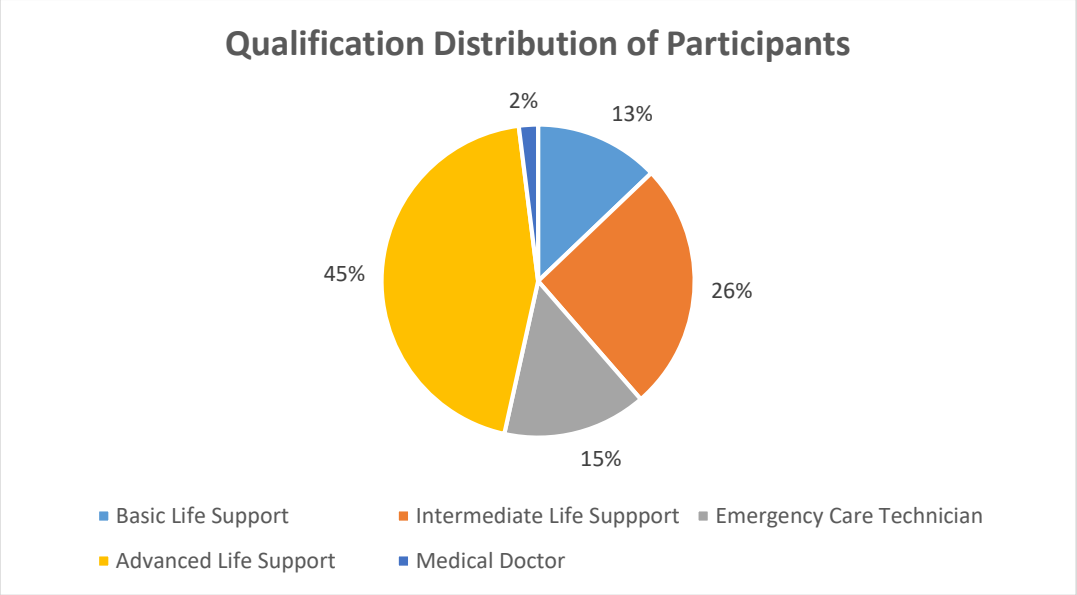


Figure 3: Qualification Distribution of Participants

Figure 4 indicates the years' experience of the participants. None of the participants had less than 5 years' experience making all 47 respondents eligible to participate in the study. *n*=18 (38%) of the 47 had between 5- and 10-years' experience, and *n*=29 (62%) participants had more than 10 years' experience. It is clear from the figure that the majority of respondents have more than 10 years' experience which is a beneficial factor for the study. The percentage ranges are displayed below.

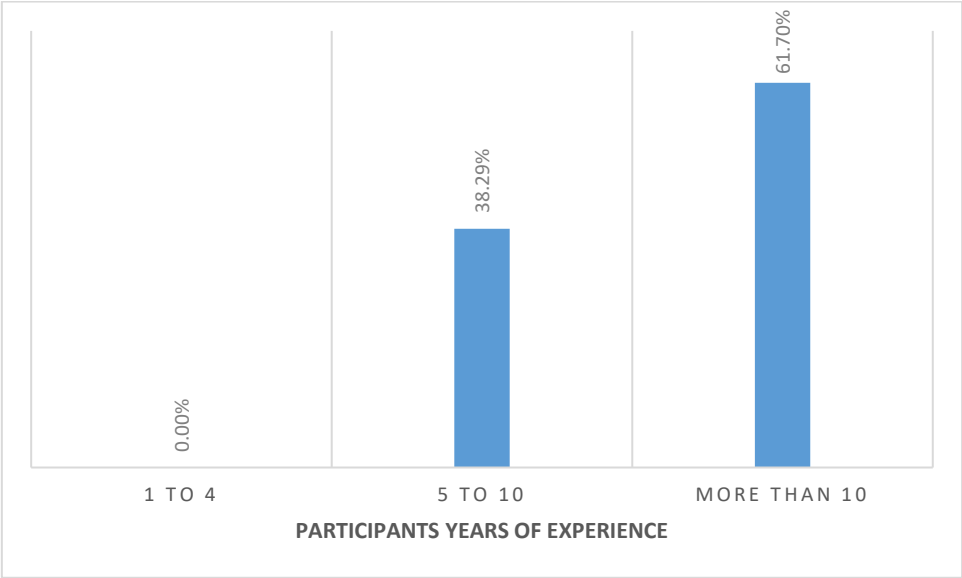


Figure 4: Years' experience in EMS/Health Sector

A greater number of participants are operational ECPs (48%), those with supervisory/managerial roles total 34%, one (2%) medical doctor and the remaining 19% consist of academic staff, clinic healthcare providers, and some are unemployed. Figure 5 displays the current position held by the respondents.

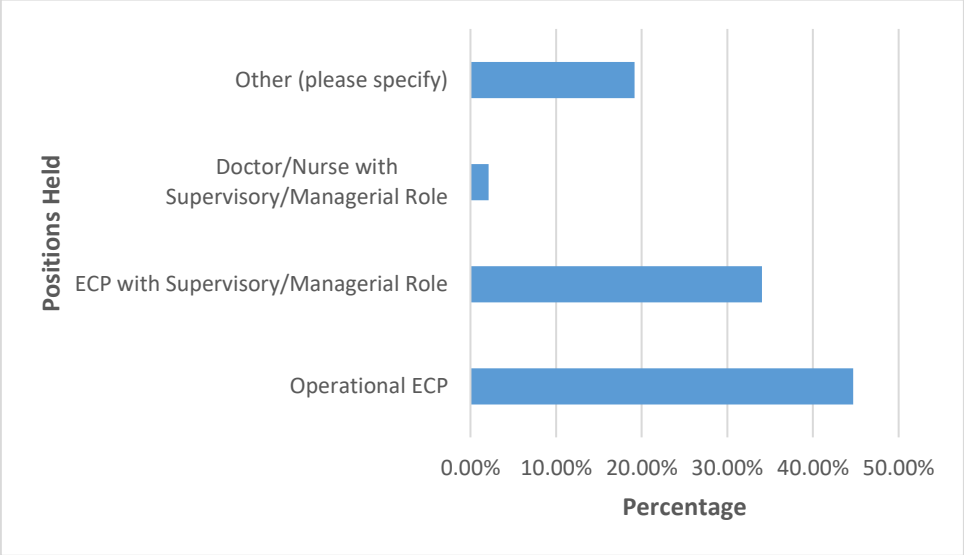


Figure 5: Positions held by participants

Figure 6 reveals that more participants work in the parastatal sector (47%) than the private sector with 43% and 10% in the MoHSS.

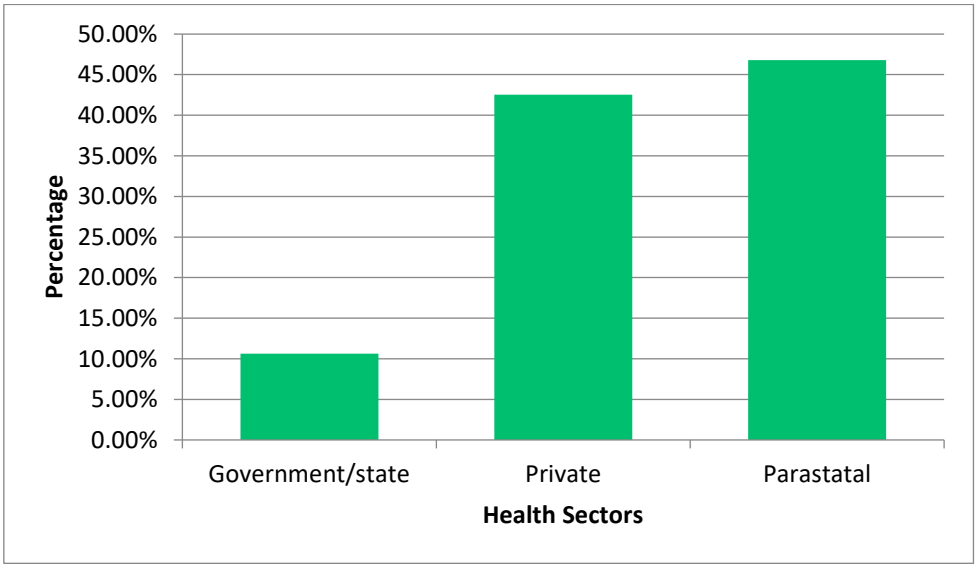


Figure 6: Participation of Health Sectors

The Delphi was not limited to a specific region in Namibia however, considering the vastness of the Namibian landscapes, it is clear that some regions are not well represented in this study. This can be as a result of the population density in the district regions. Many of the regions are covered by limited

or no EMS whether private, parastatal or government. It is evident from Figure 7 that Khomas, being in the central part of Namibia, is more densely populated with a higher representation of emergency care practitioners (55%) in the study. The Omaheke, Zambezi, Kavango East, Kavango West, Ohangwena and Kunene regions were not represented by ECPs in this study. 2% of ECP`s that responded are from the Hardap, Oshana and Omusati region respectively. *n*=4(8%) of the 47 were from the Oshikoto region, *n*=6 (12%); Otjozondjupa region, *n*=3 (6%); //Karas region, *n=5* (10%) from the Erongo region.

Regions	Responses	
Khomas	55.32%	26
Erongo	10.64%	5
Hardap	2.13%	1
//Karas	6.38%	3
Omaheke	0.00%	0
Otjozondjupa	12.77%	6
Zambezi	0.00%	0
Kavango East	0.00%	0
Kavango West	0.00%	0
Oshikoto	8.51%	4
Ohangwena	0.00%	0
Oshana	2.13%	1
Omusati	2.13%	1
Kunene	0.00%	0
	Total	**47**

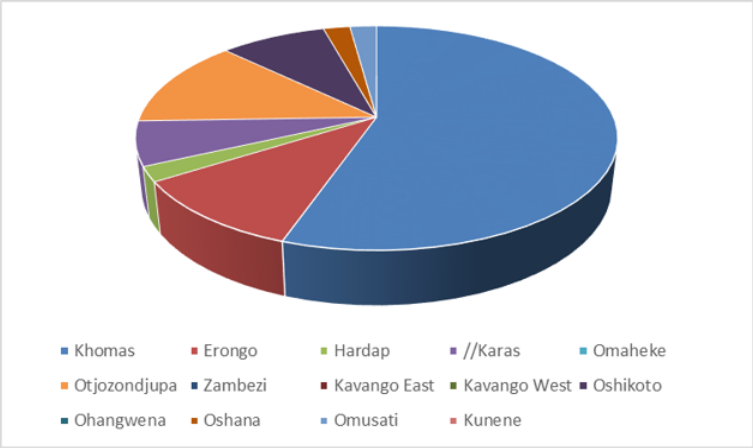


Figure 7: Participant Regions

The demographic representation indicates that a greater number of respondents are ALS practitioners whom are operational with more than 10 years' experience. Many of the respondents are in supervisory or managerial positions or have been exposed to such positions. Most of the respondents are employed within the parastatal sector and the private sector within the Khomas region.

4.2.2 Non-Clinical Indicators

Iteration one non-clinical indicators were tabulated in a three-point Likert scale. Participants rated QI's in relation to the type of quality indicator and the quality dimension of the IOM by selecting `Agree', 'Disagree' or 'Uncertain'. Respondents were provided with an explanation of the structure, process and outcome indicators, and the quality dimensions (Appendix D). Only *n*=43 participants responded to the questionnaire. For purposes of reporting the primary researcher allocated each indicator with a QI identity key outlined in Appendix A.

4.2.2.1 Response Time

The Response Time indicator had six indicators allocated to it with only *n*=2 of the six reaching consensus in this iteration. The two indicators include: RT1 – (Are emergency fleet in a well-functioning condition to respond to calls immediately?). Respondents agreed that this is a structure indicator and is seen as a timeliness quality dimension. The other indicator that achieved consensus was RT3 (Was the patient transported to the correct facility?), this indicator is patient-centred and is focused on the outcome as a type of indicator. The rest of the indicators were recirculated in iteration two.

The designation of the indicator with the response rates is outlined in the table below.

Indicator Key	Agree	No of Participants	Disagree	No of Participants	Undecided	No of Participants
RT1	80.9%	34	16.6%	7	2.3%	1
RT2	59.5%	25	19.%	8	21.4%	9
RT3	85.7%	36	9.5%	4	4.7%	2
RT4	73.8%	31	14.2%	6	11.9%	5
RT5	66.6%	28	16.6%	7	16.6%	7
RT6	40.4%	17	57.1%	24	4.7%	2

Table 1: Iteration 1- Response Time Indicator Responses

n=11 suggestions/comments were received, however only *n*=4 was eligible to be included in the following iteration. The suggestions/comments excluded did not address the proposed indicators and were mostly challenges experienced in the respondents' workplace. The 4 new suggested indicators, type of indicators and quality dimension include:

1. *Crew response skills, process, efficiency/safety*
2. *Time to definitive management, process, effectiveness*
3. *Call received to dispatch, process, timeliness*
4. *Correct information relayed to crew, process, efficiency*

4.2.2.2 On-Scene Time

The On-scene time indicator had two main indicators and received no consensus in this iteration. Again 11 respondents commented and/or provided suggestions, however only *n*=3 newly suggested indicators were included for iteration two.

Table 2 displays the responses of iteration one's feedback.

Indicator Key	Agree	No Of Participants	Disagree	No Of Participants2	Undecided	No Of Participants3
OS1	66.7%	28	7.1%	3	26.2%	11
OS2	73.8%	31	23.8%	10	2.4%	1

Table 2: Iteration 1- On-Scene Time Indicator Responses

The suggested indicators include:

1. *Available ambulances, structure, Patient-centred*
2. *Triage time by ECP, process, effectiveness*
3. *Crew Competence, outcome, effectiveness*

4.2.2.3 Dispatch Centre

There were six indicators included in iteration one with none of the indicators receiving consensus from the experts as shown in table 3 below. The experts however suggested two new indicators to be included in the following iteration. The two new indicators were:

1. *Correct Sources Dispatched? Structure, patient-centred*
2. *Quality training offered to staff? Structure, safety, efficiency*

Indicator Key	Agree	No of Participants	Disagree	No of Participants	Undecided	No of Participants
DC1	54.8%	23	40.5%	17	4.8%	2
DC2	64.3%	27	23.8%	10	11.9%	5
DC3	59.5%	25	21.4%	9	19.1%	8
DC4	47.6%	20	42.9%	18	11.9%	5
DC5	57.1%	24	26.2%	11	16.7%	7
DC6	64.3%	27	21.4%	9	14.3%	6

Table 3: Iteration 1- Dispatch Centre Indicator Responses

4.2.2.4 Equipment

No consensus was reached on the proposed indicators. Experts however proposed *n*=1 new indicator included in iteration two. The indicator proposed by one of the experts read: *Equipment Lifespan, structure, safety*. The table below shows the response rates of experts.

Indicator Key	Agree	No of Participants	Disagree	No of Participants	Undecided	No of Participants
EQ1	40.5%	17	50.0%	21	9.5%	4
EQ2	47.6%	20	40.5%	17	14.3%	6
EQ3	64.3%	27	21.4%	9	14.3%	6
EQ4	69.1%	29	21.4%	9	9.5%	4

Table 4: Iteration 1- Equipment Indicator Responses

4.2.2.5 Staff Compliment

Staff compliment as indicator had *n*=2 proposed indicators in iteration one. None of the two indicators received consensus from experts.

Indicator Key	Agree	No Of Participants	Disagree	No Of Participants	Undecided	No Of Participants
SC1	35.7%	15	50.0%	21	14.3%	6
SC2	45.2%	19	47.6%	20	7.1%	3

Table 5: Iteration 1- Staff Compliment Indicator Responses

The experts further suggested the following indicators to be included for consensus in iteration two:

1. *Are staff qualified? Type of Indicator: Process Quality Dimension: Effectiveness*
2. *Continuous Professional Development Compliance Type of Indicator: Safety Quality Dimension: Efficient*
3. *Back-up staff for Mass Casualty Incidence Type of Indicator: Structure Quality Dimension: Efficient*

4.2.2.6 Staff Training

Staff training had four indicators none of which reached consensus from the expert panel. Only one additional indicator was suggested. The indicator reads: *Debriefing Session Type of Indicator: Process Quality Dimension: Patient Centred.*

Indicator Key	Agree	No Of Participants	Disagree	No Of Participants	Undecided	No Of Participants
ST1	50.0%	21	28.6%	12	23.8%	10
ST2	57.1%	24	30.9%	13	14.3%	6
ST3	50.0%	21	38.1%	16	11.9%	5
ST4	26.2%	11	57.1%	24	16.7%	7

Table 6: Iteration 1- Staff Training Indicator Responses

4.2.2.7 Standard Operating Procedure (SOP)

There were two indicators initially included in iteration one. The experts agreed to SOP1 (Does the service have a SOP in place?) with a percentage of 83% (*n*=35), *n*=5 (11.9%) disagreed with the indicator with *n*=2 (4.8%) were uncertain on the indicator. A consensus level of 57.1% (*n*=24) disagreed with indicator SOP2 (Are SOP`s adequately executed?) and was therefore included in iteration two. One indicator was suggested by the experts and reads: *Signed off by staff Type of Indicator: Outcome Quality Dimension: Effectiveness.* The table below indicates the responses for iteration one on the SOP indicators.

Indicator Key	Agree	No Of Participants	Disagree	No Of Participants	Undecided	No Of Participants
SOP1	83.3%	35	11.9%	5	4.8%	2
SOP2	57.1%	24	33.3%	14	9.5%	4

Table 7: Iteration 1- Standard Operating Procedure Indicator Responses

4.2.2.8 Patient Report Forms (PRFs)

No consensus was reached between the experts on the PRF indicators. The highest level of consensus reached 74% (*n*=30) on PRF1 (Is data completion on PRFs adequately done) followed by 57% (*n*=24) on PRF2 (Are PRFs peer-reviewed before submission to case management?). However, experts suggested an additional three indicators to be included in iteration two. The indicators are:

1. *Adequate data capturing, Type of Indicator: Process Quality Dimension: Patient-centred*
2. *Quality Assurance performed on PRF data, Type of Indicator: Outcome Quality Dimension: Efficient*
3. *Storage and availability, Type of Indicator: Outcome Quality Dimension: Effectiveness, Patient Centred*

The table below shows experts responses on PRF indicators:

Indicator Key	Agree	No Of Participants	Disagree	No Of Participants	Undecided	No Of Participants
PRF1	71.4%	30	16.7%	7	11.9%	5
PRF2	57.1%	24	30.9%	13	11.9%	5
PRF3	47.6%	20	38.1%	16	16.7%	7

Table 8: Iteration 1- Patient Report Form Indicator Responses

4.2.2.9 Safety of Staff and Patients

The three proposed indicators did not reach the required level of consensus to be included in iteration two. SSP1 (Are patients treated according to set clinical guidelines?) received the highest level of consensus between experts with a percentage of 76.2%.

Indicator Key	Agree	No Of Participants	Disagree	No Of Participants	Undecided	No Of Participants
SSP1	76.2%	32	16.7%	7	9.5%	4
SSP2	54.8%	23	38.1%	16	9.5%	4
SSP3	54.8%	23	35.7%	15	11.9%	5

Table 9: Iteration 1- Safety of Staff and Patients Indicator Responses

The experts suggested three additional indicators to be included in the next iteration with the indicators that did not reach the required 80% criteria. The indicators are:

1. *Surveys Type of Indicator: Process Quality Dimension: Safety*
2. *Access to Counselling Type of Indicator: Structure Quality Dimension: Safety, Effectiveness*
3. *Vehicles and Equipment Maintenance Type of Indicator: Structure Quality Dimension: Safety*

4.2.2.10 Incident Reporting

For the three Incident Reporting indicators, the consensus level from experts were within the 60% range. IR1`s (Are all incidences reported immediately?) consensus was 61.9% (*n*=26), with 33.3% (*n*=14) disagreeing, and 4.8% (*n*=2) being uncertain as indicated in table 9. IR2's (Are incidences reported to the designated person in charge?) consensus was 64.3% (*n*=27), 23.8% (*n*=10) disagreeing, and 14.3% (*n*=6) being uncertain. 64.3% (*n*=27) of the experts agreed on IR3 (Are incidences addressed in the appropriate manner?), 21.4% (*n*=9) disagreeing and 16.8%(*n*=7) uncertain on the indicator. The additional indicator suggested by the experts include: *Signed off Type of Indicator: Process Quality Dimension: Safety*.

Indicator Key	Agree	No Of Participants	Disagree	No Of Participants	Undecided	No Of Participants
IR1	61.9%	26	33.3%	14	4.8%	2
IR2	64.3%	27	23.8%	10	14.3%	6
IR3	64.3%	27	21.4%	9	16.8%	7

Table 10: Iteration 1- Incident Reporting Indicator Responses

4.2.2.11 Satisfaction Survey

The Satisfaction Survey indicator had two allocated indicators. As indicated in table 11 the first iteration yielded no consensus on both indicators. The response on agreement was quite low with SS1 (Are patient/family satisfaction surveys being conducted?) reaching only a level of 42.9% (*n*=18), *n*=20 (47.6%) experts disagreed, and *n*=5 (11.9%) showed uncertainty. SS2 (Are hospital satisfaction surveys being conducted on EMS handover, inter-professional engagement/interaction and management of patients done?) revealed an agreement of 35.7% (*n*=15), 50% (*n*=21) disagreed with 16.7%(*n*=7)

showing uncertainty. The experts suggested one indicator that reads: *Survey Reviews and Implementation Type of Indicator: Process Quality Dimension: Effectiveness.*

Indicator Key	Agree	No Of Participants	Disagree	No Of Participants	Undecided	No Of Participants
SS1	42.9%	18	47.6%	20	11.9%	5
SS2	35.7%	15	50.0%	21	16.7%	7

Table 11: Iteration 1- Satisfaction Survey Indicator Responses

4.2.2.12 Competence Assurance

The Competence Assurance indicator were allocated two indicators. None of the two indicators received consensus from experts and were therefore included in the second iteration. CPA1 (Do practitioners get assessed on skills not performed within six months?) received 33.3% (*n*=14) consensus, with CPA2 (Do practitioners comply with the number of required CEUs annually?) 47.6% (*n*=20) agreement respectively. One suggestion came from the experts to be included:

1. *Staff certified as BLS HCP, Type of Indicator: Structure, Quality Dimension: Equity*

Indicator Key	Agree	No Of Participants	Disagree	No Of Participants	Undecided	No Of Participants
CPA1	33.3%	14	59.5%	25	9.5%	4
CPA2	47.6%	20	42.9%	18	11.9%	5

Table 12: Iteration 1- Competence Assurance Indicator Responses

4.2.3 Clinical Indicators

4.2.3.1 Cardiac Arrest

As indicated in the table below (Table 13) one of the six indicators allocated for the Cardiac Arrest indicator reached consensus. Consensus ranged from 37.5% (*n*=15) to 70% (*n*=28). The consensus among experts were as follows: CA1 (Does the dispatcher provide telephonic-guided CPR instructions?) 37.5% (15), CA2 (Is call to scene response interval ≤5 minutes?) 45% (18), CA3 (Does the crew identify cardiac arrest and provide basic CPR with AED initiated immediately?) 70% (28), CA4 (Is ALS present on all cardiac arrest cases?) 27.5% (11), CA5 (Is timely initial defibrillation delivered to convert arrhythmia to a sinus rhythm?) 47.5% (19), CA6 (Is ROSC achieved before or at arrival at hospital?) 45% (18) respectively. Furthermore, an additional indicator was suggested by an expert for inclusion. The indicator reads:

1. *CPR Training Type of Indicator: Outcome Quality Dimension: Effectiveness*

Indicator Key	Agree	No Of Participants	Disagree	No Of Participants	Undecided	No Of Participants
CA1	37.5%	15	40.0%	16	22.5%	9
CA2	45.0%	18	37.5%	15	20.0%	8
CA3	70.0%	28	20.0%	8	10.0%	4
CA4	27.5%	11	55.0%	22	17.5%	7
CA5	47.5%	19	25.0%	10	30.0%	12
CA6	45.0%	18	27.5%	11	27.5%	11

Table 13: Iteration 1- Cardiac Arrest Indicator Responses

4.2.3.2 ST Elevation Myocardial Infarction (STEMI)

For iteration one, STEMI was allocated with four indicators. None of the experts reached consensus on these specific indicators. STEMI1 (Administration of Aspirin, Nitroglycerine, morphine, oxygen as per protocol) and STEMI2 (12 Lead ECG before and after treatment) had 75% (n=30) consensus, with both STEMI2 and STEMI3 (Rapid transport to a PCI capable facility) on 57.5% (n=23) consensus.

Only one additional indicator was suggested: *Thrombolizing as per protocol, Type of Indicator: Process, Quality Dimension: Timeliness*

The responses for experts are outlined in the table below:

Indicator Key	Agree	No Of Participants	Disagree	No Of Participants	Undecided	No Of Participants
STEMI1	75.0%	30	15.0%	6	10.0%	4
STEMI2	57.5%	23	17.5%	7	25.0%	10
STEMI3	57.5%	23	30.0%	12	12.5%	5
STEMI4	75.0%	30	12.5%	5	15.0%	6

Table 14: Iteration 1- ST Elevation Myocardial Infarction Indicator Responses

4.2.3.3 Stroke/TIA

Table 15 shows that two of the three indicators received consensus from experts. STIA2 (Recording of blood sugar levels) and STIA3 (Recording of blood pressure) had 87.5% (*n*=35), and 92.5% (n=37) respectively. For STIA1 (Recording of FAST test) only 70% (*n*=28) participants agreed, with 17.5% (*n*=7) disagreeing and 15% (*n*=6) undecided. The experts suggested only one additional indicator: *Are crews adhering to the Angles policy, Type of Indicator: Process, Patient Centred*

Indicator Key	Agree	No Of Participants	Disagree	No Of Participants	Undecided	No Of Participants
STIA1	70.0%	28	17.5%	7	15.0%	6
STIA2	87.5%	35	10.0%	4	2.5%	1
STIA3	92.5%	37	5.0%	2	2.5%	1

Table 15: Iteration 1- Stroke/TIA Indicator Responses

4.2.3.4 Trauma Care

Trauma Care was allocated with four indicators as indicated in table 16 below. Overall, three of the indicators reached consensus among the experts. TC1 (Recording of vitals, BP, Respiratory rate, SpO2, pupil reaction and GCS), TC2 (Rapid transportation to appropriate facility), and TC4 (Stopping of severe external bleeding) reached consensus of 97.5% (n=39), 85.0% (n=34), and 90.0% (n=36) respectively. TC3 (Entrapment time <10 minutes) did not have consensus from the experts and had to be reintroduced to iteration two with newly suggested indicators. Three indicators were suggested:

1. *Pain Management Type of Indicator: Outcome Quality Dimension: Effectiveness*
2. *Blood Pressure Management, Type of Indicator: Outcome Quality Dimension: Effectiveness*
3. *Maintaining Cerebral perfusion and MAP, Type of Indicator: Outcome Quality Dimension: Effectiveness*

Indicator Key	Agree	No Of Participants	Disagree	No Of Participants	Undecided	No Of Participants
TC1	97.5%	39	2.5%	1	0.0%	0
TC2	85.0%	34	10.0%	4	5.0%	2
TC3	32.5%	13	40.0%	16	27.5%	11
TC4	90.0%	36	7.5%	3	2.5%	1

Table 16: Iteration 1- Trauma Care Indicator Responses

4.2.3.5 Seizures

Both of the Seizure indicators reached consensus from the experts. SZ1 (Administration of benzodiazepine for active convulsions) however, had a 10% (*n*=4) disagreement with *n*=4 undecided. *n*=3 candidates disagreed with SZ2 (Measurement of blood sugar level), with *n*=1 undecided. Most experts agreed with SZ1 (*n*=32) and SZ2 (*n*=36).

Additionally, one indicator was suggested: *Temperature Measurement, Type of Indicator: Process Quality Dimension: Patient centred.*

Indicator Key	Agree	No Of Participants	Disagree	No Of Participants	Undecided	No Of Participants
SZ1	80.0%	32	10.0%	4	10.0%	4
SZ2	90.0%	36	7.5%	3	2.5%	1

Table 17: Iteration 1- Seizure Indicator Responses

4.2.3.6 Asthma

Table 18 shows that Asthma had been allocated with three indicators. Of the three indicators, two reached consensuses among experts. Both AS1 (Agonist and oxygen administration) and AS2 (Recording of respiratory rate, blood sugar levels and SpO2) received 87.5% (*n*=35) agreement. AS3 (Recording of PEFR) reached only 40% (*n*=16), with 30% (*n*=12) participants in disagreement and *n*=13

unable to decide. No additional indicators were suggested by the experts. AS3 was recirculated in iteration two.

Indicator Key	Agree	No Of Participants	Disagree	No Of Participants	Undecided	No Of Participants
AS1	87.5%	35	10.0%	4	2.5%	1
AS2	87.5%	35	10.0%	4	2.5%	1
AS3	40.0%	16	30.0%	12	32.5%	13

Table 18: Iteration 1- Asthma Indicator Responses

4.2.3.7 Pulmonary Oedema

There was only one indicator allocated for Pulmonary Oedema. This indicator did not reach the requirement for consensus and was therefore reintroduced in iteration two. Table 19 outlines the responses received. No new indicators were suggested.

Indicator Key	Agree	No Of Participants	Disagree	No Of Participants	Undecided	No Of Participants
PE1	55.0%	22	15.0%	6	30.0%	12

Table 19: Iteration 1- Pulmonary Oedema Indicator Responses

4.2.3.8 Medical Airway

The Medical Airway had three indicators allocated to it. None of the three indicators reached the consensus criteria. MA1 (Are ETT placement confirmation techniques documented?) only had 65% (*n*=26) agreements, with 12.5% (*n*=5) disagreements and 25% (*n*=10) unable to decide. Both MA2 (Are misplaced or dislodged ETT identified immediately by the practitioner?) and MA3 (Do practitioners comply with intubation guidelines?) had 60% (*n*=24) agreements, however, *n*=4 disagreed and *n*=12 undecideds in MA2; *n*=5 disagreements with *n*=11 undecided in MA3.

Indicator Key	Agree	No Of Participants	Disagree	No Of Participants	Undecided	No Of Participants
MA1	65.0%	26	12.5%	5	25.0%	10
MA2	60.0%	24	10.0%	4	30.0%	12
MA3	60.0%	24	12.5%	5	27.5%	11

Table 20: Iteration 1- Medical Airway Indicator Responses

4.2.3.9 Prehospital IV Insertion

The Prehospital IV Insertion indicator reached consensus from the experts with an 82.5% (*n*=33) agreement. *n*=3 Participants disagreed and *n*=4 undecided. No new indicators were suggested.

Indicator Key	Agree	No Of Participants	Disagree	No Of Participants	Undecided	No Of Participants
IV1	82.5%	33	7.5%	3	10.0%	4

Table 21: Iteration 1- Prehospital IV Insertion Indicator Responses

4.2.3.10 Termination of Resuscitation

Termination of Resuscitation only had one indicator (Do practitioners seek additional consultation before termination of resuscitation efforts?) allocated with no consensus reached from the experts. The table indicates that only 65% (*n*=26) of participants agreed that the indicator can be used to measure quality delivery in Namibia. 27.5% (*n*=11) disagreed with *n*=4 unable to decide. Only one comment was received however, it did not address the indicator and no new suggestions were made.

Indicator Key	Agree	No Of Participants	Disagree	No Of Participants	Undecided	No Of Participants
TOR1	65.0%	26	27.5%	11	7.5%	3

Table 22: Iteration 1- Termination of Resuscitation Indicator Responses

Overall, 13 of the 67 introduced indicators received consensus from the experts in iteration one. The remaining indicators that experts disagreed on and were unable to decide on, were recirculated in iteration two to seek further consensus among the experts.

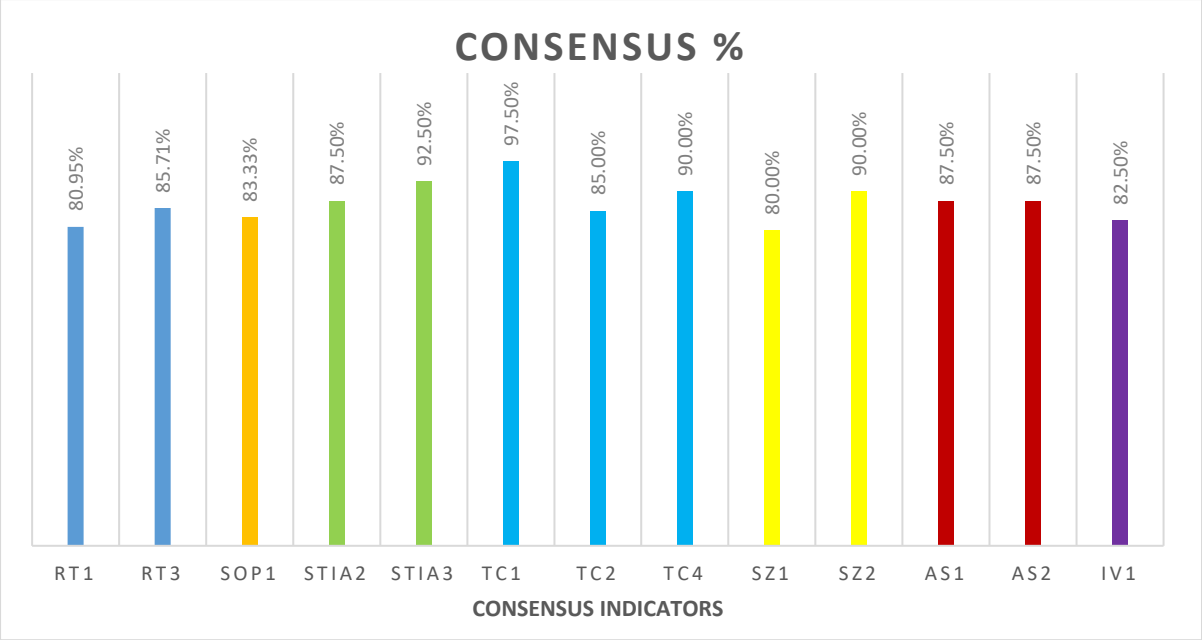
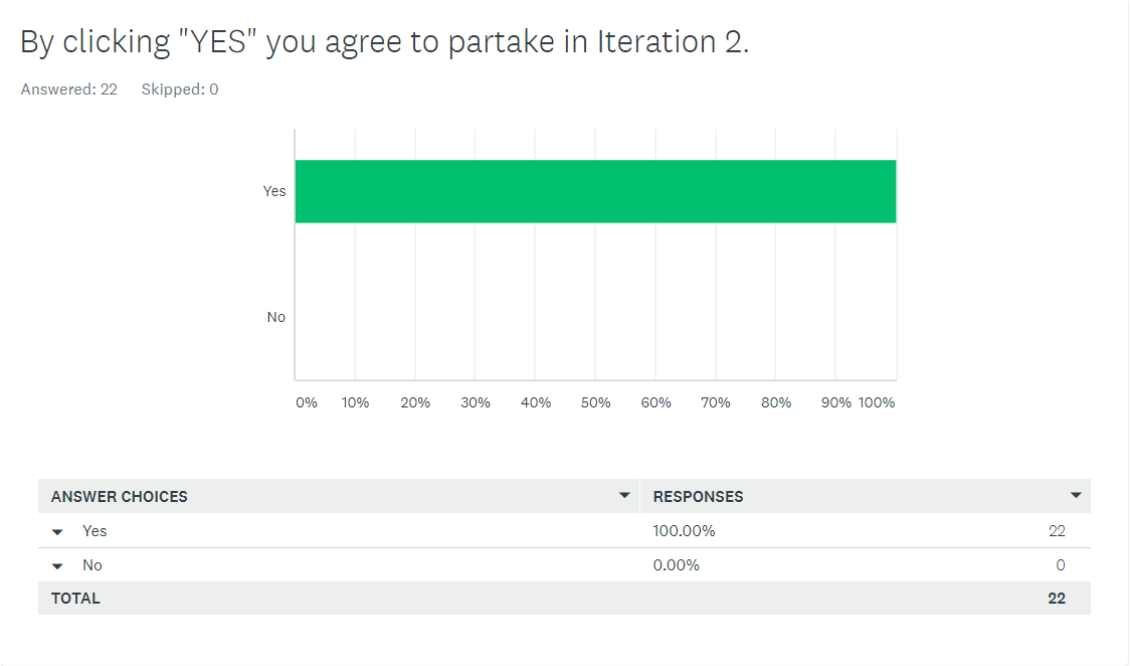


Figure 8: Iteration 1 Consensus Indicators

4.3 Iteration Two

The indicators that did not reach consensus between the experts in iteration one was restructured and recirculated in iteration two. Additionally, the suggested indicators from experts in iteration one with the type of indicator and quality dimension was added to each specific indicator. Experts were again asked to rate whether the indicators can be included in a quality assurance system to measure quality service delivery. In this iteration 22 participants agreed to continue with the survey however,

six skipped the questions with only 16 completing the survey. The figure below shows the agreement of participants.



ANSWER CHOICES	RESPONSES	
Yes	100.00%	22
No	0.00%	0
TOTAL		22

Figure 9: Participants consent for iteration 2 participation

4.3.1 Iteration Two Non-Clinical Indicators

4.3.1.1 Response Time

For iteration two the Response Time indicator had nine indicators. RT8 (Crew response skills) reached consensus between experts (*n*=13) with three disagreeing. The majority of participants showed agreement on the indicators. RT4 (Response times recorded correctly?), RT6 (Are resources allocated in the correct region/area for quick responses?) and RT11 (Correct information relayed?) having 75% (*n*=12), followed by RT5 (Did the crew encounter any dangerous situation during response?), RT9 (Time to definitive management) on 68.8% (*n*=11). The experts did not suggest any new indicators.

Indicator Key	Agree	No Of Participants	Disagree	No Of Participants	Undecided	No Of Participants
RT2	56.3%	9	18.8%	3	25.0%	4
RT4	75.0%	12	12.5%	2	12.5%	2
RT5	68.8%	11	12.5%	2	18.8%	3
RT6	75.0%	12	12.5%	2	12.5%	2
RT7	62.5%	10	37.5%	6	0.0%	0
RT8	81.3%	13	18.8%	3	0.0%	0
RT9	68.8%	11	18.8%	3	12.5%	2
RT10	68.8%	11	12.5%	2	18.8%	3
RT11	75.0%	12	12.5%	2	12.5%	2

Table 23: Iteration 2- Response Time Indicator Responses

4.3.1.2 On-Scene Time

Only one indicator achieved the consensus criteria. *n*=15 participants agreed on OS5 (crew competence on scene) indicator with one agreeing and one remaining undecided. OS1 (what is the time interval from arrival at patient until transport is initiated?) and OS2 (did the patient receive the required level of care?) each achieved 68.8% (*n*=11) consensus and *n*=10 (62.5%) participants agreeing with OS3 (available ambulances) and OS4 (triage time by ECP) respectively. No new suggestions for indicators were received.

Indicator Key	Agree	No Of Participants	Disagree	No Of Participants	Undecided	No Of Participants
OS1	68.8%	11	12.5%	2	18.8%	3
OS2	68.8%	11	18.8%	3	12.5%	2
OS3	62.5%	10	31.3%	5	6.3%	1
OS4	62.5%	10	12.5%	2	25.0%	4
OS5	87.5%	14	6.3%	1	6.3%	1

Table 24: Iteration 2- On-scene Time Indicator Responses

4.3.1.3 Dispatch Centre

Table 25 outlines the consensus ratings for the Dispatch Centre indicators. Two out of the eight indicators achieved consensus from the experts, these include both DC2 (Are staff appropriately qualified?) and DC7 (Correct resources dispatched?) on 81.3% (*n*=13). An additional indicator was suggested to be included: *Provide effective feedback & collaborate with the agent to develop an action plan? Type of indicator: Structure. Quality Dimension: Effectiveness*. This indicator will be identified as DC9 in iteration three.

Indicator Key	Agree	No Of Participants	Disagree	No Of Participants	Undecided	No Of Participants
DC1	62.5%	10	31.3%	5	6.3%	1
DC2	81.3%	13	12.5%	2	6.3%	1
DC3	56.3%	9	31.3%	5	12.5%	2
DC4	62.5%	10	18.8%	3	18.8%	3
DC5	62.5%	10	25.0%	4	12.5%	2
DC6	62.5%	10	18.8%	3	18.8%	3
DC7	81.3%	13	18.8%	3	0.0%	0
DC8	68.8%	11	31.3%	5	0.0%	0

Table 25: Iteration 2- Dispatch Centre Indicator Responses

4.3.1.4 Equipment

None of the indicators for Equipment achieved consensus from the experts. The highest achieved between *n*=11 of the participants for EQ1 (Do ambulances and response vehicles have the required equipment at all times?) was 68.8%. EQ3 (Are equipment inventory records available?), EQ4 (Are

breakages and faults reported on the inventory and to the relevant supervisor/manager?) and EQ5 (Equipment lifespan) all had 62.5% consensus among the experts (*n*=10). The lowest consensus percentage was that of EQ2 (Is equipment in a properly functioning condition, serviced and calibration maintained?) on 43.8% (*n*=7). There were no new indicators for suggested by the experts.

Indicator Key	Agree	No Of Participants	Disagree	No Of Participants	Undecided	No Of Participants
EQ1	68.8%	11	25.0%	4	6.3%	1
EQ2	43.8%	7	37.5%	6	18.8%	3
EQ3	62.5%	10	31.3%	5	6.3%	1
EQ4	62.5%	10	25.0%	4	12.5%	2
EQ5	62.5%	10	18.8%	3	18.8%	3

Table 26: Iteration 2- Equipment Indicator Responses

4.3.1.5 Staff Compliment

In this iteration only one indicator for Staff Compliment achieved consensus. 81.3% (*n*=13) of the experts agreed with SC3 (Are staff qualified?), and *n*=3 (25%) disagreeing. Two of the indicators, SC1 (Does the emergency service have enough staff to run operations smoothly?) and SC5 (Back up staff for mass casualty incidences), both achieved 56.3% consensus, SC2 (Does the emergency service have a balance staff compliment of BLS, ILS, ECT & ALS?) almost reaching the consensus criteria with 75%, and SC4 (CPS compliance) falling short with 37.5%. This indicator did not receive any new suggestions.

Indicator Key	Agree	No Of Participants	Disagree	No Of Participants	Undecided	No Of Participants
SC1	56.3%	9	25.0%	4	18.8%	3
SC2	75.0%	12	12.5%	2	12.5%	2
SC3	81.3%	13	18.8%	3	0.0%	0
SC4	37.5%	6	25.0%	4	37.5%	6
SC5	56.3%	9	25.0%	4	18.8%	3

Table 27: Iteration 2 Staff Compliment Indicator Responses

4.3.1.6 Staff Training

Indicators for Staff Training did not achieve the consensus criteria. The highest percentage of consensus was ST4 (Does the service have a mentorship programme?) on 75%, followed by ST1 (Are staff members appropriately trained and skilled?) and ST5 (Debriefing sessions) with 68.3% (*n*=11) of participants, and ST2 (Does the emergency service provide continuing development programmes for staff?) and ST3 (Are case reviews and debriefing sessions conducted on difficult cases?) on 56.3% (*n*=9). No new indicators were suggested.

Indicator Key	Agree	No Of Participants	Disagree	No Of Participants	Undecided	No Of Participants
ST1	68.8%	11	25.0%	4	6.3%	1
ST2	56.3%	9	37.5%	6	6.3%	1
ST3	56.3%	9	37.5%	6	6.3%	1
ST4	75.0%	12	12.5%	2	12.5%	2
ST5	68.8%	11	25.0%	4	6.3%	1

Table 28: Iteration 2- Staff Training Indicator Responses

4.3.1.7 Standard Operating Procedures

The SOP2 (Are SOPs adequately executed?) indicator achieved consensus from *n*=13 (81.3%) of the experts. SOP3 (Signed off by staff?) did not achieve the consensus criteria with only 68.8% (*n*=11). *n*=3 (18.8%) of the experts disagreed with *n*=2 unable to decide. No new suggestions were received from any of the experts.

Indicator Key	Agree	No Of Participants	Disagree	No Of Participants	Undecided	No Of Participants
SOP2	81.3%	13	12.5%	2	6.3%	1
SOP3	68.8%	11	18.8%	3	12.5%	2

Table 29: Iteration 2- Standard Operating Procedures Indicator Responses

4.3.1.8 Patient Report Forms

None of the PRF indicators achieved consensus from the experts. PRF2 (Are PRFs peer-reviewed before submission to case management unit?), PRF4 (Adequate data capturing) and PRF5 (QA performed on PRFs) received 68.8% consensus with *n*=3 experts disagreeing and *n*=2 undecided. None of the experts suggested any new indicators.

Indicator Key	Agree	No Of Participants	Disagree	No Of Participants	Undecided	No Of Participants
PRF1	75.0%	12	12.5%	2	12.5%	2
PRF2	68.8%	11	18.8%	3	12.5%	2
PRF3	56.3%	9	31.3%	5	12.5%	2
PRF4	68.3%	11	18.8%	3	12.5%	2
PRF5	68.3%	11	18.8%	3	12.5%	2
PRF6	62.5%	10	25.0%	4	12.5%	2

Table 30: Iteration 2 Patient Report Forms Indicator Responses

4.3.1.9 Safety of Staff and Patients

Safety of Staff and Patients also did not achieve consensus on any of the indicators. The highest achieved consensus percentage was SSP6 (Vehicles and Equipment maintenance) with a consensus percentage of 68.8%, making up *n*=11 of the experts. However, two new suggestions were received

that will be identified as SSP7 (Implementation of health and wellness programme) and SSP8 (Effective provision policy) in iteration three respectively:

1. *Implement and manage Health promotion and Wellness programmes. Type of Indicator: Structure. Quality Dimension: Safety*
2. *Develop policy for effective service provision in private and public EMRS. Type of indictor: Process indicator. Quality Dimension: Safety, Effectiveness*

Indicator Key	Agree	No Of Participants	Disagree	No Of Participants	Undecided	No Of Participants
SSP1	56.3%	9	31.3%	5	12.5%	2
SSP2	62.5%	10	25.0%	4	12.5%	2
SSP3	62.5%	10	25.0%	4	12.5%	2
SSP4	50.0%	8	25.0%	4	25.0%	4
SSP5	62.5%	10	31.3%	5	6.3%	1
SSP6	68.8%	11	25.0%	4	6.3%	1

Table 31: Iteration 2- Safety of Staff and Patients Indicator Responses

4.3.1.10 Incident Reporting

For the Incident Reporting indicators, none achieved consensus from the experts. *n*=12 of the experts agreed on indicator IR1 (Are all incidences reported immediately?) and IR2 (Are incidences reported to the designated person in charge?) with a 75% consensus, *n*=2 disagreed and were undecided for the same indicators. IR3 (Are incidences addressed in the appropriate manner?) only received 68.8% (*n*=11) consensus and IR4 (IR signed off?) 65.5% (*n*=10). No new indicators were suggested.

Indicator Key	Agree	No Of Participants	Disagree	No Of Participants	Undecided	No Of Participants
IR1	75.0%	12	12.5%	2	12.5%	2
IR2	75.0%	12	12.5%	2	12.5%	2
IR3	68.8%	11	25.0%	4	6.3%	1
IR4	65.5%	10	18.8%	3	18.8%	3

Table 32: Iteration 2- Incident Reporting Indicator Responses

4.3.1.11 Satisfaction Survey

The Satisfaction Survey indicators received quite low consensus from the experts. SS1 (Are patient/family satisfaction surveys being conducted?) and SS2 (Are hospital satisfaction surveys conducted on EMS handover, inter-professional engagements/interaction and management of patients done?) only received 56.3%, with SS3 (Surveys reviewed and implemented?) having the

lowest consensus percentage of 43.8%. Disagreement stood at 25% for SS1 and SS2, and on 31.3% for SS3. The experts did not propose any new indicators.

Indicator Key	Agree	No Of Participants	Disagree	No Of Participants	Undecided	No Of Participants
SS1	56.3%	9	25.0%	4	18.8%	3
SS2	56.3%	9	25.0%	4	18.8%	3
SS3	43.8%	7	31.3%	5	25.0%	4

Table 33: Iteration 2- Satisfaction Survey Indicator Responses

4.3.1.12 Competence Assurance

The experts reached consensus on indicator CPA2 (Do practitioners comply with number of required CEUs annually?) with a percentage of 87.5%, making up *n*=14 of total experts. CPA1 (Do practitioners get assessed on skills not performed within six months?) stood on 50% (*n*=8) and CPA3 (Staff certified with BLS for HCP?) on 75% (*n*=12). No new indicators were proposed by the experts.

Indicator Key	Agree	No Of Participants	Disagree	No Of Participants	Undecided	No Of Participants
CPA1	50.0%	8	31.3%	5	25.0%	4
CPA2	87.5%	14	12.5%	2	0.0%	0
CPA3	75.0%	12	12.5%	2	12.5%	2

Table 34: Iteration 2- Competence Assurance Indicator Responses

4.3.2 Iteration Two Clinical Indicators

4.3.2.1 Cardiac Arrest

Two of the Cardiac Arrest indicators reached consensus from the experts. CA5 (Is timely initial defibrillation delivered to convert arrhythmia to a sinus rhythm?) and CA7 (CPR training) both achieved 81.3%. This is *n*=13 of the 16 participants. The rest of the indicators did not achieve the consensus criteria. CA2 (Is call to scene time ≤5 minutes?), CA3 (Does the crew identify cardiac arrest and basic CPR with AED initiated?) and CA4 (Is ALS present on all cardiac arrest cases?) all reached 68.8% being *n*=11 experts. CA1 (Does the dispatcher provide telephonic-guided CPR instructions?) and CA6 (Is ROSC achieved before or at arrival of hospital?) both reached 65.3%. No new suggestions for indicators were received from the experts.

Indicator Key	Agree	No Of Participants	Disagree	No Of Participants	Undecided	No Of Participants
CA1	56.3%	9	12.5%	2	31.3%	5
CA2	68.8%	11	12.5%	2	18.8%	3
CA3	68.8%	11	12.5%	2	18.8%	3
CA4	68.8%	11	6.3%	1	25.0%	4
CA5	81.3%	13	6.3%	1	12.5%	2
CA6	56.3%	9	12.5%	2	31.3%	5
CA7	81.3%	13	12.5%	2	6.3%	1

Table 35: Iteration 2- Cardiac Arrest Indicator Responses

4.3.2.2 ST Elevation Myocardial Infarction

n=13 (81.3%) of the 16 experts agreed on STEMI1 (Administration of aspirin, nitroglycerine, morphine, oxygen as per protocol) and STEMI4 (Recording of pain score before and after treatment) indicators. The rest of the indicators did not achieve the consensus criteria. STEMI5 (Thrombolizing as per protocol) had the lowest consensus with 50%. These indicators will be reintroduced to the experts in iteration three to assess whether they can achieve the consensus criteria. The experts further did not propose any new indicators to be included.

Indicator Key	Agree	No Of Participants	Disagree	No Of Participants	Undecided	No Of Participants
STEMI1	81.3%	13	0.0%	0	18.8%	3
STEMI2	68.8%	11	18.8%	3	12.5%	2
STEMI3	62.5%	10	25.0%	4	12.5%	2
STEMI4	81.3%	13	6.3%	1	12.5%	2
STEMI5	50.0%	8	18.8%	3	31.3%	5

Table 36: Iteration 2- ST Elevation Myocardial Infarction Indicator Responses

4.3.2.3 Stroke/TIA

The Stroke/TIA indicator STIA1 (Recording of FAST test) achieved consensus from *n*=13 of the experts. The STIA4 (Adherence to Angles policy) indicator however did not achieved consensus and will be circulated in iteration three. The experts also did not propose any new indicators.

Indicator Key	Agree	No Of Participants	Disagree	No Of Participants	Undecided	No Of Participants
STIA1	81.3%	13	12.5%	2	6.3%	1
STIA4	68.8%	11	12.5%	2	18.8%	3

Table 37: Iteration 2 Stroke/TIA Indicator Responses

4.3.2.4 Trauma Care

The Trauma Care indicators did not achieve consensus from the experts and no new suggestions for indicator were made. The highest achieved consensus percentage for indicators are: TC5 (Pain

management outcome) and TC7 (Maintaining cerebral perfusion and MAP) with both 68.8%, followed by TC6 (Blood pressure management) on 62.5% and then TC3 (Entrapment time of <10minutes) with the lowest at 37.5%. No new indicators were suggested. However, suggestion was made to change indicator TC6 wording from Blood Pressure Management to Hypovolaemia Management in iteration three.

Indicator Key	Agree	No Of Participants	Disagree	No Of Participants	Undecided	No Of Participants
TC3	37.5%	6	31.3%	5	31.3%	5
TC5	68.8%	11	18.8%	3	12.5%	2
TC6	62.5%	10	18.8%	3	18.8%	3
TC7	68.8%	11	6.3%	1	25.0%	4

Table 38: Iteration 2 Trauma Care Indicator Responses

4.3.2.5 Seizures

The Seizures indicator did not achieve consensus from the experts. As indicated in Table 39 the indicator SZ3 (Temperature measurement) only reached 68.8%, which is *n*=11 of the 16 participants. *N*=4 of the participants disagreed with the indicator and *n*=1 was unable to decide. No new indicator was proposed.

Indicator Key	Agree	No Of Participants	Disagree	No Of Participants	Undecided	No Of Participants
SZ3	68.8%	11	25.0%	4	6.3%	1

Table 39: Iteration 2- Seizures Indicator Responses

4.3.2.6 Asthma

AS3 (Recording of PEFR) only reached 62.5% (*n*=10) consensus from the 16 participants. *N*=3 of the experts disagreed and *n*=3 was unable to decide. The experts also did not propose any new indicators.

Indicator Key	Agree	No Of Participants	Disagree	No Of Participants	Undecided	No Of Participants
AS3	62.5%	10	18.8%	3	18.8%	3

Table 40: Iteration 2- Asthma Indicator Responses

4.3.2.7 Pulmonary Oedema

The PE1 (Administration on non-invasive positive pressure ventilation) indicator did not achieve the consensus criteria to be included in iteration three. Only 68.8% (*n*=11) were achieved, with 12.5% (*n*=2) disagreement and 18.8% (*n*=3) undecided. No new indicator was proposed.

Indicator Key	Agree	No Of Participants	Disagree	No Of Participants	Undecided	No Of Participants
PE1	68.8%	11	12.5%	2	18.8%	3

Table 41: Iteration 2 Pulmonary Oedema Indicator Responses

4.3.2.8 Medical Airway

For the Medical Airway indicators, MA1 (Are ETT placement confirmation techniques documented?), MA2 (Are misplaced or dislodged ETT identified immediately by the practitioner?) and MA3 (Do practitioners comply with intubation guidelines?), consensus was only at 68.8%. Of the 16 participants only *n*=11 reached agreement, for MA1 *n*=3 (18.8%) disagreed and *n*=2 undecided. MA2 and MA3 disagreement stood at 12.5% (*n*=2) and undecided on 18.8% (*n*=3). The experts did not propose any new indicators.

Indicator Key	Agree	No Of Participants	Disagree	No Of Participants	Undecided	No Of Participants
MA1	68.8%	11	18.8%	3	12.5%	2
MA2	68.8%	11	12.5%	2	18.8%	3
MA3	68.8%	11	12.5%	2	18.8%	3

Table 42: Iteration 2 Medical Airway Indicator Responses

4.3.2.9 Termination of Resuscitation

The consensus level for the Termination of Resuscitation indicator, TOR1 (Do practitioner seek additional consultation before termination of resuscitation efforts?), scored a low level of consensus from the experts. Only *n*=7 (43.8%) out of the 16 participants agreed, with *n*=5 (31.3) disagreeing and *n*=4 (25%) undecided. The experts did not propose any new indicators to be included in the next iteration.

Indicator Key	Agree	No Of Participants	Disagree	No Of Participants	Undecided	No Of Participants
TOR1	43.8%	7	31.3%	5	25.0%	4

Table 43: Iteration 2 Termination of Resuscitation Indicator Responses

As shown in Figure 10 a total of *n*=12 indicators (seven non-clinical & five clinical) achieved consensus in iteration two. These indicators will be added to the list of indicators that achieved the consensus criteria in iteration one to be included in the pilot study for a QA system. The indicators that did not reach the consensus criteria will however be reintroduced for a final round in iteration three.

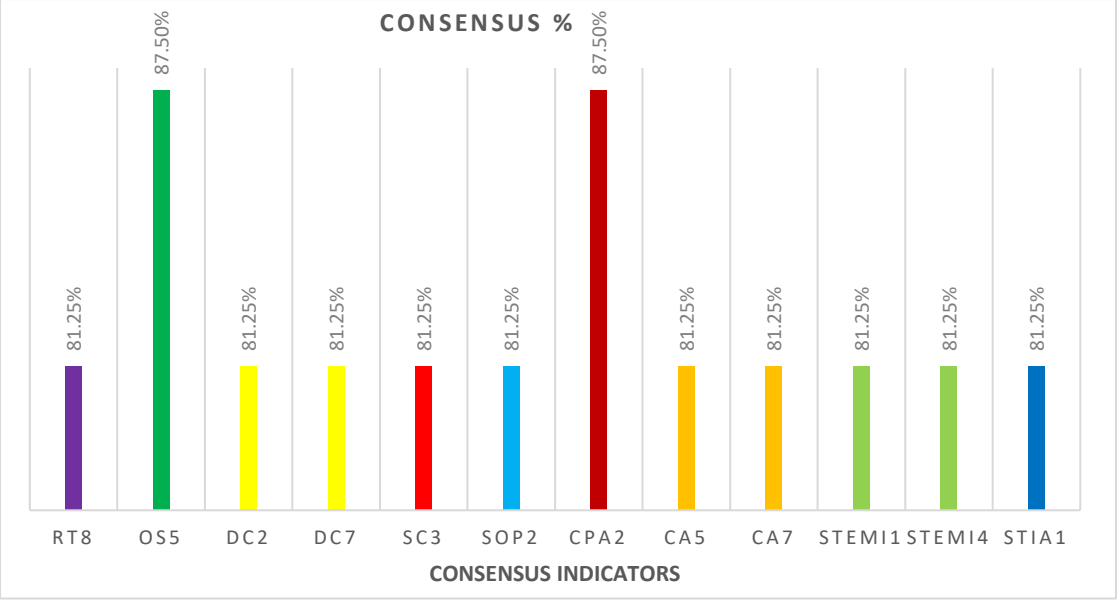
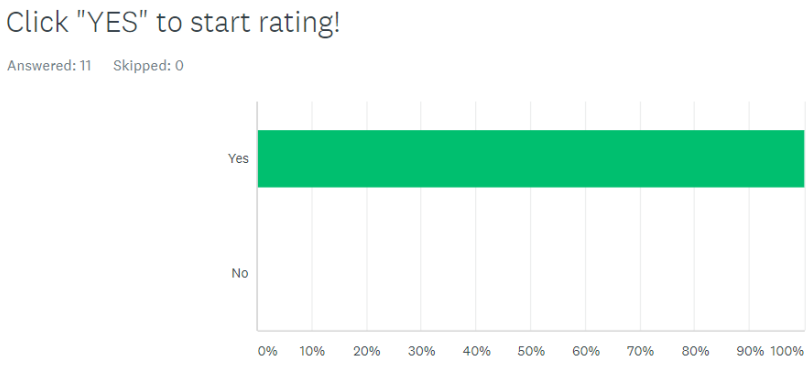


Figure 10: Iteration 2 Consensus Indicators

4.4 Iteration Three

As with iterations one and two, participants of iteration three were again asked to rate the indicators for inclusion in QA system to for the Namibian EMS service delivery. The indicators included in this iteration were those that did not achieve the consensus criteria in iteration two and those proposed by the experts to be included. The consensus criteria for this iteration still remains at 80%. Iteration three is the final round of the survey. Indicators that did not reach the consensus criteria will be excluded from the study and only those with ≥80% consensus will be used in the pilot study. As shown in Figure 11, only 11 experts agreed to participate in iteration three.



ANSWER CHOICES	RESPONSES	
Yes	100.00%	11
No	0.00%	0
TOTAL		11

Figure 11: Participants consent for iteration 3 participation

4.4.1 Iteration Three Non-Clinical Indicators

4.4.1.1 Response Time

In this iteration, three of the Response Time indicators achieved consensus. They are: RT2 (What is the time interval from when the call is received until the first unit arrives at the patient?) with 90.9% (*n*=10), RT5 (Did the crew encounter any dangerous situation during response?) at 81.9% (*n*=9), and RT10 (Call received to dispatch) with 90.9% (*n*=10). The RT2 (What is the time interval from when the call is received until the first unit arrives at the patient?) indicator did not have any disagreement from the experts however, *n*=1 expert was unable to decided. For RT5, *n*=1 expert was in disagreement and *n*=1 undecided. For the rest of the indicators [RT6 (Are resources allocated in the correct region/area for quick responses?), RT7 (Response Distance Radius), RT9 (Time to definitive management) and RT11 (Correct information relayed to crew)] the consensus level was at 63.6%, and for RT4 (Are response times recorded correctly?) a consensus level of 72.7% was achieved.

Indicator Key	Agree	No Of Participants	Disagree	No Of Participants	Undecided	No Of Participants
RT2	90.9%	10	0.0%	0	9.1%	1
RT4	72.7%	8	18.2%	2	9.1%	1
RT5	81.8%	9	9.1%	1	9.1%	1
RT6	63.6%	7	36.4%	4	0.0%	0
RT7	63.6%	7	18.2%	2	18.2%	2
RT9	63.6%	7	18.2%	2	18.2%	2
RT10	90.9%	10	9.1%	1	0.0%	0
RT11	63.6%	7	36.4%	4	0.0%	0

Table 44: Iteration 3- Response Time Indicator Responses

4.4.1.2 On-Scene Time

The On-scene Time indicator had four indicators with only one (OS2 - Did the patient receive the required level of care?) achieving consensus of 81.8%. (*n*=9). Indicators OS1 (What is the time interval from arrival at the patient until transport is initiated?), OS3 (Available ambulances) and OS4 (Triage time by ECP) consensus levels were at 54.6%, 63.6% and 72.7% respectively, not reaching the consensus criteria. For all four indicators *n*=2 experts disagreed with the statements. For OS1 *n*=3 experts were undecided, OS3 *n*=2 and OS4 *n*=1.

Indicator Key	Agree	No Of Participants	Disagree	No Of Participants	Undecided	No Of Participants
OS1	54.6%	6	18.2%	2	27.3%	3
OS2	81.8%	9	18.2%	2	0.0%	0
OS3	63.6%	7	18.2%	2	18.2%	2
OS4	72.7%	8	18.2%	2	9.1%	1

Table 45: Iteration 3 On-Scene Time Indicator Responses

4.4.1.3 Dispatch Time

Out of seven indicators, only one achieved the consensus criteria. *n*=9 (81.8%) experts coincided on DC1 (Appropriately staffed per shift), and *n*=2 (18.2%) disagreed. For indicators DC3 (Does the dispatcher get adequate information for responding units?), DC4 (Does the dispatcher provide online medical assistance and feedback?) and DC8 (Quality training offered to staff) *n*=7 experts coincided with a percentage of 63.6%. For DC5 (Does the dispatch centre have dispatch criteria for different resources?), DC6 (Does the supervisor/manager provide assistance and oversight in mass casualty incidences?) and DC9 (Provide effective feedback & collaborate with the agent to develop an action plan) *n*=7 experts agreed.

Indicator Key	Agree	No Of Participants	Disagree	No Of Participants	Undecided	No Of Participants
DC1	81.8%	9	18.2%	2	0.0%	0
DC3	63.6%	7	27.3%	3	9.1%	1
DC4	63.6%	7	36.4%	4	0.0%	0
DC5	72.7%	8	9.1%	1	18.2%	2
DC6	72.7%	8	18.2%	2	9.1%	1
DC8	63.6%	7	27.3%	3	9.1%	1
DC9	72.7%	8	18.2%	2	9.1%	1

Table 46: Iteration 3- Dispatch Time Indicator Responses

4.4.1.4 Equipment

In this iteration none of the Equipment indicators achieved consensus from the experts. Consensus levels ranged from 54.6% (*n*=6) for both EQ1 (Do the ambulances and response vehicles have the required equipment at all times?) and EQ3 (Are equipment inventory records available?), 63.6% (*n*=7) for both EQ2 (Is equipment in a properly functioning condition, serviced and calibration maintained?) and EQ5 (Equipment Lifespan), and 72.7% (*n*=8) for EQ4 (Are breakages and faults reported on the inventory and to the relevant supervisor/manager?). These indicators will therefore not be included in the QA system.

Indicator Key	Agree	No Of Participants	Disagree	No Of Participants	Undecided	No Of Participants
EQ1	54.6%	6	36.4%	4	9.1%	1
EQ2	63.6%	7	27.3%	3	9.1%	1
EQ3	54.6%	6	27.3%	3	18.2%	2
EQ4	72.7%	8	27.3%	3	0.0%	0
EQ5	63.6%	7	36.4%	4	0.0%	0

Table 47: Iteration 3- Equipment Indicator Responses

4.4.1.5 Staff Compliment

The Staff Compliment indicator responses did not achieve the required consensus level. SC4 (Continuous Professional Development Compliance) and SC5 (Back-up staff for Mass Casualty Incidence) reached 72.7% (*n*=8) consensus, with *n*=2 (18.2%) disagreement and *n*=1 undecided. SC1 (Does the emergency service have enough staff to run operations smoothly?) reached 63.6% (*n*=7), with *n*=3 disagreement and *n*=1 undecided. SC2 (Does the emergency service have a balanced staff compliment of BLS, ILS, ECT & ALS?) had the lowest level of consensus at 54.6% (*n*=6), *n*=4 experts disagreed and *n*=1 undecided. None will be used in the pilot study.

Indicator Key	Agree	No Of Participants	Disagree	No Of Participants	Undecided	No Of Participants
SC1	63.6%	7	27.3%	3	9.1%	1
SC2	54.6%	6	36.4%	4	9.1%	1
SC4	72.7%	8	18.2%	2	9.1%	1
SC5	72.7%	8	18.2%	2	9.1%	1

Table 48: Iteration 3- Staff Compliment Indicator Responses

4.4.1.6 Staff Training

ST1 (Are staff members appropriately trained and skilled competent?) reached a consensus percentage of 81.8%. This is *n*=9 out of the 11 experts. Furthermore, none of the other indicators (ST2 (Does the emergency service provide continuing development programmes for staff?), ST3 (Are case reviews and debriefing sessions conducted on difficult cases?), ST4 (Does the service have a mentorship programme for newly qualified staff?) and ST5 (Debriefing Session) achieved the consensus criteria. The consensus levels ranged from 54.6% to 72.7% respectively.

Indicator Key	Agree	No Of Participants	Disagree	No Of Participants	Undecided	No Of Participants
ST1	81.8%	9	9.1%	1	9.1%	1
ST2	54.6%	6	45.5%	5	0.0%	0
ST3	54.6%	6	27.3%	3	18.2%	2
ST5	72.7%	8	18.2%	2	9.1%	1
ST4	63.6%	7	36.4%	4	0.0%	0

Table 49: Iteration 3- Staff Training Indicator Responses

4.4.1.7 Standard Operating Procedures

Only *n*=7 experts agreed on SOP3 (Signed off by staff) with a consensus percentage of 63.6%. *n*=2 (18.2%) disagreed and *n*=2 (18.2%) unable to decide.

Indicator Key	Agree	No Of Participants	Disagree	No Of Participants	Undecided	No Of Participants
SOP3	63.6%	7	18.2%	2	18.2%	2

Table 50: Iteration 3- Standard Operating Procedures Indicator Responses

4.4.1.8 Patient Report Form

There were six indicators under PRF in this iteration. Only one indicator (PRF3 - Are PRFs reviewed by ALS or supervisor and feedback provided?) achieved the consensus criteria with a percentage of 81.8%. This makes up *n*=9 of the 11 experts. Four of the indicators (PRF1 (Is data completion on PRFs adequately done?), PRF2 (Are PRFs peer-reviewed before submission to case management unit?), PRF5 (Quality Assurance performed on PRF data) and PRF6 (Storage and availability)) achieved 72.7% consensus, and PRF4 (Adequate data capturing) achieved 63.6%.

Indicator Key	Agree	No Of Participants	Disagree	No Of Participants	Undecided	No Of Participants
PRF1	72.7%	8	9.2%	1	18.2%	2
PRF2	72.7%	8	27.3%	3	0.0%	0
PRF3	81.8%	9	18.2%	2	0.0%	0
PRF4	63.6%	7	36.4%	4	0.0%	0
PRF5	72.7%	8	18.2%	2	9.1%	1
PRF6	72.7%	8	27.3%	3	0.0%	0

Table 51: Iteration 3- Patient Report Form Indicator Responses

4.4.1.9 Incident Reporting

The Incident Reporting indicators were four in this iteration. However, none of the indicators achieved the required level of consensus. IR1 (Are all incidents reported immediately) and IR2 (Are Incidences reported to the designated person in charge?) achieved only 72.7% which is *n*=8 of the 11 experts, and IR3 (Are incidents addressed in the appropriate manner?) and IR4 (Signed off) achieved 54.6% which is *n*=6 experts.

Indicator Key	Agree	No Of Participants	Disagree	No Of Participants	Undecided	No Of Participants
IR1	72.7%	8	27.3%	3	0.0%	0
IR2	72.7%	8	27.3%	3	0.0%	0
IR3	54.6%	6	45.5%	5	0.0%	0
IR4	54.6%	6	36.4%	4	9.1%	1

Table 52: Iteration 3- Incident Reporting Indicator Responses

4.4.1.10 Safety of Staff and Patient

Safety of Staff and Patients had eight indicators for iteration three, however, only SSP1 (Are patients treated according to set clinical Guidelines?) achieved the consensus criteria with a percentage of 90.9% which is *n*=10 of the 11 experts. The rest of the consensus percentages range from 54.6% to 72.7% which are below the consensus criteria to be included in the pilot study.

Indicator Key	Agree	No Of Participants	Disagree	No Of Participants	Undecided	No Of Participants
SSP1	90.9%	10	9.1%	1	0.0%	0
SSP2	63.6%	7	27.3%	3	9.1%	1
SSP3	72.7%	8	27.3%	3	0.0%	0
SSP4	54.6%	6	36.4%	4	9.1%	1
SSP5	72.7%	8	27.3%	3	0.0%	0
SSP6	63.6%	7	18.2%	2	18.2%	2
SSP7	54.6%	6	27.3%	3	18.2%	2
SSP8	54.6%	6	27.3%	3	18.2%	2

Table 53: Iteration 3- Safety of Staff and Patient Indicator Responses

4.4.1.11 Satisfaction Survey

For iteration three the Satisfaction Survey had three indicators. SS1 (Are patient/family satisfaction surveys being conducted?) reached consensus among *n*=9 experts with a percentage of 81.8%. SS2 (Are hospital satisfaction surveys being conducted on EMS hand over, inter-professional engagement/interaction and management of patients done?) only achieved 63.6% and SS3 (Survey Reviews and Implementation) 72.7% not reaching the consensus criteria. Both SS2 and SS3 had a disagreement percentage of 27.3% which is *n*=3 experts.

Indicator Key	Agree	No Of Participants	Disagree	No Of Participants	Undecided	No Of Participants
SS1	81.8%	9	18.2%	2	9.1%	1
SS2	63.6%	7	27.3%	3	9.1%	1
SS3	72.7%	8	27.3%	3	0.0%	0

Table 54: Iteration 3- Satisfaction Survey Indicator Responses

4.4.1.12 Competence Assurance

The Competence Assurance indicators were two from the previous iteration. However, only one indicator achieved the consensus criteria. CPA3 (Staff certified as BLS HCP) reached a consensus percentage of 81.8% which is consensus among *n*=9 out of the 11 experts. CPA1 (Do practitioners get assessed on skills not performed within six months?) only reached a 45.5% consensus percentage and equally a 45.5% disagreement percentage from the experts.

Indicator Key	Agree	No Of Participants	Disagree	No Of Participants	Undecided	No Of Participants
CPA1	45.5%	5	45.5%	5	9.1%	1
CPA3	81.8%	9	18.2%	2	0.0%	0

Table 55: Iteration 3- Competence Assurance Indicator Responses

4.4.2 Iteration Three Clinical Indicators

4.4.2.1 Cardiac Arrest

For iteration three the Cardiac Arrest indicators achieved consensus on *n*=4 of the five indicators. CA1 (Does the dispatcher provide telephonic-guided CPR instructions?) and CA4 (Is ALS present on all cardiac arrest cases?) both reached 81.8% consensus which is *n*=9 experts out of the 11. CA2 (Is call to scene response interval ≥5 minutes?) and CA3 (Does the crew identify cardiac arrest and basic CPR with AED initiated immediately?) both reached the highest percentage at 90.9%, which is *n*=10 of the 11 experts. CA6 (Is ROSC achieved before or at arrival at hospital) did not achieve the consensus criteria and stood at 63.6%, *n*=3 (27.3%) of the experts were unable to decide on CA6 with *n*=1 (9%) in disagreement bringing down the consensus percentage.

Indicator Key	Agree	No Of Participants	Disagree	No Of Participants	Undecided	No Of Participants
CA1	81.8%	9	9.1%	1	9.1%	1
CA2	90.9%	10	9.1%	1	0.0%	0
CA3	90.9%	10	9.1%	1	0.0%	0
CA4	81.8%	9	18.2%	2	0.0%	0
CA6	63.6%	7	9.1%	1	27.3%	3

Table 56: Iteration 3- Cardiac Arrest Indicator Responses

4.4.2.2 ST Elevation Myocardial Infarction

None of the STEMI indicators achieved consensus from the experts and will therefore not be included in the pilot study. STEMI2 (12 Lead ECG before and after treatment) and STEMI5 (Thrombolizing as per protocol) only reached 72.7% (*n*=8), with STEMI3 (Rapid transportation to PCI capable facility) reaching 63.6%, *n*=7 of the experts agreed with *n*=4 disagreeing on the indicator.

Indicator Key	Agree	No Of Participants	Disagree	No Of Participants	Undecided	No Of Participants
STEMI2	72.7%	8	18.2%	2	9.1%	1
STEMI3	63.6%	7	36.4%	4	0.0%	0
STEMI5	72.7%	8	27.3%	3	0.0%	0

Table 57: Iteration 3- ST Elevation Myocardial Infarction Indicator Responses

4.4.2.3 Stroke/Transient Ischemic Attack

In this iteration the Stroke/TIA had only one indicator achieving a consensus percentage of 81.8%, *n*=9 of the experts agreed on the indicator.

Indicator Key	Agree	No Of Participants	Disagree	No Of Participants	Undecided	No Of Participants
STIA4	81.8%	9	9.1%	1	9.1%	1

Table 58: Iteration 3- Stroke/Transient Ischemic Attack Indicator Response

4.4.2.4 Trauma Care

Trauma Care was allocated four indicators. TC5 (Pain management), TC6 (Hypovolaemia management) and TC7 (Maintaining cerebral perfusion and MAP) which all reached a consensus of 72.7% and TC3 (Entrapment time < 10 minutes.) achieved a consensus of 45.5%. None of which thus achieved the consensus criteria. Disagreement on TC3 was relatively high with *n*=5 of the 11 experts not agreeing. Disagreement for TC5 and TC7 stood at 18.2%, being *n*=2 experts.

Indicator Key	Agree	No Of Participants	Disagree	No Of Participants	Undecided	No Of Participants
TC3	45.5%	5	45.5%	5	9.1%	1
TC5	72.7%	8	18.2%	2	9.1%	1
TC6	72.7%	8	9.1%	1	18.2%	2
TC7	72.7%	8	18.2%	2	9.1%	1

Table 59: Iteration 3- Trauma Care Indicator Responses

4.4.2.5 Seizures

The Seizure indicator achieved 90.9%, surpassing the consensus criteria. Agreement on the indicator was high as *n*=10 experts concurred with the indicator. (SZ3 – Temperature measurement).

Indicator Key	Agree	No Of Participants	Disagree	No Of Participants	Undecided	No Of Participants
SZ3	90.9%	10	9.1%	1	0.0%	0

Table 60: Iteration 3- Seizures Indicator Response

4.4.2.6 Asthma

The Asthma indicator AS3 (Recording of PEFR) did not reach the consensus criteria as only *n*=7 (63.6%) experts agreed on the indicator, *n*=3 (27.3%) disagreed and *n*=1(9%) undecided on the indicator.

Indicator Key	Agree	No Of Participants	Disagree	No Of Participants	Undecided	No Of Participants
AS3	63.6%	7	27.3%	3	9.1%	1

Table 61: Iteration 3- Asthma Indicator Response

4.4.2.7 Pulmonary Oedema

For this iteration the Pulmonary Oedema indicator (PE1 - Administration of non-invasive positive pressure ventilation) did not reach the consensus criteria as it only achieved a 63.6% which is *n*=7 experts, *n*=2 (18.2%) experts were in disagreement with another *n*=2 (18.2%) uncertain about whether the indicator should be included in a QA system.

Indicator Key	Agree	No Of Participants	Disagree	No Of Participants	Undecided	No Of Participants
PE1	63.6%	7	18.2%	2	18.2%	2

Table 62: Iteration 3- Pulmonary Oedema Indicator Response

4.4.2.8 Medical Airway

The Medical Airway indicator in this iteration had three indicators. MA1 (Are ETT placement confirmation techniques documented?) was the only indicator that achieved consensus criteria with *n*=9 (81.8%) of the experts agreeing, and only *n*=1 (9%) disagreeing and undecided. The other two indicators MA2 (Are misplaced or dislodged ETT identified immediately by the practitioner?) and MA3 (Do practitioners comply with intubation guidelines?) only achieved 63.6% and 72.7% respectively.

Indicator Key	Agree	No Of Participants	Disagree	No Of Participants	Undecided	No Of Participants
MA1	81.8%	9	9.1%	1	9.1%	1
MA2	63.6%	7	18.2%	2	18.2%	2
MA3	72.7%	8	18.2%	2	9.%	1

Table 63: Iteration 3- Medical Airway Indicator Responses

4.4.2.9 Termination of Resuscitation

The TOR1 (Do practitioners seek additional consultation before termination of resuscitation efforts?) indicator only achieved 72.7% consensus, *n*=8 of the experts agreed, with *n*=2 being in disagreement and *n*=1 undecided on this indicator.

Indicator Key	Agree	No Of Participants	Disagree	No Of Participants	Undecided	No Of Participants
TOR1	72.7%	8	18.2%	2	9.1%	1

Table 64: Iteration 3- Termination of Resuscitation Indicator Response

For iteration three a total of 17 indicators (ten non-clinical & seven clinical) were extracted that achieved the consensus criteria from the experts. These indicators will be added to iteration one and iteration two's indicators to formulate the indicators for the QA system to be piloted. The figure below shows the indicators with their respective consensus percentages.

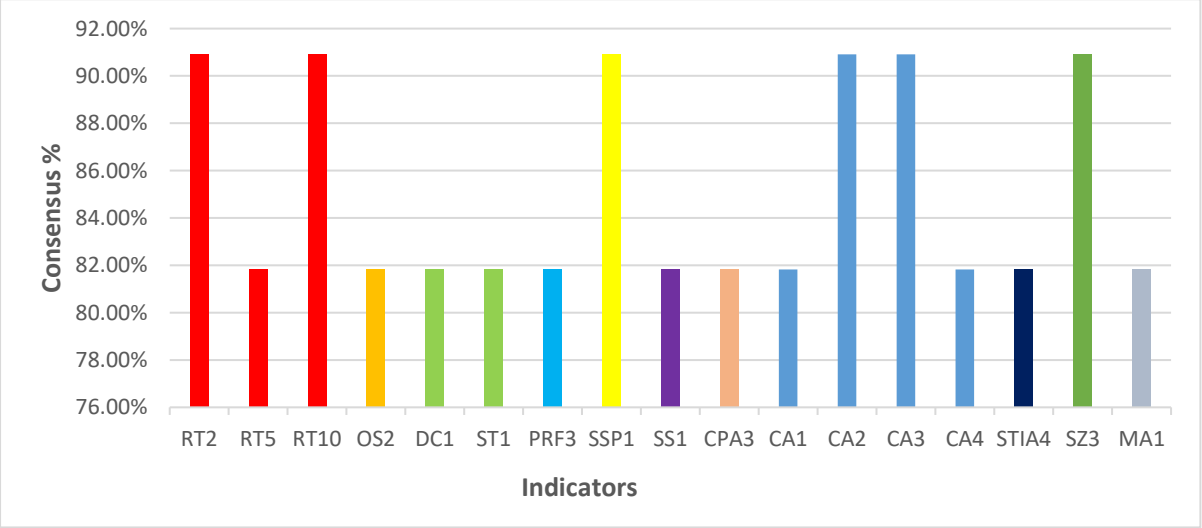


Figure 12: Iteration three Consensus Indicators

4.5 Consensus Indicators for the Namibian Quality Assurance System

The primary investigator extrapolated 67 indicators from the comparative analysis that were circulated through the iterations for the experts to reach consensus on. An additional 34 indicators were proposed by experts throughout the three iterations. The final consensus indicators that experts agreed on totals to 42. The Figure below outlines the consensus indicators.

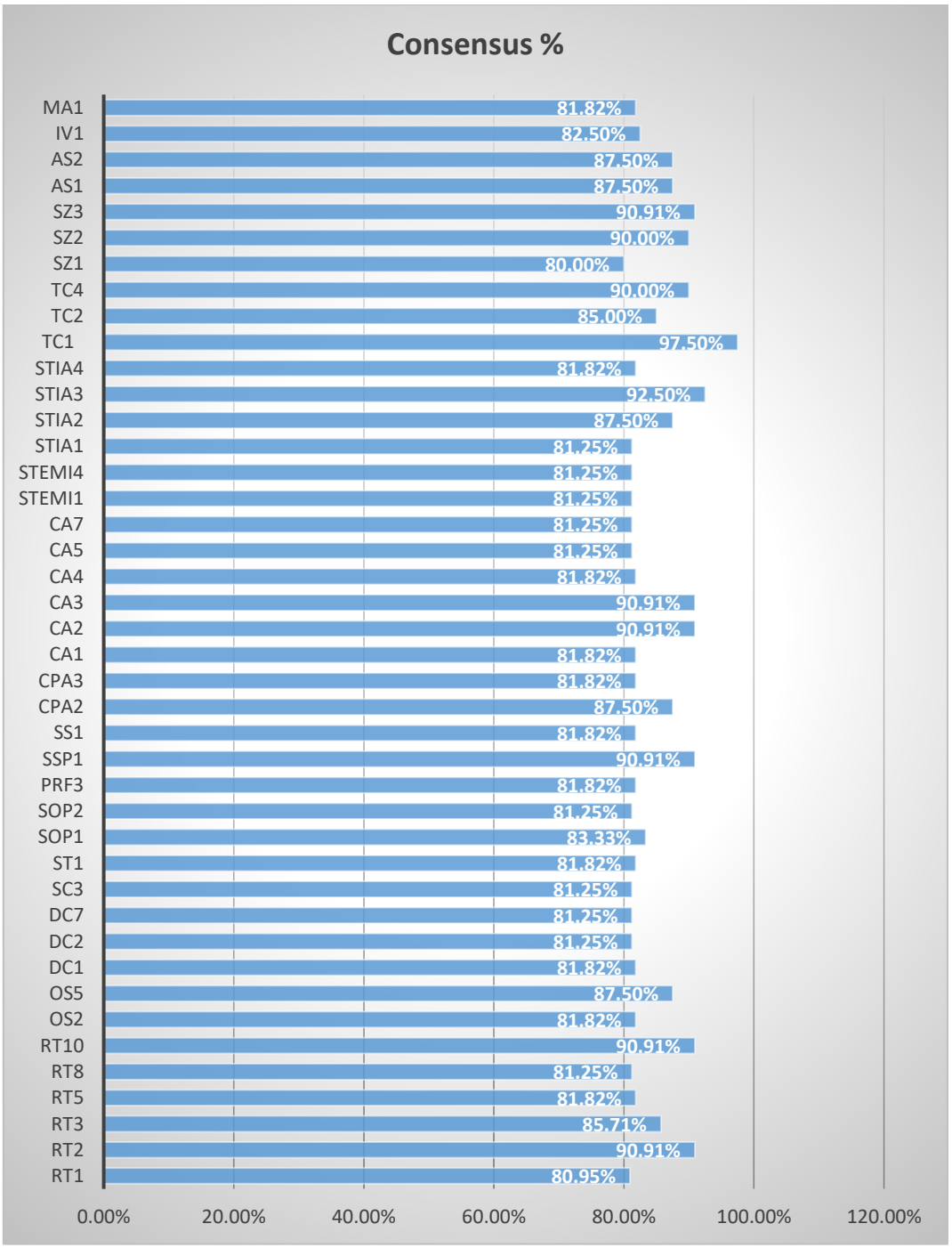


Figure 13: Consensus Indicators for Namibian EMS QA system

4.6 Pilot Study on Compliance of Emergency Services to Proposed Quality Indicators

This study only saw the response of two of the four emergency services granting approval to complete the survey. The two companies were designated with a letter X and Y for purposes of identification and anonymity. The results displayed below are representative of the compliance with the selected indicators from the Delphi study. This is based on the survey conducted at the respective emergency companies.

4.6.1 Company X Compliance on Indicators

Five participants from company X completed the survey. The qualification designation within this survey saw 2x ALS, 1x ECT and 2x ILS practitioners with relevant experience. According to the participants, company X complies with *n*=21 (50%) of the 42 indicators, 8 of which are non-clinical and 13 clinical. There is variance of opinions on the other *n*=21 (50%) indicators, 12 non-clinical and 9 clinical. Both the agreement and variance of the non-clinical indicators achieved a mean of 4. The clinical indicators had a mean of 4.4. Furthermore, participants made 11 suggestions on ways to improve indicators RT1 (Are emergency fleet in a well-functioning condition to respond to calls immediately?), RT2 (What is the time interval from when the call is received until the first unit arrives at the patient?), RT5 (Did the crew encounter any dangerous situations during response?), RT8 (Crew response skills), ST1 (Are staff members appropriately trained and skilled (competent)?), CA1 (Does the dispatcher provide telephonic-guided CPR instructions?), CA7 (CPR Training), SZ1 (Administration of benzodiazepine for active convulsions), SZ3 (Temperature measurement) and MA1 (Are ETT placement confirmation techniques documented?). Table 65 outlines the Non-clinical results of this survey.

Indicator Key	Participant Agreement	Agreement %	Participant Variance	Variance %	Improvement Suggestion
RT1	5	100%	0	0%	- Management to ensure continuous operation of fleet - Ensure daily checks of fleet
RT2	4	80%	1	20%	• Update GPS systems
RT3	3	60%	2	40%	None
RT5	4	80%	1	20%	• Conduct public education on how to respond to oncoming emergency vehicles
RT8	3	60%	2	40%	• Train crews in defensive/advanced driving skills
RT10	4	80%	1	20%	None
OS2	4	80%	1	20%	None
OS5	4	80%	1	20%	None
DC1	5	100%	0	0%	None
DC2	3	60%	2	40%	None
DC7	2	40%	3	60%	None
SC3	5	100%	0	0%	None
ST1	5	100%	0	0%	• Introduce ALS guidance program
SOP1	5	100%	0	0%	None
SOP2	3	60%	2	40%	None
PRF3	5	100%	0	0%	None
SSP1	5	100%	0	0%	None
SS1	2	40%	3	60%	None
CPA2	4	80%	1	20%	None
CPA3	5	100%	0	0%	None

Table 65: Company X Non-Clinical Indicator Results

The table below outlines the clinical responses for the survey.

Indicator Key	Participant Agreement	Agreement %	Participant Variance	Variance %	Improvement Suggestion
CA1	3	60%	2	40%	• Conduct training to be able to provide on-line medical assistance
CA2	2	40%	3	60%	None
CA3	5	100%	0	0%	None
CA4	3	60%	2	40%	None
CA5	5	100%	0	0%	None
CA7	2	40%	3	60%	• Make it an annual QA indicator
STEMI1	5	100%	0	0%	None
STEMI4	5	100%	0	0%	None
STIA1	5	100%	0	0%	None
STIA2	5	100%	0	0%	None
STIA3	5	100%	0	0%	None
STIA4	4	80%	1	20%	None
TC1	5	100%	0	0%	None
TC2	3	60%	2	40%	None
TC4	5	100%	0	0%	None
SZ1	5	100%	0	0%	• Ensure ALS/ECT dispatched for administration
SZ2	5	100%	0	0%	None
SZ3	3	60%	2	40%	• Procure proper thermometers to test accurately
AS1	5	100%	0	0%	None
AS2	5	100%	0	0%	None
IVI	4	80%	1	20%	None
MA1	2	40%	3	60%	• Crews to Adhere to ATLS guidelines

Table 66: Company X Clinical Indicator Results

4.6.3 Company Y Compliance on Indicators

For company Y, five participants agreed to complete the survey. The qualification levels for the participants were 2x ALS and 3x ECT practitioners. The participants felt that company Y complied with *n*=15 (36%) of the 42 indicators, of which 5 were non-clinical indicators and 10 clinical indicators. Variance of opinions saw a much higher number for company Y in this survey. Participants had different opinions on *n*=27 (64%) indicators, 15 being non-clinical indicators and 12 clinical indicators. The clinical indicators achieved a mean of 4, with the non-clinical indicators achieving a mean of 4.4. Furthermore, the participants proposed five ways to improve on the indicators RT3 (Was the patient transported to the correct facility?), RT8 (Crew response skills), SS1 (Are patient/family satisfaction

surveys being conducted?), CA7 (CPR Training) and SZ1 (Administration of benzodiazepine for active convulsions). Table 67 and Table 68 outlines the responses from the participants respectively.

Indicator Key	Participant Agreement	Agreement %	Participant Variance	Variance %	Improvement Suggestion
RT1	4	80%	1	20%	None
RT2	5	100%	0	0%	•
RT3	1	20%	4	80%	• Improvement of current trauma centres
RT5	4	80%	1	20%	None
RT8	3	60%	2	40%	• Drivers to be trained in advanced techniques
RT10	1	20%	4	80%	None
OS2	3	60%	2	40%	None
OS5	3	60%	2	40%	None
DC1	3	60%	2	40%	None
DC2	4	80%	1	20%	None
DC7	3	60%	2	40%	None
SC3	5	100%	0	0%	None
ST1	4	80%	1	20%	None
SOP1	5	100%	0	0%	None
SOP2	4	80%	1	20%	None
PRF3	5	100%	0	0%	None
SSP1	4	80%	1	20%	None
SS1	5	100%	0	0%	• Introduce surveys to patients & family
CPA2	3	60%	2	40%	None
CPA3	4	80%	1	20%	None

Table 67: Company Y Non-Clinical Indicator Results

The following table outlines the compliance of company Y to the clinical indicators.

Indicator Key	Participant Agreement	Agreement %	Participant Variance	Variance %	Improvement Suggestion
CA1	4	80%	1	20%	None
CA2	4	80%	1	20%	None
CA3	5	100%	0	0%	
CA4	3	60%	2	40%	None
CA5	3	60%	2	40%	None
CA7	3	60%	2	40%	• Conduct CPR training every quarter
STEMI1	5	100%	0	0%	None
STEMI4	3	60%	2	40%	None
STIA1	3	60%	2	40%	None
STIA2	4	80%	1	20%	None
STIA3	5	100%	0	0%	None
STIA4	4	80%	1	20%	None
TC1	5	100%	0	0%	None
TC2	3	60%	2	40%	None
TC4	5	100%	0	0%	None
SZ1	5	100%	0	0%	• Ensure that ALS or ECT to cover each shift to be able to attend and administer drugs
SZ2	5	100%	0	0%	None
SZ3	5	100%	0	0%	None
AS1	5	100%	0	0%	None
AS2	4	80%	1	20%	None
IVI	5	100%	0	0%	None
MA1	3	60%	2	40%	None

Table 68: Company Y Clinical Indicator Results

CHAPTER 5: DISCUSSION

It is clear from a number of studies that Quality Assurance has become a vitally important process in the modern-day healthcare system, and the literature has proven that quality improvement programmes do in fact improve quality care (Aaronson et al.,2015). Namibia with an EMS system that is only in its infancy stage would benefit from developing and implementing a QA system for service delivery in emergency medical care. The Namibian EMS system is currently guided by international protocols and clinical practice guidelines with no locally adopted medical protocols, and with the pace at which the international profession is expanding the call from public members, healthcare professionals and medical insurance companies to deliver quality prehospital care is becoming more evident.

This study contributed to the initiation of the identification of quality indicators to measure the effectiveness of the Namibian emergency medical care service delivery. The main aim of the study was to identify QI and allow experts to deliberate and reach consensus on the indicators and to test whether the indicators can be used to improve service delivery. This was achieved through a comparative analysis of international indicators, followed by a three iteration Delphi process and finally a pilot study of those indicators being conducted at emergency services in Namibia.

5.1 Comparative Analysis of International Quality Indicators

The formulation/identification of QI's can be a stringent process when there is a lack of research. In the absence of robust evidence-based indicators, it is most commonly followed by a process where experts suggest indicators guided by personal opinion and through experience within the field (MacFarlane & Benn, 2003). However, this can in some instances result in unmeasurable results as seen from a majority of the studies abroad. Since EMS in Namibia is under developed and research on the identification or implementation of quality indicators is relatively non-existent, the only acceptable option was to follow suit of other countries to identify quality indicators through a comparative analysis of international EMS quality assurance systems. This approach was followed by the Australians in developing a performance framework for their ambulance services. The frameworks were based on the Canadian Health Indicators Framework and the National Health Service in the United Kingdom. Similarly, the work extracted from the UK correlates with the Joint Commission on Accreditation of Healthcare Organizations developed in the United States of America (O`Meara, 2005).

It stands to reason that although the EMS systems differ between countries, there is some correlation when it comes to quality indicators. From review of the studies it is evident that first world countries such as the USA, UK, Australia, Asia and Scandinavia, and recently South Africa all employ the same

subset of indicators to assess quality delivery even though it is measured in a different framework. A majority of the countries also use the Donabedian Framework as an identifier to classify the indicators according to structure, process and outcome. Similarly, the IOM six quality dimensions are also employed.

As a result of access limitation to studies the comparative analysis yielded only 67 quality indicators relevant to the Namibian setting. This number in relation to the size of the Namibian EMS fraternity is adequate to measure quality. In a review of the South Australian ambulance services, it was noted that they defined eight measures with ten key performance areas, and is seen as the most innovative service relating to performance measurement (O`Meara, 2005). It is therefore arguable that the success of measuring the quality of an ambulance service does not lie with the number of indicators but rather the quality of the indicators identified. Being a study first of its kind in Namibia, the indicators identified cover a broad spectrum of indicators to ensure improvement of emergency service delivery.

A great number of indicators (58%) identified from the comparative analysis fall within the Non-Clinical domain, while 42% constitute the clinical domain. Generally, the non-clinical domain of indicators has been dominating the indicator category when quality is being measured. From the review of studies focusing on quality assessment, it is noticeable that the non-clinical indicators are more easily implemented because it does not require complicated structures or electronic systems for execution. These indicators also do not require high cognition and knowledge levels expected from that of ALS practitioners or senior/managerial personnel, but can be implemented by the lower level categories (BLS, ILS & ECTs) in EMS (Howard, Cameron, Wallis, Castren and Lindstrom, 2019).

The clinical domain of indicators is also not far from the non-clinical domain and indicates that the same intervention/treatment-based indicators measured by the first world countries are considered to be measured in the Namibian setting. These are relevant to the Namibian setting because protocols and guidelines in Namibia are largely based on international guidelines and recommendations. It is expected that EMS in Namibia will see an improvement in the quality of service delivery because these indicators are simple and can be easily measured and implemented. This is attributed to the fact that most private ambulance services are small and the state service is still in the infancy stage, which will make adoption of these indicators less complex.

5.1.2 Non-Clinical Indicators

Historically, the non-clinical domain of measuring quality of emergency services has primarily focused on time-based indicators such as response times and on-scene times and has for many years been the

main factor indicating whether a service is successful or not. However, as research evolved over the years these indicators were under much scrutiny (Howard *et al.,* 2019). Although, time-based indicators do not form the basis of success for ambulance services, it still has a place in the measurement of quality delivery. One can argue that, if the emergency fleet is not in a proper condition when the time comes to respond to an emergency, then there will be a delay in managing patients. This, in the case of a cardiac arrest patients requiring immediate, proper CPR and advanced life support can be fatal for these patients should there be a delay. Similarly, should crews spend too much time on a scene with a critical patient, the chances of survival and the chance to full recovery reduces. This falls within the principle of the golden hour, where a statistically significant increase in mortality is foreseen when prehospital on scene times are more than 60 minutes (MacFarlane and Benn, 2003). Namibia with its geographical vast distances however, makes it difficult to measure quality of time-based indicators in relation to the golden hour, but because of these vast distances finding ways of minimizing response times and reducing delays is of utmost importance, and should therefore be part of a quality assurance system.

The other non-clinical indicators also relate to the functional system of emergency services which if without the service will not be able to operate. As such the dispatch centre requires optimal operation with adequately trained staff. Haughland, Rehn, Klepstad & Kruger (2017) measured the effectiveness of the dispatch centre by ensuring that all calls reported to the dispatch centre is coordinated by a specially trained physician. Dispatchers play an integral part in the performance of any EMS system (Myers et al., 2008). They are often faced with distraught patients, family members and bystanders calling in to report an emergency and should be able to assist them calmly, provide on-line medical assistance and ensure the right resources are sent to the emergency. This requires constant training of staff members to be abreast with new evidence and upskilling of competence levels. This study incorporated these indicators to compliment the Namibian EMS quality assurance system.

On ground level the Emergency Care Practitioners should ensure understanding of all equipment used, ensure it is cleaned and in a proper working condition, ensure proper completion of Patient Report Forms (PRFs) and completion of incident reports so that issues can be resolved. Generally, this requires documentation such as a Standard Operating Procedure (SOP) that clearly outlines all rules, regulations and procedures. Constant review of SOP's is also important to ensure that the operational processes follow the correct and current procedures. All these indicators comply with the IOM quality dimension that enforces the system personnel, equipment and facilities to compliment the delivery of quality health care (El Sayed, 2012).

5.1.3 Clinical Indicators

The comparative analysis extrapolated 28 clinical indicators from international studies that were deemed relevant to the Namibian scope of practice. In parallel view of the non-clinical time-based indicators, the clinical indicator domain is also known with one standard metric that has been measured in international EMS systems for quite some time. Out of hospital Cardiac Arrest has been the only clinical indicator related to performance measurement in the prehospital setting (Myers *et al.*, 2008). However, the 2007 consortium of U.S. Metropolitan Municipalities EMS Medical Director meeting proposed to include new evidence-based performance measures for EMS. These indicators include ST Elevation Myocardial Infarction (inclusive of Acute Coronary Syndromes), Trauma, Respiratory Distress (Bronchospasm), and seizure management. These indicators are similarly included in other countries' EMS quality improvement systems such as USA, UK, and Australia, and since these countries form part of the comparative analysis of the study, hence the inclusion of the indicators in the Namibian quality assurance system.

The prehospital profession is constantly under scrutiny for treatment performed by ECPs. Many authors still question the validity of prehospital care despite a positive outcome. Cardiac Arrest is an internationally measured indicator. Myers *et al.* (2008) considers out of hospital Cardiac Arrest as a measure with a possible high success rate if correct measures are put in place to measure it. It stands to reason that the success of out of hospital Cardiac Arrest is based on many aspects of the EMS system, this includes but not limited to online CPR instructions by dispatchers, early recognition and early defibrillation and high quality advanced cardiac life support is provided by the crew on the ground. To ensure that the EMS system achieve these successes, a performance measurement system should be in place.

Namibia unfortunately does not always benefit from short transportation times to definitive care facilities, which means that the prehospital crew has the responsibility to manage patients until they are handed over at an appropriate facility. There is also a scarcity of definitive facilities with the correct resources and healthcare specialists that can provide the required interventions in Namibia. This for many conditions is worrisome as there is a major delay to perform interventions.

As per the 2015 American Heart Association guidelines, STEMI patients should receive Percutaneous Coronary Intervention (PCI) within 90 minutes. However, patients in the district areas cannot always be directly transported to Percutaneous Coronary Intervention (PCI) facilities. Paramedics therefore have to initiate the necessary treatment through consultation with a cardiologist. Fibrinolysis in the prehospital field has not yet been performed in the Namibian setting despite overwhelming evidence of its success rates (AHA, p 190). The development of the fourth year Bachelor of Emergency Medical

Care programme at the Namibia University of Science and Technology (NUST) has included prehospital fibrinolysis as part of the training curriculum for their graduates. Similarly, the recent government gazette on the scope of practice for emergency care has indicated its inclusion on the paramedic scope of practice (Government Gazette, 2018). This means that prehospital fibrinolysis might soon be performed without any quality assurance in place. According to the ACLS Experienced Provider Manual (p 191) a robust quality improvement system with constant training should be in place for these interventions to be measured and to ensure its quality.

The management of a suspected or confirmed stroke cases is considered a time-sensitive condition meaning that if there is a delay in identification, transportation and treatment, the brain is more prone to permanent damage, with slim chance of recovery and even death. Hence the saying: "Time is brain" (AHA, p236). According to Daudelin *et al.* (2013) Emergency services are the first contact in approximately 50% of stroke cases and even though they are trained in recognizing, rapid triage and transport of stroke cases, no internationally prehospital stroke performance indicators exist to measure the current guidelines. The Massachusetts EMS forum for this reason developed quality indicators to assist emergency organizations to make what they call "breakthrough" improvements in stroke management. Through this collaboration 17 EMS agencies participated and indicated a significant improvement and adherence to stroke guidelines (Daudelin *et al.*, 2013).

It is no secret that Namibia is burdened by a high number of trauma related cases ranging from assaults to motor vehicle accidents. These form part of the majority of calls attended to by state emergency services. It is necessary that the management of trauma victims be measured to ensure that they receive the most appropriate treatment from emergency services. The World Health Organization Global Status Report on Road Safety has indicated that Namibia has the highest number of fatality rates in motor vehicle accidents per 100 000 people (WHO, 2018). The WHO (2018) further declares that deaths occurring as a result of motor vehicle accidents has exceeded that of diseases such as HIV/ADIS, tuberculosis, and diarrhoeal diseases, and is ranked the eighth cause of death in the world. Despite their being improvement of post-crash care, more work should be done for quality care (WHO, 2018). This therefore calls for measurement of primary trauma care indicators to ensure that the care and transport delivered to trauma victims is based on evidence informed metrics.

The management of pulmonary oedema has indicated a 2% reduction in mortality rates with prehospital intervention. Although this is a small percentage, it is a step in the right direction as these patients do not require endotracheal intubation on arrival at hospital, these further speeds up recovery and reduces their length of stay in hospital (Myers *et al.*, 2008). This was achieved through

the identification of two metrics for managing pulmonary oedema patients to ensure that quality care in the prehospital setting is adhered to.

Internationally, the management of bronchospasm still remains the administration of a beta-agonist as the primary intervention. The advantage of this intervention is that it can be administered by the lower level ECPs in mild to moderate cases of bronchospasm (Myers *et al.*, 2008). In a comparison of performance indicators done by El Sayed (2011), both the USA and UK included asthma with the administration of beta-agonist as performance indicators. However, the UK included additional indicators to measure quality management of asthmatic patients.

There are similarities between the USA and other countries on indicators specific to seizure management. The primary treatment modality for seizures is the cessation of convulsion with benzodiazepine therapy. However, additional indicators focus on causative elements and those that may result in adverse outcomes such as low blood sugar levels (Myers *et al.*, 2008; El Sayed, 2011). To ensure that these measures are not excluded from the general assessment and treatment of seizures, they are included as part of the indicators for seizures.

The Hamad Medical Corporation in Qatar, developed key performance metrics to improve their physician directed EMS model. They reported success on most of the metrics of the quality assurance programme which were conducted over a 14-month period. Misplaced endotracheal tubes reduced from 2-7% to a 0.6% within the first month, and later to zero. The intravenous (IV) catheterization also saw an improvement in unstable patients from a 67% to 92% three months after protocol rollouts. Furthermore, after protocol rollout and training, the success rate of practitioners successfully terminating futile asystole instead of prolonging futile resuscitations increased from 0% to 31%. Even though it does not yet meet the benchmark of 50%, a significant difference is noted (Munk *et al.,*2009). Even though it does not constitute a research study, their quality assurance intervention has shown a positive result and adds to the current discussion of quality assurance for other developing EMS systems (Munk *et al.*,2009).

One can argue that there is an inter-linkage of the clinical and non-clinical indicators. The success of the EMS system cannot be solely measured on one indicator but should be seen holistically as a whole system with many factors that can affect the performance. It is clear that the study has identified a wide variety of indicators that covers a broad spectrum of metrics to measure the service delivery of emergency care within Namibia.

5.2 Delphi study on Applicable Quality Indicators

The experts reached consensus on some of the indicators within the first iteration, this shows that those specific indicators are well understood and known within the EMS operation. However, the other indicators only achieved consensus in iteration two and some only in iteration three. There are indicators that did not achieve the minimum criteria of 80% and were therefore excluded from the study after iteration three. Surprisingly, four of the indicator metrics did not achieve the 80% consensus criteria in either three of the iterations. These indicators include: *Equipment*, and *Incident Report* from the non-clinical domain, and *Pulmonary Oedema* and *Termination of Resuscitation* under the clinical domain.

It was expected that equipment would have achieved consensus, however, this was not the case. Equipment being an important component of an emergency service and for patient treatment should ideally be in a very good condition, regularly serviced and calibrated, all which were covered as part of the indicators. Equipment is one of the components that assist ECP's in performing their work optimally, for example an electrocardiogram not serviced and calibrated may give more artefacts and incorrect rhythms which can be misinterpreted by a paramedic. Similarly, a suction unit is an important device when it comes to airway management, and having a device with low battery power can result in the device not creating sufficient suction to clear the airway properly. For this reason, a system should be in place to ensure that the equipment used is in a properly working condition. Incident reporting is important to ensure that all issues are addressed by the supervising team and that if negligence is suspected from crew members that it is also addressed. It can be a valuable tool to identify shortcomings and areas for improvement. Ideally, incidence reporting is a process to ensure problems are identified as early as possible and to fix those problems to prevent resulting events, rather than blaming and disciplining crews.

Pulmonary oedema is a condition that requires intervention from ECP's with an advanced level of training. Myers *et al.* (2008) noted a positive result of patients treated with non-invasive positive pressure ventilation (NIPPV). Providing NIPPV requires special training and a device that can deliver the ventilation modality. Under the Namibian scope of practice, it is only ALS paramedics that can administer NIPPV to patients (Government Gazette, 2018). Judging from the consensus iterations, it stands to reason that the consensus achieved was from the ALS paramedics whom have a better understanding on the use of NIPPV. With a reduction of patients requiring endotracheal intubation, it is an important indicator to include as part of a quality assurance system.

The Namibian scope of practice for Emergency Care allows declaration of death by ILS practitioners. It has allowed for an independent practice where ILS practitioners can make a decision without

consultation from an ALS paramedic or a medical doctor. It was somewhat foreseeable that the experts would disagree with medical direction when it comes to termination of resuscitation efforts which was the case throughout the iterations. For termination of resuscitation efforts Myers *et al*. (2008) in their quality intervention required practitioners to conduct at least 20 minutes of ACLS care, and only after medical consultation, were allowed to terminate the resuscitation. This system provides an additional thought process to ensure that crews cover all basis before declaring a patient dead.

Despite the fact that these indicators did not achieve consensus from the experts, it is the view of the primary researcher that with an update of the quality assurance system that these indicators should form part of the holistic quality assurance system to measure service delivery in the Namibian EMS system (Rahman et al. 2015; Myers *et al.,*2008). Since this study is a first of its kind the possibility of misinterpretation from participants may have led to the indicators not achieving consensus. The indicator metrics that did achieve consensus are discussed as follows:

5.2.1 Response Time

This category saw consensus on two of the indicators (RT1 and RT3) in the first iteration. The experts agreed that response a fleet should be in a well-functioning condition to respond to calls immediately, and that patients are transported to the correct facility. It was surprizing to see that the experts did not agree on the time interval from when the call is achieved until the first unit arrives, as not important to reach consensus within the first iteration, since it deals with the time frame it takes the crew to get to the patient. This indicator only achieved consensus in the third iteration. It appears that some of the experts required sensitization before agreeing to the indicators.

The experts also suggested to add “crew response skills” to the list as it is viewed important for drivers to have specific skills when responding, “Time to definitive management, call received to dispatch of the crew, and correct information relayed” were also suggestions from the experts. However, only some received consensus. The final iteration yielded consensus on three indicators namely time interval from when the call is received until the first unit arrives on scene, response time recorded correctly and correct information relayed are also suggested indicators. Namibia with its vast distances between towns and its definitive care facilities only being in Windhoek cannot truly benefit under the definition of the golden hour. The response time indicators are therefore focused on the structure metric of quality meaning ensuring proper response fleet and maintenance, ensuring the drivers are well trained to respond to minimize the risk of crashes while responding. Since these indicators are based on anecdotal non-clinical end points it cannot be used to measure the success of the emergency

service (Howard *et al.,* 2018), however, it should be used as an intervention and in conjunction of other quality indicators to ensure that service delivery is to a satisfactory level.

5.2.2 On-Scene Time

The indicators within this metric only achieved consensus in iteration two and three, no consensus was reached in iteration one. This metric also received three additional suggestions from the experts to be included in iteration two and three. However, the experts only agreed on *crew competence* as an indicator. An interesting observation is that the experts agreed that crew competence plays an important role when it comes to on-scene management more than the time interval from arrival on-scene until transport is initiated. It is arguable that the competence of the crew will determine when a patient requires urgent transport to a hospital and when the condition is stable enough to "stay and play" before transporting to hospital. Ideally, transportation to hospital should not be delayed, however, this is determined by factors such as number of casualties, severity of injury, distance to and from the scene, and additional resources available and required on the scene.

Available ambulances and triage time by ECPs are the other two additional suggested indicators in iteration one that the experts did not agree on. Even though these two indicators can be considered important to ensure rapid transportation of patients, the experts differed in opinion regarding these two indicators. The focus of the on-scene time metric is for crews not to spend unnecessary time on scene and delay transportation of critical patients by performing unimportant interventions which does not improve the patient's chances of survival such as splinting of fractures.

5.2.3 Dispatch Centre

No consensus was reached in the initial iteration for the dispatch centre indicators. The consensus reached was only in the second and third iteration. Since the dispatch centre is seen as the heart of an emergency service (Myers et al.,2008), it is important that the quality delivered is constantly measured and improved. The experts agreed that the dispatch centre should be staffed by appropriately qualified persons, however, the agreement was only achieved in the third iteration. Similarly, the staff should also be appropriately qualified. Through discussions with supervisors of private ambulance services the researcher noted that a minimum of BLS as a qualification is required to operate in the dispatch centre. Although there is no evidence on the minimum requirements of dispatch centre staff, it is reasonable that they should have an adequate idea and experience of what happens in the prehospital field. A preposition for the minimum requirements would be that of ILS,

but a metric that requires further investigation. Haugland *et al.* (2017) for their physician staffed emergency service required the dispatch centre staff to be specially trained physicians which is a level much higher than that of ambulance services in Namibia.

The experts also agreed that the dispatch of appropriate resources should make part of the indicators to be used in the quality assurance system. This is paramount in special rescue situations when fire and rescue services are required to extricate people trapped in a vehicle or any other emergency situations or police is required to ensure scene safety for practitioners and patients. One would expect that quality training offered to staff, as suggested by one of the experts would be considered important for dispatch centre staff, however, interestingly this indicator did not achieve consensus from all experts. It was anticipated that continuous training should form the basis of best practice in the dispatch centre. Other indicators that was anticipated to be part of the quality assurance system but did not get the agreement of all experts include the acquiring of adequate information for responding units, having some dispatch criteria for different resources, supervisor oversight and assistance, and lastly online medical assistance. It stands to reason that these indicators could potentially improve the service delivered by emergency services if executed properly. However, the experts viewed it as less important.

5.2.4 Staff Compliment

Throughout the three iterations, only one indicator yielded consensus from the experts. None of the selected indicators from the comparative analysis and indicators used by the studies were considered eligible by the experts throughout all the iterations. The exception is a suggested indicator which focuses on staff qualification. In light of the qualification of staff, the experts share the same sentiment that staff should be adequately qualified to work at an ambulance service. Although there is no specification on the level of the staff members, it is the view of the researcher that each shift should at least be manned by an ALS paramedic. This can either be on the ambulance or provide assistance with an additional response vehicle when the need arises. Despite the rise of scrutiny and the questioning of the effectiveness of ALS intervention on scene (El Sayed, 2012), some have indicated positive outcomes especially for STEMI cases and severe respiratory distress (Myers *et al.,* 2008). It is also arguable that despite reaching no consensus, compliment staff for mass casualties should be considered important to ensure proficient disaster risk management in the case of a disaster. Emergency services should therefore have a redundancy plan to ensure that service delivery can continue when a member gets sick or is injured while on duty and needs to be replaced.

5.2.5 Staff Training

In this category only one of the total five indicators received consensus from the expert panel. Again, staff training and level of skill were at the forefront of agreement between the experts. However, this indicator focuses on the training that the staff members receive to retain skills set. Unexpectedly, indicators such as the provision of Continuous Professional Development (CPD) sessions, case reviews and debriefing sessions, and mentorship programmes for newly appointed staff were not awarded with consensus. These indicators form part of each practitioners' biannual compliance assessment conducted by the Allied Health Professions Council of Namibia (AHPCNA). Practitioners are required to attend a certain amount of CPD sessions to be awarded with Continuing Education Units (CEUs). This assessment process is conducted by the AHPCNA to ensure that practitioners stay current regarding knowledge and skills. It is therefore a strange observation that these indicators did not achieve complete consensus from the experts as it is a standing process for all ECP's. As can be derived from the Colorado Department of Public Health and Environmental, the EMS services require all medical directors to conduct a CEU programme as part of improving quality (Hall *et al.,* 2017).

In light of the observation from this metric, the consensus in iteration one ranges from 26.2% to 57% which is relatively low for this indicator, and disagreement ranges from 28.6% to 57%. Iteration saw a slight increase with 75% consensus and 37.5% disagreement. Apart from the indicator achieving consensus, the second highest consensus percentage is 72.7%, and disagreement on 45.5%. This can be perceived as misinterpretation of information from the experts. It would appear as if some experts viewed the survey as an assessment of the company they are employed or were employed at instead of assessing whether the indicators listed are eligible to be part of the quality assurance system.

5.2.6 Standard Operating Procedures

The SOP indicator metric were designated with two indicators from the comparative analysis and one suggested indicator from one expert. The experts agreed that the emergency service should have an SOP in place and that it should be executed properly. The adequately executed indicator falls under the process category and subsequently measures the effectiveness of what is expected. Having an SOP in place also falls under the process category but measures safety in the sense that all processes that happens in the organization is done within a safe set guideline. As mentioned by Hall *et al.* (2017): "*…all field providers should clearly be able to understand what they are expected to do to meet the agency…, protocols, policies and procedures are used to identify the expected level of performance for the agency*". The additional indicator suggested that the SOP should be signed off by staff members as this serves as a form of confirmation that they understand and will comply with the SOP. However,

this indicator did not achieve the consensus criteria and was therefore eliminated from the list. It is important for emergency services to have an SOP, and similarly ensure that it is executed by the staff members, this especially for newly appointed staff. It serves to give direction for uniformity among members.

5.2.7 Patient Report Forms

No consensus was achieved in the first two iterations of the Delphi study for this category of indicators. The panel agreed that PRF reviews conducted by ALS or the supervisor with feedback provided should form part of the quality assurance indicator list. According to O`Meara (2005), a lack of proper documentation has led to a reduction in validity of performance measurements. It was also mentioned that emergency crews might lack the skills and adequate knowledge on how to properly complete PRF's. Review of PRF's by the ALS crews will ensure that the correct information and medical terminology is used. The phrase "if it is not written, it is not done", is familiar across all levels of prehospital emergency crews and constitute that if an intervention is performed it should be noted on the PRF.

The understanding is that should a practitioner omit to note down relevant information, the potential that it might lead to inability to provide concrete evidence of activities on scene exist. This is particularly important when crews are summoned to court as witnesses. It is argued that the PRF serves as the legal document of what transpired for the duration that the patient was in the care of the practitioner. One can therefore reason that measuring the quality of PRF's is paramount to ensure improved quality and to avert unnecessary medico-legal litigation. Interestingly, a preposition by one of the experts was made to include quality assurance on PRF's to allow for constant improvement. However, despite a good level of agreement this metric did not achieve the required 80%. Although this indicator did not meet the criteria, review by ALS can be seen as a quality measure on PRF's.

5.2.8 Safety of Staff and Patients

The safety of staff and patient's indicator metric was allocated with a total of eight indicators, three from the comparative analysis and five suggested throughout the iteration process. There was only one consensus achievement, and was only reached in iteration three. The majority of experts agreed that patients should be treated according to set clinical guidelines. This can be interpreted both ways in safety measurement – that of the patient and the treating crew member. With the advancement of the scope of practice and skills of paramedics, it was considered necessary to have a standard in place

for prehospital care (El Sayed,2012; Howard *et al.,* 2018 and O`Meara, 2005). One can argue that when crew members treat patients according to a set clinical guideline, then the risk of medico-legal litigation is reduced because the practitioner or the company does not necessarily have to take the responsibility when patients or family decide to take legal action. These guidelines should however, be based on sound evidence. Similarly, the patient benefits the most as he/she will get the required treatment based on best-practice and evidence-based practice.

Some of the suggestions focused on the safety of practitioners primarily. These include: access to counselling, implementation of the health and wellness policies, and effective provision of policies. One can agree that as much as the patient is the main focus of every emergency service, it is of utmost importance to take care of the staff members. It is unfortunate that these indicators did not meet the consensus criteria. Future reviews of indicators in a quality assurance system might yield the necessity to be included as part of such a system.

5.2.9 Satisfaction Survey

No agreement was reached in the initial two iterations. The indicator - patient/family satisfaction surveys conducted is the only indicator to achieve consensus in iteration three. This indicator is viewed as an outcome indicator and is focused on patient-centred measurement. According to Myers *et al.* (2008) this indicator forms part of the non-evidence-based measures to judge the performance of EMS systems. It stands to reason that it can be seen as an indicator for quality intervention processes. Eun *et al.* (2013) also used patient satisfaction surveys for their Emergency Medical Services Index. Similarly, satisfaction which is included as one of the Emergency Medical Services Outcome Project (EMSOP) initiated in the US, has provided an expedient framework for the South Australian Ambulance Service. With the review of the surveys, organizational managers can provide direct feedback to staff members on the positive outcomes and gives a starting point to address the short comings and potential for improvement. The iterations did not yield any further suggestions based on satisfaction surveys. It would appear that the experts were happy with the first indicator. Although one would expect feedback from the hospital staff and other services to improve inter-relationships among emergency services, no consensus was achieved for this indicator.

5.2.10 Competence Assurance

This indicator achieved mid to late consensus in the Delphi study. Consensus was only reached in the final two iterations. An interesting observation was that the experts did not consider the assessment

of skills not performed within six months to be of value to the measurement of quality in EMS. It is expected that practitioners maintain their competence of skills even though they do not perform these skills on patients regularly. Despite the non-consensus reached, this indicator focuses on maintaining and improving of hands-on skills of practitioners, and even though not included in the pilot study, should be reviewed for inclusion of future quality assurance systems. Interestingly, it was agreed that all emergency staff should comply with the AHA BLS for Healthcare provider course as a minimum to ensure competence assurance. Practitioners can therefore then proceed to complete the advanced courses as the BLS for Healthcare providers is a pre-requisite course. As a requirement all practitioners should comply with proper CPR standards and therefore the inclusion of this indicator will ensure that CPR competence is maintained.

Compliance with annual CEUs as discussed earlier is also considered for competence assurance of practitioners. Generally, practitioners should comply with the AHPCNA regulations with regards to the number of CEUs to be achieved every two years. Practitioners run the risk of being deregistered when they do not have the minimum amount of CEUs, which means that they cannot operate on the ambulance. This in itself fosters challenges for the supervising team of the emergency service, as logistical arrangements should be put in place for replacement staff. These two indicators form valuable metrics to measure the quality delivered by EMS systems and is therefore necessary for inclusion in the quality assurance system.

5.2.11 Cardiac Arrest

This indicator metric saw an improved consensus with the re-introduction in iteration two and iteration three respectively. Consensus was reached on timely defibrillation of arrhythmias and CPR training. In iteration three more indicators achieved consensus. These include telephonic guided CPR instructions, a call to scene response time of ≥5 minutes, identification of cardiac arrest and basic CPR with AED, and ALS attendance on cardiac arrest calls. The primary function of these indicators are to improve the survival of cardiac arrest victims. The outcomes success in prehospital cardiac arrest is linked to a multifactorial process within the EMS and is not purely based on a singular event (Myers et al., 2008). It is therefore important for the EMS system to have a holistic approach to ensure that all factors that could potentially affect the overall quality service delivery is continuously monitored and improved. It is evident that out-of-hospital cardiac arrest is an indicator measured in many of the first world countries. Despite having different indicators the country outcomes remain to improve response to, and survival from cardiac arrest (El Sayed, 2012). Similarly, it is envisaged that the indicators will initiate the improvement of response and survival of cardiac arrest victims in Namibia.

Realistically, a call to scene response time of ≤5 minutes can be very challenging if not impossible in Namibia, keeping in mind not to push crews to achieve 5-minute response times at the cost of endangering themselves and the public more than what they already are when responding. Additionally, emphasis should rather be placed on bystander CPR initiated via the dispatcher if CPR is not already performed on scene. The AHA has shown that chances of survival can double when bystander CPR is performed, this also increases the success rates of defibrillation in ventricular fibrillation (ACLS EP, p8). The sooner CPR can be started and an AED attached, with shock delivered, the better chance of survival for cardiac arrest victims. The AHA further mentions that: "For every minute that passes between collapse and defibrillation without CPR, survival rates from witnessed ventricular fibrillation sudden cardiac arrest decrease 7% to 10%. CPR provided by bystanders result in a more gradual decrease in survival rates that averages 3% to 4% per minute from collapse to defibrillation", (ACLS EP, p8). This smooth type of operation requires continuous training, from the dispatcher to the crews on scene. Training was again suggested as an addition to the cardiac arrest metric. This indicator received consensus from majority of the experts hence the inclusion in the pool of indicators for the quality assurance system.

5.2.12 ST Elevation Myocardial Infarction

Only two of the five indicators received consensus. An additional suggestion was made to add fibrinolysis as per protocol as a process indicator and timeliness as a quality dimension. However, this indicator did not achieve the 80% criteria mark. Similarly, the indicator – 12 lead ECG before and after treatment, and indicator – rapid transportation to PCI capable facility, also did not achieve consensus criteria. This was quite an interesting and bizarre observation as 12 lead ECG is the most important aspect of diagnosing a STEMI and should be done within 10 minutes of first contact with a patient (AHA, 2016). As in the case of rapid transportation to a PCI capable facility, since Namibia has not yet started the prehospital fibrinolysis process, it is of utmost importance that these patients are transported to a PCI facility, or then to a facility that can perform fibrinolysis if a PCI facility is not in close proximity or available. These non-consensus indicators form part of the AHA`s Acute Coronary Syndromes (ACS) algorithm and should be part of a quality assurance system when the quality of STEMI management is evaluated (AHA, 2016).

Two of the indicators did achieve the 80% criteria in iteration two. Administration of aspirin, nitroglycerine, morphine and oxygen as per protocol, and recording of pain score before and after treatment were the two consensus indicators. This result was expected because ACS has been treated with aspirin, nitroglycerine, morphine and oxygen for many years now. The mnemonic "MONA "which

stands for Morphine, Oxygen, Nitrates and Oxygen is well-known within the EMS and Emergency Medicine industry. Similarly, the recording of pain score is also well-known as it forms part of the mnemonic "OPQRST" for the assessment of ACS patients. This mnemonic stands for: Onset, Provoke/Palliate, Quality, Radiation, Severity and Time – pain score falls under the severity metric which measures the pain severity that the patient is experiencing expressed in a scale form. 1 is the least amount of pain, and 10 being the worst pain ever felt (Friese, 2020). Despite the two indicators achieving consensus, the quality measurement of STEMI should include a holistic approach to indicators as the success cannot be measured solely on one or two indicators but a collaborative of indicators.

5.2.13 Stroke

This indicator metric achieved consensus on all the proposed indicators. Two of the indicators reached consensus in iteration one, with the following iterations receiving consensus on one indicator each respectively. This result was expected as the standard assessment and care of suspected stroke patients in the prehospital setting includes the assessment of blood sugar levels, blood pressure, and the FAST assessment which represent Facial drop, Arm drop, Slurred Speech and recording time of onset of symptoms. All these assessments play a vital role in the positive identification of stroke. According to the American Heart Association (2016), the prehospital FAST criteria has a sensitivity of 86% to 96% in identification of a stroke. A low blood sugar level has similar presentations that can mimic that of a stroke hence the importance of its assessment and correction of blood sugar levels (Agrawal, Jamshed, Aggarwal and Ekka, 2014). As with STEMI, Stroke is also a time-based condition, meaning that if there is a time delay to reperfusion, more brain cells die as a result of lack of perfusion and oxygen, hence the saying "time is brain" (AHA, 2016). Stroke patients require a rapid assessment and identification and most importantly transportation to a facility that can adequately provide stroke care because fibrinolytic therapy should be administered within 3 hours of onset of symptoms for improved survival rates (AHA,2016). It is without a doubt that the quality care delivered prehospital to stroke victims should be evaluated, short comings identified and consequently improved.

5.2.14 Trauma Care

This category of indicators saw early consensus of three indicators in iteration one and none in iteration two and three. Recording of vital signs, rapid transportation to appropriate facility, and stopping of severe external bleeding are the three consensus indicators. It is not surprizing that these indicators achieved consensus because vital sign assessment and stopping of external bleeding falls

within the first priorities of caring for a trauma victim. Transportation to appropriate facility in Namibia as mentioned before is sometimes a challenge, especially the district areas of Namibia with only primary health clinics limited in resources and healthcare workers. Ensuring the basics of trauma care by prehospital staff is therefore of vital importance. It is arguable that to improve on the management of trauma care, a performance review needs to be done.

Surprisingly, despite three decent suggested indicators, the experts did not agree on any of them. The indicators include: Pain management, blood pressure management and cerebral perfusion and mean arterial pressure management. Lourens, Parker and Hodkinson (2020) concluded in their study that acute pain assessment and management in South Africa is below the international standards and should be monitored and promoted by EMS to ensure quality pain care by all cadres. The management of blood pressure management in trauma patients is somewhat controversial as no concrete evidence suggest specific blood pressure measurements for trauma patients of different aetiology. Generally, the permissive hypotension therapy has been the recommended management of traumatic shock, however, more in-depth studies are required to conclude who would benefit most from this intervention (Kudo, Yoshida and Kushimoto, 2017). Based on the current evidence and recommendations from the studies reviewed, it should be considered that these indicators be included in a monitoring and improvement system.

5.2.15 Seizures

The Delphi study yielded early and late agreement between experts on the indicators. Within the first iteration, the indicators – administration of benzodiazepine for active convulsions, and measurement of blood sugar levels achieved consensus. There was no agreement in the second iteration with one suggested indicator achieving consensus in the final iteration. The experts agreed that temperature measurement be added to the list of indicators for seizure management, which can be the route case of a convulsion, especially in paediatrics. It was expected that the indicators will achieve consensus. Internationally, the first line treatment for convulsions are benzodiazepines. Also, the assessment of blood sugar levels is considered as vital in the overall management of seizure victims by Myers *et al.,* (2008), and El Sayed, (2012). This therefore confirms its importance of inclusion to a quality assurance system.

5.2.16 Asthma

Beta-agonist and oxygen administration is the first line agents to relief the symptoms of asthma in patients. This is followed by the assessment of the patients` vitals such as respiratory rate, blood sugar levels and saturation of oxygen. It is not surprizing that these indicators achieved early consensus as it is already part of the scope of practice for emergency crews in Namibia. Being included in a quality assurance system would ensure continual quality care delivery to these cohorts of patients. Consideration of other more invasive pharmacological agents and procedures such as in-line nebulization for more severe case can be reviewed for future inclusion. The other two iterations did not yield any agreement. The indicator that fell in this category of non-consensus is the recording of Peak Expiratory Flow Rate (PEFR). A comment from a participant discredits its use as it takes time to calculate.

5.2.17 Medical Airway

The indicators in this category focused on advanced airway management, specifically documentation of endotracheal intubation confirmation, identification of dislodged/misplaced tubes and compliance with set guidelines. However, late consensus was achieved with only one indicator reaching the criteria for consensus. Documentation of endotracheal intubation was considered by the experts in this metric. As mentioned previously, documentation of skills performed is vital to any emergency service. It serves as evidence to the patient condition, the interventions performed and how that influenced the patients` condition, whether with a positive or negative outcome. Documentation can be viewed as a skill that needs to be practiced, evaluated and improved. Interestingly, the other two indicators did not fall in the success criteria for consensus. However, the success of the medical airway metric cannot be measured on one indicator only.

Despite disagreement from the participants, it is the view of the researcher that the identification of misplaced or dislodged endotracheal tubes should be considered imminent when there is a change of vital signs and immediately corrected as it can result in inadequate oxygenation and ventilation, and death if not resolved. This requires continuous training of practitioners and evaluation to ensure improvement. The compliance to airway management guidelines in itself has a multifactorial approach to ensure quality of the skill performed. Most guidelines are based on evidence informed procedures to ensure that the skills performed are safe and beneficial to the patients. To ensure that practitioners adhere to such guidelines therefore requires some form of evaluation. These indicators require a system to evaluate and improve its quality and should therefore be considered for inclusion in a quality assurance system.

5.2.18 Prehospital Intravenous Cannulation

This indicator achieved consensus within the first iteration with no new suggestions or comments. It was therefore not part of iterations two and three. Agreement was achieved on the attempt of IV lines on priority one patients before or during transportation to hospital. This indicator focuses on the attempt of the skill, as IV cannulation are not always successful. According to Revel, Porter and Greaves (2002), the technical skill is much easier if done earlier in the shocked patient rather than later on, as they might become peripherally shutdown, reducing the chance of successfully siting an IV. Despite the ongoing scrutiny of prehospital interventions causing a delay of transport to hospital, the benefits of having IV access can be equalized by ensuring that IV cannulation is performed en-route to hospital. There is an obvious health and safety risk performing the skill in a moving ambulance, however the suggestion has gained substantial support with the opinion that it can be done safely (Revel, Porter and Greaves,2002). There is no doubt that continuous training and evaluation is needed to ensure the benefit outweigh the risk, with the risk minimized as much as possible.

5.2.19 Consensus Indicators for the Namibian EMS Quality Assurance System

The Delphi study furnished consensus on 42 of the 67 proposed indicators. In Iteration one, experts agreed on 13 indicators, iteration two saw consensus on 12 indicators, and iteration three 17. It was expected that the indicators will achieve an 80% consensus quite easily because most of the indicators are well-known and assumed to be practiced within the EMS industry. However, it was surprizing to see some indicators not achieving consensus despite good evidence for its inclusion. Furthermore, it is suspected that some of the participants evaluated the compliance of their current or previous emergency organization with the indicators instead of considering the indicators for inclusion for a quality assurance system. This observation was made through the comments and suggestions made by some experts. Despite this observation, the study has made a good effort in the identification of indicators to initiate the first ever evaluation of EMS service delivery in Namibia.

5.3 Pilot Study on Quality Indicators

The pilot study was conducted at two of Namibia's emergency services identified as company X and Company Y for this study. Even though four of the emergency services within Windhoek were initially approached to be part of the pilot study, only two agreed with completion of the questionnaires. One company did not respond to the initial request, and the other despite granting permission, submitted two incomplete responses from the participants. These companies were therefore excluded from the pilot survey.

Since there is no scientific literature on a universally accepted and standardized assessment tool for prehospital emergency care (Razzak *et al.,* 2008), the investigator developed a survey with the primary objective of evaluating whether the emergency services in Windhoek comply with the proposed indicators. The survey was completed by the practitioners of the respective emergency services. Similarly, Daudelin *et al.* (2013) in the Massachusetts EMS Stroke Quality Improvement Collaborative conducted a survey to assess the emergency crews` experiences and perceptions on the stroke assessment and management at their respective emergency services. This pilot study yielded a positive response as participants received constant updates on the management of stroke patients. It is arguable that to conduct a questionnaire for the pilot study is a feasible way to ascertain quality indicator compliance. Furthermore, an approach to include in future evaluations is to employ the Plan-Do-Study-Act (PDSA) improvement model as used by Daudelin *et al.* (2013). However, due to time constraints this model could not be employed as part of this pilot study, consideration for future use is accepted.

The pilot study conducted at company X yielded a 50% agreement on quality indicators, and 50% variance on the other quality indicators. There was more agreement (*n*=13) than variance (*n*=9) in the clinical indicator domain, and more variance (*n*=12) than agreement (*n=8*) in the non-clinical domain. This means that participants agree more on the interventions performed on patients than the processes in the organization's operation. Caution should therefore be taken for the organizational processes not to affect the quality delivery of the clinical domain.

The non-clinical domain of indicators as mentioned previously is generally easily fixed as it does not require complex electronic systems and can easily be implemented by everyone. The participants made the following suggestions to improve the quality delivery. Daily checks of fleet should be introduced to ensure that the emergency fleet is in a well-functioning condition to respond to calls immediately. Regular checks of the fleet check sheets should be reviewed by management to identify shortcomings. To ensure the crew reaches the patient within the shortest possible time, it was suggested that the GPS systems be regularly updated. One participant felt that the public should be educated on how to react when emergency vehicles are approaching with lights and sirens to reduce the risk of crashes. Management should ensure that crews are trained in defensive and/or advanced driving techniques to ensure a safer and more experienced driver, and finally an ALS guidance program should be introduced for newly qualified staff to assist them with confidence levels as well as to ensure competence.

Within in the clinical domain, a participant felt that dispatchers should be trained to conduct online medical assistance as not all are equipped to provide the online care required. The training of CPR

should become part of the annual performance assessment for crews to ensure compliance. This will ensure that crews stay competent in performing the skill of CPR. Furthermore, ALS or ECT should be stationed on an ambulance or dispatched to all seizure calls for prompt administration of a benzodiazepine in the event of a presenting convulsion. Another participant felt that the company should provide proper equipment to assess for temperature. In the case of providing on-scene IV access, it is advisable that practitioners adhere to the ATLS guidelines on prehospital IV access and fluid resuscitation.

At company Y, the pilot study saw a 36% (*n*=15) agreement, and a 64% (*n*=27) variance on the compliance of the proposed quality indicators. Interestingly, the non-clinical domain showed a higher variance in both the non-clinical (*n*=15) and clinical (*n*=12) indicator domain. The agreement in this pilot study was lower than expected with n=5 in the non-clinical and n=10 in the clinical domain. It stands to reason that with a greater number of variance there is less compliance to specific indicators and therefore requires a great deal of improvement to ensure adequate service delivery and consistency among practitioners on the operational and clinical level.

An interesting observation was that similar to company X participants from company Y made the same suggestions to improve the quality delivery of some indicators. These include: training of drivers with advanced driving techniques will improve driver skills to respond to calls safely. Quarterly CPR training will ensure competence of CPR skills and knowledge. Furthermore, ensuring that each shift is manned by an ALS or ECT practitioner will result in the administration of drugs when necessary. Participants confirmed that no patient or family satisfaction surveys are being conducted and should be introduced at company Y for feedback on how well the service is delivered.

It was observed that majority of the suggestions are not substantiated by evidence. However, it is expected that the initiation of this pilot study will encourage participants to gather more data on the specific indicators for future research. It is also envisaged that with the results from the pilot study, managers/supervisors of company X and Y will be encouraged to consider the employment of quality indicators to measure the effectiveness of the organization. The employment of a pilot study to measure the quality service delivery indicators requires more research and refinement before final role out is done.

5.4 Limitations

The limitations that exist within this study includes:

1. Access to many relevant journals that would have provided studies relating to the research objectives were limited despite the effort and assistance of the librarian.
2. The Delphi study is based on expert opinion which has potential for inherent bias as iterations progress.
3. There is a small data set due to a small number of experts.
4. A drop in response rate with progressing iterations of the Delphi.
5. The Delphi does not allow in-depth analysis of expert opinion of indicators. Interpretation of expert suggestions can be challenging if comments and suggestions are not comprehensive enough.
6. No set standard of quality assurance for EMS exist, and the quality assurance system will be based on trial and error.
7. Quality assurance is a new concept in the Namibian EMS system, and therefore could have resulted in misinterpretation from the experts on the indicator metrics.
8. Receptiveness to implementation of quality indicators were low. This may indicate that change management within the EMS sector is not welcomed as expected.
9. The implementation of quality indicators in larger health institutions such as the State ambulance service which would have affected improvement of EMS service delivery on a larger scale is lacking.
10. By-in from EMS management, especially private services to partake in the initiation of a collective quality assurance system for the whole of Namibia is not welcomed by all.
11. Private ambulance services are relatively small, so a small participant number for the pilot study resulted in a small data set
12. The response rate of emergency services on pilot study limited the data collected.

CHAPTER 6: CONCLUSION

The main aim of the study was to develop a quality assurance system by identifying quality indicators used by EMS organizations internationally. This was achieved by a comparative analysis of international quality assurance systems. The literature review revealed that many high-income countries employ quality indicators to measure the quality care delivered in the prehospital field. Despite there being no universally set standard of developing quality indicators substantiated by evidence, EMS systems resort to benchmark approaches to identify quality indicators that suit their system locally. This allowed for the extrapolation of quality indicators for the Namibian setting. The study identified quality indicators that are relevant to the Namibian setting for implementation in EMS organizations to ensure improvement of care delivered.

The constant evolution of the emergency medical field requires continuing improvement of care provided by emergency practitioners. The role that EMS play in the chain of survival of critically ill and injured people demands that the care delivered remains at an acceptable standard and in line with current evidence-based practices. The assessment of EMS has therefore become a day-to-day function to ensure the performance is kept at that acceptable level. The success of prehospital care has previously been decided on individual non-clinical indicators and has not included a holistic view of other metrics that affect the quality of care delivered. High-income countries have already initiated research in this field and have succeeded in improving their quality systems by implementing the quality indicators extrapolated from benchmarks with other countries. The Namibian EMS being in the infancy stage, was sensitized through the objectives of this study by identifying an array of indicators that covers the non-clinical aspect as well as the clinical aspect of quality delivery. This ensures a holistic approach to measure the performance of emergency medical care delivery in Namibia.

Through a Delphi process, experts within the Namibian EMS fraternity were able to agree on quality indicators that can be implemented in the rest of EMS organizations to improve service delivery. Although these indicators are not evidence-based, it adds to the existing cohort of indicators being measured internationally. More in-depth research into the Namibian indicators is warranted and will ensure that the true effectiveness of service delivery can be pinpointed and improved.

A pilot of the consensus indicators revealed that two emergency services in Windhoek already comply with most of the indicators. This shows the potential for improvement in these services should the interest for quality measurement grow in other emergency services across Namibia. Continuation of assessment of these indicators at the respective emergency services will foster better ways of improvement. Ideally, the implementation of a quality assurance system should be regulated by the

MOHSS to ensure that all emergency services comply with the developed indicators, and if non-compliance is identified, it be addressed as soon as possible.

The development of a quality measurement system will ensure the collection of sound literature for future reference in prehospital research. For long the Namibian EMS industry has suffered the consequences of not having a quality assurance system in place that measure the quality of emergency medical care delivered. A lot has been learnt about the identification of quality indicators and the implementation of it. This study has allowed the Namibian EMS industry to follow suit of international standards of quality care assessments.

CHAPTER 7: RECOMMENDATIONS

This research study presents the following recommendations:

- The majority of quality indicators are process indicators, thus further investigation to identify indicators that focus on patient outcomes is needed.
- Inclusion of other emergency services such as the state ambulance service, and other private ambulance services in the north and western parts of Namibia to be included in the quality assurance system measurement.
- Consensus meetings should be conducted before the commencement of the online survey to ensure clarity and understanding on expectations of participants.
- It is recommended that the criteria for the Delphi expert panel be reviewed and increased to a higher level of experience in the field of EMS, an addition of a research background will be beneficial.
- The identification of useful articles requires access to web-based journals specifically for the prehospital emergency care industry. Access to these journals to be sought and confirmed for free-access to the necessary research articles to identify a larger number of quality indicators.

REFERENCES

Aaronson, E.L., Marsh, R.H., Guha, M., Schuur, J.D., Rouhani, S.A. (2015) Emergency department quality and safety indicators in resource-limited setting: an environmental survey. *International Journal of Emergency Medicine*. *8*(39), DOI 10.1186/s12245-015-0088-x

Agrawal, N., Jamshed, N., Aggarwal, P., Ekka, M., (2014). Severe Hypoglycaemia Masquerading as Cerebellar Stroke. *Journal of Family Medicine and Primary Care*, *3*(4):440-442. doi: 10.4103/2249-4863.148144

Al-Shaqsi, S. (2010). Models of International Emergency Medical Services (EMS) Systems. *Oman Medical Journal*. *25*(4): 320-323. DOI: 10.5001/omj.2010.92

Ameh, S., Gomez-Olive, F.X., Kahn, K., Tollman, S.M., Klipstein-Grobusch, K. (2017). Relationship between structure, process and outcome to assess quality of integrated chronic disease management in a rural South African setting: applying a structurally equation model. BMC Health Services Research. *17*(229), DOI 10.1186/s12913-017-2177-4

American Heart Association, Advanced Cardiac Life Support Provider Manual. 2016

American Heart Association, ACLS for Experienced Providers Manual and Resource Text. 2017

Ayanian, J.Z., Markel, H. 2016. Donabedian Framework for Health Care Quality, *The New England Journal of Medicine. Retrieved from www.nejm.org*

Beattie, M., Shepherd, A., Howieson, B. (2013). Do the Institutes of Medicine`s (IOM) dimensions of Quality capture the current meaning of quality in health Care? – An Integrative review, *Journal of Research in Nursing. 18*(4)288-304. doi:10.117/1744987112440568

Beattie, E., Mackway-Jones, K. (2004). A Delphi study to identify performance indicators for emergency medicine. *Emergency Medical Journal*. *21*(1)47-50. Doi:101136/emj.2003.001123

Boulkedid, R., Abdoul, H., Loustau, M., Sibony, O., Alberti, C. (2011). Using and Reporting the Delphi Method for Selecting Healthcare Quality Indicators: A Systematic Review. *6*(6): doi.org/10.1371/journal.pone.0020476

Brady, S., R. (2015). Utilizing and Adapting the Delphi Method for Use in Qualitative Research.

International Journal of Qualitative Methods, (2015)1-6 doi: 10.1177/1609406915621381

Braithwaite, S., Dorsett, M., Redlener, M. (2019). Quality in EMS: Past, Present& Future. *Journal of Emergency Medical Services*. Retrieved from https://www.jems.com/2019/03/29/quality-in-ems-past-present-and-future/

Broccoli, M., C., Moresky, R., Dixon, J., Maya, I., Taubman, C., Wallis, L., A., Hynes, E., J., C. (2017). Defining quality indicators for emergency care delivery: findings of an expert consensus process by emergency care practitioners in Africa. *BMJ Global Health*. Retrieved from https://gh.bmj.com/content/bmjgh/3/1/e000479.full.pdf

Brown, L., Franco, L., Rafeh, N., Hatzell, T. (2000). Quality Assurance Methodology Refinement Series: Quality Assurance of Health Care in Developing Countries. Retrieved from https://pdfs.semanticscholar.org/db7a/71c45f42e17bf6be7e578325ff85d20a22d1.pdf

Christensen, E., F., Belac, P., A., Nielsen, H., Christiansen, F. (2016). The Danish quality database for prehospital emergency medical services. *Dove Press: Clinical Epidemiology*. Retrieved from file:///C:/Users/Brandon.Diergaardt/Downloads/CLEP-100919-the-danish-quality-database-for-prehospital-emergency-medica_102516.pdf

Dantas, R.A.N., Torres, G.V., Salvetti, M.G., Dantas, D.V., Elza, A., Mendonca, O. (2015). Instrument for assessing the quality of mobile emergency pre-hospital care: content validation. *Journal of School of Nursing. 49*(3). 380-386. Retrieved from http://www.scielo.br/pdf/reeusp/v49n3/0080-6234-reeusp-49-03-0381.pdf

De Villiers, M.R., De Villiers, P. (2015). The Delphi technique in health science education. *Medical Teacher. 27* (7), 639-643. Retrieved from https://www.researchgate.net/publication//7436195

Daudelin, D.H., Kulick, E.R., D`Amore, K., Lutz, J.S., Barrientos, M.T., Foell, K. (2013). The Massachusetts Emergency Medical Service Stroke Quality Improvement Collaborative, 2009-2012. *Preventing Chronic Disease*; *10*:130126. DOI: http://dx.doi.org/10.5888/pcd10.130126.

El Sayed, M. J. (2012). Measuring Quality in Emergency Medical Services: A Review of Clinical Performance Indicators. *Emergency Medicine International*, (2012). Article 61630, doi:10.1155/2012/61630

Eun, S.J., Lee, J.S., Kim,Y., Jung, K.Y., Park, S.K., Lee, JiY. (2013). Evaluating the Performance of the Emergency Medical Services Index. *Health Policy Management. 23*(2) 176-187. Retrieved fromhttps://www.researchgate.net/publication/263992988_Evaluating_the_Performance_of_the_Emergency_Medical_Services_Index

Fatta, S., Johnsen, A.S., Sollid, S.J.M., Wisborg, T., Rehn, M. (2016). Reporting Helicopter Emergency Medical Services in Major Incidents: A Delphi Study. *Air Medical Journal. 35* (2016) 348-351

Friese, G. (2020). How to use OPQRST as an effective patient assessment tool. Retrieved from https://www.ems1.com/ems-products/education/articles/how-to-use-opqrst-as-an-effective-patient-assessment-tool-yd2KWgJIBdtd7D5T/

Government Gazette of the Republic of Namibia (2018). *Regulations Relating to Scope of Practice for the Profession of Emergency Care: Allied Health Professions Act, 2004.* (Publication No 6690) Retrieved from https://www.greengazette.co.na/notices/regulations-relating-to-scope-of-practice-for-the-profession-of-emergency-care-allied-health-professions-act-2004_20180829-GGN-06690-00196

Graff, L., Stevens, C. and Spaite, D. (2002). Measuring and Improving Quality in Emergency Medicine. *ACAD EMERG MED, 9* (1), 1091-1107. Retrieved from https://www.academia.edu/32736171/Measuring_and_Improving_Quality_in_Emergency_Medicine

Hall, W., Boukas, N., Bronsky, S., Caffrey, S., Chambers, B., Clark, W. … & Weber, K. (2017). An introduction to continuous quality improvement for EMS systems. Colorado Department of Public Health and Environment. Retrieved from https://labent.catalog.aspencat.info/GroupedWork/bdf1dc8e-5d13-0b3d-0790-ef4cd97da086/Home

Hanafin, S. (2004). Review of Literature on Delphi Technique (PHD Thesis). Retrieved from https://www.dcya.gov.ie/documents/publications/Delphi_Technique_A_Literature_Review.pdf

Haugland, H., Rehn, M., Klepstad, P., Kruger, A. & The EQUIPE-collaboration group. (2017).

Developing quality indicators for physician-staffed emergency medical services: a consensus process . *Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine,* 2017:14, doi: 10.1186/s13049-017-0362-4

Howard, I., Cameron, P., Wallis, L., Castren, M., Lindstrom, V. (2018). Quality Indicators for Evaluating Prehospital Emergency Care: A Scoping Review, Retrieved from https://doi.org/10.1017/S1049023X17007014

Howard, I., Cameron, P., Wallis, L., Castren, M., Lindstrom, V. (2019). Identifying quality indicators for Prehospital emergency care services in the low to middle income setting: The South African perspective. *African Journal of Emergency Medicine, 9,* 185-192. Doi:10.1016/j.afjem.2019.07.003

Howel, M., A. (2007). *A Quality Assurance Initiative for Emergency Medical Services* (Master's Thesis) Retrieved from http://corescholar.libraries.wright.edu/cgi/viewcontent.cgi?article=1064&context=mph

Hung, K., Jerng, J. (2014). Time to have a paradigm shift in healthcare quality measurement. *Journal of the Formosan Medical Association, 113*(673-679). Retrieved from http://dx.doi.org/10.1016/j.jfma.2014.06.003

Islam, F., Rahman, A., Halim, A., Eriksson, C., Rahman, F., Dalal, K. (2015). Perceptions of health care providers and patients on quality of care in maternal and neonatal health in fourteen Bangladesh government healthcare facilities: a mixed-method study. *BioMed Central Health Services Research*, *15*(237). DOI 10.1186/s12913-015-0918-9

Kelly, J.J., Thallner, E., Broida, R.I., Cheung, D., Meisl, H., Hamedani, A.G., Klauer, K., & Beach, C. (2010). Emergency Medicine Quality Improvement and Patient Safety Curriculum. *Society for Academic Emergency Medicine*, *17*(S2). Retrieved from https://doi.org/10.1111/j.1553-2712.2010.00897.x

Kudo, D., Yoshida, Y., Kushimoto., S., (2017). Permissive hypotension/hypotensive resuscitation and Restrictive/controlled resuscitation in patients with severe trauma. *Journal of Intensive Care*. *5*(11). Retrieved from https://jintensivecare.biomedcentral.com/articles/10.1186/s40560-016-0202-z

Lighter, D. (2015). How (and why) do quality improvement professionals measure performance?

*International Journal of Paediatrics and Adolescent Medicine (2),*7-11. Retrieved from http://dx.doi.org/10.1016/j.ijpam.2015.03.003

Lincoln, E.W., Reed-Schrader, E., & Jarvis, J.L., (2019). EMS Quality Improvement Programs. *Stat Pearls Publishing.* Retrieved from http://ncbi.nlm.nih.gov/books/NBK536982/

Lourens, A., Parker, R., Hodkinson, P., (2020). Prehospital acute traumatic pain assessment and management practices in the Western Cape, South Africa: a retrospective study. *International Journal of Emergency Medicine,* 13:21. Retrieved from http://doi.org/10.1186/s12245-020-00278-w

MacFarlane, C., Benn, C.A. (2003). Evaluation of emergency medical services systems: a classification to assist in determination of indicators, *Emergency Medical Journal 20*(2). Retrieved from https://emj.bmj.com/content/emermed/20/2/188.full.pdf

Mains, J. (2003). Defining and classifying clinical indicators for quality improvement. *International Journal for Quality in Health Care, 15* (6): 523-530. doi: 10.1093/intqhc/mzg081

Maphumulo, W.T., & Bhengu, B.R., (2019). Challenges of quality improvement in the healthcare of South Africa post-apartheid: A critical review, *Curationis,* 42(1), Retrieved from https://doi.org/10.4102/curationis.v42i1.1901

Maritz, D., Hodkinson, P., Wallis, L. (2010). Identification of performance indicators for emergency centres in South Africa: results of a Delphi Study, *International Journal of Emergency Medicine, 3* (4): 341 – 349. doi: 10.1007/S12245-010-0240-6

McLean, S.A., Maio, R.F., Spaite, D.W., Garrison, H.G., (2002). Emergency Medical Services Outcomes Research: Evaluating the Effectiveness of Prehospital Care. *Prehospital Emergency Care*, *6*(2), 52-56. doi: 3109/10903120209102683

Messelken, M., Kehrberger, E., Dirks, B., Fischer, M. (2010). The Quality of Emergency Medical Care in Baden-Wurttemberg (Germany). *Deutsches Arzteblatt International*, *107*(30): 523-30. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2925343/

Mitchell, P., Ferketich, S., Jennings, B.M. (1998). Quality Health Outcomes Model. *Journal of Nursing*

Scholarship, *4*(4), 43-46. Retrieved from https://sigmapubs.onlinelibrary.wiley.com/doi/abs/10.1111/j.1547-5069.1998.tb01234.x

MoHSS (2014). Ministry of Health and Social Services. *Assessment of the National Quality Management Systems Used to Monitor and Improve Quality in Health Service Provision in Hospitals and Health Centres in Namibia.* Final Report, Windhoek, Namibia; retrieved from http://www.mhss.gov.na/files/downloads/fa1_Quality%20Management%20Systems%20Assessment%20Report%202014.pdf-17-07-2017

Moore, L. (1999). Measuring quality and effectiveness of prehospital ems. *Prehospital Emergency Care*, *3* (4), 325-331. Retrieved from http://dx.doi.org/10.1080/10903129908958963

Munk, M.D., White, S.D., Perry, M.L., Platt, T.E., Hardan, M.S., Stoy, W.A., (2009). Physician Medical Direction and Clinical Performance at an Established Emergency Medical Services System. *Prehospital Emergency Care, 13*:185-192. Doi:10.1080/10903120802706120

Murphy, A., Wakai, A., Walsh, C., Cummings, F., O`Sullivan, R. (2016). Development of key performance indicators for prehospital emergency care. *Journal of Emergency Medicine*, *33*:286-292. DOI: 10.1136/emermed-2015-204793

Myers, J. B., Slovis, C. M., Eckstein, M., Goodloe, J. M., Isaacs, S. M., Loflin, J. R., ... & Pepe, P. E. (2008). Evidence-Based Performance Measures for Emergency Medical Services Systems: A Model for Expanded EMS Benchmarking, A Statement Developed by the 2007 Consortium U.S. Metropolitan Municipalities EMS Medical Directors (Appendix). *Prehospital Emergency Care 2008;12*: 141-151. Doi:10.1080/10903120801903793

Namibia Statistics Agency. (2017) *Namibia Inter-censal Demographic Survey 2016 Report.* Retrieved from https://d3rp5jatom3eyn.cloudfront.net/cms/assets/documents/NIDS_2016.pdf

O`Meara, P. (2005). A generic framework for ambulance services: An Australian health services perspective. *Journal of Emergency Primary Health Care, 3*(3), 2005. Retrieved from https://www.researchgate.net/publication/239604504_POLICY_AND_SERVICE_DELIVERY_A_generic_performance_framework_for_ambulance_services_an_Australian_health_services_perspective_Article_990132

Pap, R., Lockwood, C., Stephenson, M., Simpson, P. (2017). Indicators to measure prehospital care

quality: a scoping review. *Joanna Briggs Institute Database of Systematic Reviews and Implementation Reports. 15*(6):1537–1542. DOI: 10.11124/JBISRIR-2016-003141

Poulsen, N.R., Jepsen, J.F., Christensen, E.F. (2019). Quality indicators in the prehospital emergency medical service: A scoping review. *BMJ Open* 2019;9. Retrieved from https://bmjopen.bmj.com/content/bmjopen/9/Suppl_2/A4.1.full.pdf

Rahman, N.H., Tanaka, H., Shin, S.D., Yih Ng, Y., Piyasuwankul, T., Lin, C.H., Eng Hock Ong, M. (2015). Emergency medical services key performance measurement in Asian cities. *International Journal of Emergency Medicine*. *8*(12). DOI 10.1186/s12245-015-0062-7

Revel, K., Porter, K., Greaves, I., (2002). Fluid resuscitation in prehospital trauma care: a consensus review. *Emergency Medicine Journal*. (19): 494-498. Retrieved from https://emj.bmj.com/content/emermed/19/6/494.full.pdf

Razzak, J.A., Hyder, A.A., Akhtar, T., Khan, M., Khan, U.R., (2008). Assessing emergency medical care in low income countries: A pilot study from Pakistan. *BMC Emergency Medicine*, *8*(8). Doi:10.1186/147I-227X-8-8

Stelfox, H.T., Bobranska-Artiuch, B., Nathens, A., Straus, S.E., (2010). Quality Indicators for Evaluating Trauma Care, A Scoping Review. *Archsurg 145*(3):286-295. Retrieved from www.archsurg.com

Stelofox, H.T., Straus, S.E., (2013). Measuring quality of care: considering measurement frameworks and needs assessment to guide quality indicator development. *Journal of Clinical Epidemiology,* (66):1320-1327. Retrieved from https://www.jclinepi.com/article/S0895-4356(13)00254-0/pdf

Tesser, M.,(2017, December 19). EMS Namibia – Discover the public ambulance service with the Ministry of Health and Social Services. *Emergency Live*. Retrieved from https://www.emergency-live.com/ambulance/ems-namibia-discover-the-public-ambulance-service-with-the-ministry-of-health-and-social-services/

Tesser, M., (2018). Australian researchers together to find new evidence based quality Indicators for prehospital care. *Australian Prehospital care quality Indicator Projects*. Retrieved from https://www.emergency-live.com/ambulance/aspire-australian-researchers-together-to-find-new-evidence-based-quality-indicators-for-prehospital-care/

Tozija, F., Jankulovski, N., (2013). Strategy to improve quality in emergency medical services: from assessment to policy. *Arh Hig Rada Toksikol*, *64* (4): 567-79. Retrieved from https://pubmed.ncbi.nlm.nih.gov/24384764/

Tottossy, A.P., (2005). Teacher Selection: A Delphi Study. PHD Thesis. Retrieved from https://vtechworks.lib.vt.edu/bitstream/handle/10919/26442/TottossyFinal317PDF.pdf;sequence=1

Twycross, A.M., Chorney, J.M., McGrath, P.J., Finley, G.A., Boliver, D.M., Mifflin, K.A. ,(2013). A Delphi study to identify indicators of poorly managed pain for paediatric postoperative and procedural pain. *Pain Resuscitation Management*,*18*(5), e68-e74. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3805352/

Van de Glind, I., Berben, B., Zeegers, F., Poppen, H., Hoogeveen, M., Bolt, I., …. Vloet, L., (2016). A national research agenda for prehospital emergency medical services in the Netherlands: A Delphi-study. *Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine, 24*(2). Retrieved from https://sjtrem.biomedcentral.com/track/pdf/10.1186/s13049-015-0195-y

Venter, M., Stassen, W., (2016). The capabilities and scope-of-practice requirements of advanced life support practitioners undertaking critical care transfers: A Delphi study. *South African Journal of Critical Care. 32*(2):58-61. DOI 10.7196/SAJCC. 2016.v32i2.275

World Health Organization, (2018). *Global Status Report on Road Safety.* Retrieved from https://apps.who.int/iris/bitstream/handle/10665/276462/9789241565684-eng.pdf?ua=1&ua=1

Appendix A – Quality Indicator Identity key

Indicator	Indicator Identity Key	Non-Clinical Indictor
Response Time	RT1	Are emergency fleet in a well-functioning condition to respond to calls immediately? Type of Indicator: Structure Quality Dimension: Timeliness
	RT2	What is the time interval from when the call is received until the first unit arrives at the patient? Type of Indicator: Structure Quality Dimension: Timeliness
	RT3	Was the patient transported to the correct facility? Type of Indicator: Outcome Quality Dimension: Patient-centred
	RT4	Are response times recorded correctly? Type of Indicator: Process Quality Dimension: Effectiveness
	RT5	Did the crew encounter any dangerous situation during response? Type of Indicator: Process Quality Dimension: Safety
	RT6	Are resources allocated in the correct region/area for quick responses? Type of Indicator: Structure Quality Dimension: Timeliness
	RT7	Response Distance Radius, Type of Indicator: Structure, Quality Dimension: Timeliness
	RT8	Crew response skills, Type of Indicator Process, Quality Dimension Efficiency/Safety
	RT9	Time to definitive management, Type of Indicator Process, Quality Dimension Effectiveness
	RT10	Call received to dispatch, Type of Indicator Process, Quality Dimension Timeliness
	RT11	Correct information relayed to crew, Type of Indicator Process, Quality Dimension Efficiency
On-scene Time	OS1	What is the time interval from arrival at the patient until transport is initiated? Type of Indicator: Process Quality Dimension: Timeliness
	OS2	Did the patient receive the required level of care? Type of Indicator: Process Quality Dimension: Effectiveness
	OS3	Available ambulances, Type of Indicator Structure, Quality Dimension Patient-centred
	OS4	Triage time by ECP, Type of Indicator Process, Quality Dimension Effectiveness
	OS5	Crew Competence, Type of Indicator Outcome, Quality Dimension Effectiveness
Dispatch Centre	DC1	Appropriately staffed per shift. Type of indicator: Structure Quality Dimension: Efficient
	DC2	Are the staff appropriately qualified in the dispatch centre? Type of indicator: Structure Quality Dimension: Effectiveness
	DC3	Does the dispatcher get adequate information for responding units? Type of indicator: Process Quality Dimension: Effectiveness
	DC4	Does the dispatcher provide online medical assistance and feedback? Type of indicator: Process Quality Dimension: Patient-centred
	DC5	Does the dispatch centre have dispatch criteria for different resources? Type of indicator: Structure Quality Dimension: Efficient
	DC6	Does the supervisor/manager provide assistance and oversight in mass casualty incidences? Type of indicator: Process Quality Dimension: Effectiveness
	DC7	Correct Sources Dispatched? Structure, patient-centred
	DC8	Quality training offered to staff? Structure, safety, efficiency
	DC9	Provide effective feedback & collaborate with the agent to develop an action plan? Type of indicator: Structure. Quality Dimension: Effectiveness.
Equipment	EQ1	Do the ambulances and response vehicles have the required equipment at all times? Type of Indicator: Structure Quality Dimension: Efficient
	EQ2	Is equipment in a properly functioning condition, serviced and calibration maintained? Type of Indicator: Structure Quality Dimension: Efficient

	EQ3	Are equipment inventory records available? Type of Indicator: Structure Quality Dimension: Efficient
	EQ4	Are breakages and faults reported on the inventory and to the relevant supervisor/manager? Type of Indicator: Process Quality Dimension: Effectiveness
	EQ5	Equipment Lifespan, structure, safety
Staff Compliment	SC1	Does the emergency service have enough staff to run operations smoothly? Type of Indicator: Structure Quality Dimension: Efficient
	SC2	20. Staff Compliment - Does the emergency service have a balanced staff compliment of BLS, ILS, ECT & ALS? Type of Indicator: Structure Quality Dimension: Efficient
	SC3	Are staff qualified? Type of Indicator: Process Quality Dimension: Effectiveness
	SC4	Continuous Professional Development Compliance Type of Indicator: Safety Quality Dimension: Efficient
	SC5	Back-up staff for Mass Casualty Incidence Type of Indicator: Structure Quality Dimension: Efficient
Staff Training	ST1	Are staff members appropriately trained and skilled (competent)?Type of Indicator: Structure Quality Dimension: Effectiveness
	ST2	Does the emergency service provide continuing development programmes for staff? Type of Indicator: Structure Quality Dimension: Efficient
	ST3	Are case reviews and debriefing sessions conducted on difficult cases? Type of Indicator: Process Quality Dimension: Efficient
	ST4	Does the service have a mentorship programme for newly qualified staff? Type of Indicator: Structure Quality Dimension: Safety
	ST5	Debriefing Session Type of Indicator: Process Quality Dimension: Patient Centered.
Standard Operating Procedures	SOP1	Does the service have a SOP in place? Type of Indicator: Process Quality Dimension: Safety
	SOP2	Are the SOP`s adequately executed? Type of Indicator: Process; Quality Dimension: Effectiveness
	SOP3	Signed off by staff Type of Indicator: Outcome Quality Dimension: Effectiveness.
Patient Report Form	PRF1	Is data completion on PRFs adequately done? Type of Indicator: Process Quality Dimension: Effectiveness
	PRF2	Are PRFs peer-reviewed before submission to case management unit? Type of Indicator: Process Quality Dimension: Effectiveness
	PRF3	Are PRFs reviewed by ALS or supervisor and feedback provided? Type of Indicator: Process Quality Dimension: Effectiveness
	PRF4	Adequate data capturing, Type of Indicator: Process Quality Dimension: Patient-centred
	PRF5	Quality Assurance performed on PRF data, Type of Indicator: Outcome Quality Dimension: Efficient
	PRF6	Storage and availability, Type of Indicator: Outcome Quality Dimension: Effectiveness, Patient centred
Incident Reporting	IR1	Are all incidents reported immediately? Type of Indicator: Process Quality Dimension: Timeliness
	IR2	Are Incidences reported to the designated person in charge? Type of Indicator: Process Quality Dimension: Efficient
	IR3	Are incidents addressed in the appropriate manner? Type of Indicator: Process Quality Dimension: Effectiveness
	IR4	Signed off Type of Indicator: Process Quality Dimension: Safety.
Safety of Staff and Patients	SSP1	Are patients treated according to set clinical Guidelines? Type of Indicator: Process Quality Dimension: Patient-centred

	SSP2	Are the facilities conducive for staff comfort? Type of Indicator: Structure Quality Dimension: Safety
	SSP3	Are working conditions and working hours conducive for staff? Type of Indicator: Structure Quality Dimension: Equity
	SSP4	Surveys Type of Indicator: Process Quality Dimension: Safety
	SSP5	Access to Counselling Type of Indicator: Structure Quality Dimension: Safety, Effectiveness
	SSP6	Vehicles and Equipment Maintenance Type of Indicator: Structure Quality Dimension: Safety
	SSP7	Implement and manage Health promotion and Wellness programmes. Type of Indicator: Structure. Quality Dimension: Safety
	SSP8	Develop policy for effective service provision in private and public EMRS. Type of indictor: Process indicator. Quality Dimension: Safety, Effectiveness
Satisfaction Surveys	SS1	Are patient/family satisfaction surveys being conducted? Type of Indicator: Outcome Quality Dimension: Patient-centred
	SS2	Are hospital satisfaction surveys being conducted on EMS hand over, inter-professional engagement/interaction and management of patients done? Type of Indicator: Outcome Quality Dimension: Efficient
	SS3	Survey Reviews and Implementation Type of Indicator: Process Quality Dimension: Effectiveness.
Competence Assurance	CPA1	Do practitioners get assessed on skills not performed within six months? Type of Indicator: Structure Quality Dimension: Efficiency
	CPA2	Do practitioners comply with the number of required Continuing Education Units (CEUs) annually? Type of Indicator: Structure Quality Dimension: Safety
	CPA3	Staff certified as BLS HCP, Type of Indicator: Structure, Quality Dimension: Equity
Indicator	**Indicator Identity Key**	**Clinical Indictors**
Cardiac Arrest	CA1	Does the dispatcher provide telephonic-guided CPR instructions? Type of Indicator: Process Quality Dimension: Effectiveness
	CA2	Is call to scene response interval ≤5 minutes? Type of Indicator: Process Quality Dimension: Efficient
	CA3	Does the crew identify cardiac arrest and basic CPR with AED initiated immediately? Type of Indicator: Process Quality Dimension: Effectiveness
	CA4	Is ALS present on all cardiac arrest cases? Type of Indicator: Process Quality Dimension: Efficient
	CA5	Is timely initial defibrillation delivered to convert arrhythmia to a sinus rhythm? Type of Indicator: Outcome Quality Dimension: Effectiveness
	CA6	Is Return of Spontaneous Circulation (ROSC) achieved before or at arrival at hospital? Type of Indicator: Outcome Quality Dimension: Effectiveness
	CA7	CPR Training Type of Indicator: Outcome Quality Dimension: Effectiveness
ST Elevation Myocardial Infarction	STEMI1	Administration of Aspirin, Nitroglycerine, morphine, oxygen as per protocol. Type of Indicator: Process Quality Dimension: Effectiveness
	STEMI2	12 Lead ECG before and after treatment. Type of Indicator: Process Quality Dimension: Effectiveness
	STEMI3	Rapid transportation to PCI capable facility. Type of Indicator: Process Quality Dimension: Effectiveness
	STEMI4	Recording of pain score before and after treatment. Type of Indicator: Process Quality Dimension: Effectiveness
	STEMI5	Thrombolizing as per protocol, Type of Indicator: Process, Quality Dimension: Timeliness

Stroke/ Transient Ischemic Attack	STIA1	Recording of FAST test. Type of Indicator: Process Quality Dimension: Effectiveness
	STIA2	Recording of blood sugar levels. Type of Indicator: Process Quality Dimension: Effectiveness
	STIA3	Recording of Blood Pressure. Type of Indicator: Process Quality Dimension: Effectiveness
	STIA4	Are crews adhering to the Angles policy, ToI: Process, Patient centred
Trauma Care	TC1	Recording of vitals (BP, Respiratory Rate, SpO2, Pupil Reaction, GCS). Type of Indicator: Process Quality Dimension: Efficient
	TC2	Rapid transportation to appropriate facility. Type of Indicator: Process Quality Dimension: Effectiveness
	TC3	Entrapment time < 10 minutes. Type of Indicator: Process Quality Dimension: Effectiveness
	TC4	Stopping of severe external bleeding. Type of Indicator: Process Quality Dimension: Effectiveness
	TC5	Pain Management Type of Indicator: Outcome Quality Dimension: Effectiveness
	TC6	Blood Pressure Management, Type of Indicator: Outcome Quality Dimension: Effectiveness
	TC7	Maintaining Cerebral perfusion and MAP, Type of Indicator: Outcome Quality Dimension: Effectiveness
Seizures	SZ1	Administration of benzodiazepine for active convulsions. Type of Indicator: Process Quality Dimension: Effectiveness
	SZ2	Measurement of blood sugar level. Type of Indicator: Process Quality Dimension: Effectiveness
	SZ3	Temperature Measurement, Type of Indicator: Process Quality Dimension: Patient centred
Asthma	AS1	Agonist and oxygen administration. Type of indicator: Process Quality Dimension: Effectiveness
	AS2	Recording of respiratory rate, blood sugar levels and SpO2.Type of Indicator: Process Quality Dimension: Effectiveness
	AS3	Recording of Peak Expiratory Flow Rate (PEFR) Type of Indicator: Process Quality Dimension: Effectiveness
Pulmonary Oedema	PE1	Administration of Non-invasive positive pressure ventilation. Type of Indicator: Process Quality Dimension: Effectiveness
Medical Airway	MA1	Are ETT placement confirmation techniques documented? Type of Indicator: Process Quality Dimension: Effectiveness
	MA2	Are misplaced or dislodged ETT identified immediately by the practitioner? Type of Indicator: Process Quality Dimension: Efficient
	MA3	Do practitioners comply with intubation guidelines? Type of Indicator: Process Quality Dimension: Safety
Prehospital IV insertion	IV1	66. Prehospital IV Insertion - Are IV lines attempted on priority 1 patients before or en-route to hospital? Type of Indicator: Process Quality Dimension: Patient-centred
Termination of Resuscitation	TOR1	67. Termination of Resuscitation - Do practitioners seek additional consultation before termination of resuscitation efforts? Type of Indicator: Process Quality Dimension: Safety

Appendix B - Comparative Analysis of International Quality Indicators: Non-Clinical Indicators

Authors	Year	Country	Response Times	On-Scene Time	Dispatch Centre	Equipment	Staff Compliment	Staff Training	SOPs	PRFs	Incident Reporting	Safety	Surveys	Competence Assurance
MacFarlane & Benn	2018	South Africa	X	X										
Myers et al.	2008	Asia	X			X	X						X	
Howel	2007	USA - Ohio	X			X		X		X				X
El Sayed	2011	USA & UK	X			X	X	X				X		X
O`Meara	2005	Australia	X	X		X	X	X	X			X	X	
Munk et al.	2009	Qatar						X		X	X			X
Haugland et al	2017	Scandinavia	X	X	X				X	X	X	X	X	X
Mears et al.	2010	USA – North Carolina	X											
Hall et al.	2017	USA – Colorado						X	X	X	X			
Howard et al.	2018	USA, Australia	X											
Eun et al.	2013	Korea	X	X				X					X	
Daudelin et al.	2013	USA												
No of QI Extrapolated (Duplicates excluded)			6	2	6	4	2	4	2	3	3	3	2	2

Appendix C – Comparative Analysis of International Quality Indicators: Clinical Indicators

Authors	Year	Country	Cardiac Arrest	STEMI	Stroke	Trauma Care	Seizures	Asthma	Pulmonary Oedema	Medical Airway	Prehospital IV Insertion	Termination of Resuscitation
MacFarlane & Benn	2018	South Africa										
Myers et al.	2008	Asia	X	X		X	X		X			
Howel	2007	USA	X		X	X	X	X				
El Sayed	2011	USA & UK	X	X	X	X	X	X	X			
O`Meara	2005	Australia	X									
Munk et al	2009	Qatar		X						X	X	X
Haugland et al.	2017	Scandinavia	X									
Mears et al.	2010	USA – North Carolina	X	X	X	X						
Hall et al.	2017	USA – Colorado	X	X								
Howard et al.	2018	USA, Australia	X		X	X	X	X		X		
Eun et al.	2013	Korea		X								
Daudelin et al.	2013	USA			X							
Total No of indicators Extrapolated (Duplicates excluded)			6	4	3	4	2	3	1	3	1	1

Appendix D – Consent to participate in Delphi Study

CONSENT FORM FOR PARTICIPANTS OF A DELPHI STUDY

Introduction:
Quality Assurance (QA) is at the forefront of Emergency Medical Services in developed countries. The Namibian EMS system is a small but rapidly growing sector of Health in Namibia. However, until now there has been no evidence of documentation of a QA system. The development and implementation of a QA system should aid Namibian EMS service delivery to stay abreast with the current evolution of EMS internationally and to ensure quality of care to the public.

Aim of Study:
The study aims to develop a Quality Assurance system for Namibian EMS service delivery by conducting a comparative analysis of quality indicators of international quality assurance systems and reaching consensus from a group of experts on the identified quality indicators within the field of EMS.

Method:
A three iteration Delphi study will be conducted over two months (July & August 2019). During this period experts within the pre-hospital/rescue and emergency medicine field will be voluntarily and anonymously asked to rate three iterations of statements/questionnaires. After each iteration the researcher will collect and analyse the responses for consensus. Consensus will be set at 80% to formulate the statements/questionnaires for the subsequent iterations.

Your role in this study:
You will be required to voluntarily complete a three-iteration survey that will be distributed via email. The questionnaire will be in the form of a Likert Scale and you will have to rate each statement on the scale that represents your view on the statement. The questionnaire also contains a comment section at the end of each statement to add your suggestions.

Question Title

*1. **By clicking "*YES*" you agree to the following:**

- **You understand the aim and purpose of this study.**
- **You have not been coerced into partaking in this study.**
- **You agree to partake in this study voluntarily.**

○ Yes

○ No

NEXT

Appendix E – Introduction to Non-Clinical Indicators

Delphi Study on Namibian EMS Service Delivery Quality Indicators:
Consensus Iteration 1

Non-Clinical Quality Indicators

The following indicators are categorized as non-clinical. **Non-clinical indicators** are those that relate to specific aspects of service delivery and not directly to patient assessment/management or disease process.

Each of the statements/questions are designated with a Type of Indicator (according to the Donabedian framework) and a Quality Dimension (as outlined by the Institute of Medicine) listed below:

Type of Indicators:

1. Structure Indicator - The setting where the care is provided and includes the organizational structure, facilities, equipment, assets, knowledge base of the providers and the human resources.

2. Process Indicator - An indicator that outlines a single step or different steps that form the health care process within an organization.

3. Outcome Indicator - Are indicators that show the impact or result of a specific intervention performed, and gives an indication of the overall delivery of care in an organization.

Quality Dimensions:

1. Safety

2. Timelines

3. Efficiency

4. Equity

5. Effectiveness

6. Patient-centred

Please rate the following Quality Indicators listed below in relation to the Type of Indicator and the Quality Dimension.

Choose only ONE answer in each row.

OK

Appendix F – Consent Form to Participate in a Pilot Study

CONSENT FORM FOR A PILOT STUDY

Study Title: Developing a Quality Assurance System for Emergency Medical Care Service Delivery in Namibia

Primary Investigator: Brandon Diergaardt **Student Number: 217126650**

Introduction:

I am a student at the Namibia University of Science and Technology (NUST). In fulfilment of a Masters of Health Sciences Degree, I am conducting a pilot study on developing a quality assurance system for Namibian Emergency Medical Care service delivery by using quality indicators selected by a group of experts within the Namibian Emergency Medical Services fraternity. This pilot study aims to test the feasibility of using quality indicators to develop a quality assurance system.

Your role in this study:

You are required to answer 42 short questions by selecting either YES or NO based on what you believe best represents your view. The questionnaire also contains a comment section at the end of each question for you to add your opinion/suggestions. The questionnaire should take you no more than 15 minutes.

NOTE: Your participation is completely voluntary. All information will be kept confidential and anonymous.

Please indicate your response by ticking the appropriate box:

	YES	NO
Do you understand the aim or purpose of this study?	☐	☐
Have you been coerced into partaking in this study?	☐	☐
Do you agree to partake in this study?	☐	☐

Date: _____/_____/ 2020

Initial and Surname: _____ (Optional)

Appendix G – Participant Questionnaire for Pilot Study

Participant Questionnaire

Kindly answer by marking either YES or NO, and indicate how service delivery can be improved within your EMS organization.

Quality Indicator Statement/Questions	Mark with X	
1. The emergency response fleet is in a well-functioning condition to respond to calls immediately. _____ _____	**YES**	**NO**
2. The crew reaches the patient within the shortest possible timeframe. _____ _____	**YES**	**NO**
3. Patients are transported to the most appropriate facility. _____ _____	**YES**	**NO**
4. Are the crews exposed to dangerous situations during responses? _____ _____	**YES**	**NO**
5. Does the crew have adequate driving skills to respond to calls? _____ _____	**YES**	**NO**
6. Are there any delays from the time the call is received to the dispatch of the crews? _____ _____	**YES**	**NO**
7. Do all patients receive the required level of care on scene? _____ _____	**YES**	**NO**
8. Do practitioners have an adequate level of competence on scenes? _____ _____	**YES**	**NO**
9. The dispatch centre is adequately staffed for each shift. _____ _____	**YES**	**NO**
10. Dispatch centre staff are adequately qualified. _____ _____	**YES**	**NO**
11. The correct resources are dispatched to each call. _____ _____	**YES**	**NO**

12. Are ambulance crews adequately qualified? _____ _____	**YES**	**NO**
13. Crew members are appropriately skilled and trained. _____ _____	**YES**	**NO**
14. The company has a Standard Operating Procedure (SOP) in place. _____ _____	**YES**	**NO**
15. The SOPs are adequately executed and implemented. _____ _____	**YES**	**NO**
16. PRFs are reviewed by the ALS/supervisor and feedback provided. _____ _____	**YES**	**NO**
17. Patients are treated according to set clinical guidelines. _____ _____	**YES**	**NO**
18. Patient/family satisfaction surveys are often conducted. _____ _____	**YES**	**NO**
19. Practitioners comply with the annual required Continuing Education Units (CEUs). _____ _____	**YES**	**NO**
20. All ambulance crews are certified with the AHA`s BLS HCP. _____ _____	**YES**	**NO**
21. Dispatchers are able to provide telephonic-guided CPR instructions. _____ _____	**YES**	**NO**
22. For cardiac arrest cases, call to scene response interval are ≥5 minutes. _____ _____	**YES**	**NO**
23. Crew members are able to identify cardiac arrest and initiate CPR with AED in the shortest possible time. _____ _____	**YES**	**NO**
24. ALS is dispatched and present at all cardiac cases. _____ _____	**YES**	**NO**

25. Are shockable rhythms treated by defibrillation in a timely manner? _____ _____	**YES**	**NO**
26. CPR training for crew members are conducted often. _____ _____	**YES**	**NO**
27. STEMI`s are treated with Aspirin, Nitroglycerine, morphine and oxygen as per protocol. _____ _____	**YES**	**NO**
28. Pain scores are recorded before and after treatment. _____ _____	**YES**	**NO**
29. Crew members apply the FAST assessment for suspected/confirmed stroke cases. _____ _____	**YES**	**NO**
30. Blood sugar levels are always tested in suspected/confirmed stroke cases. _____ _____	**YES**	**NO**
31. Blood Pressure measurements are always taken in suspected/confirmed stroke cases. _____ _____	**YES**	**NO**
32. Crews are adhering to the Angels policy in all stroke cases. _____ _____	**YES**	**NO**
33. Vitals (BP, Respiratory Rate, SpO2, Pupil Reaction, GCS) are recorded for all trauma patients. _____ _____	**YES**	**NO**
34. Priority 1 trauma patients are rapidly transported to the appropriate facility. _____ _____	**YES**	**NO**
35. Severe external bleeding is stopped appropriately within the shortest possible time. _____ _____	**YES**	**NO**
36. Benzodiazepines are always administered for active convulsions. _____ _____	**YES**	**NO**
37. Blood Sugar levels are always measured in patients with seizures. _____ _____	**YES**	**NO**

38. Temperature measurements are always measured in paediatric patients having seizures. _____ _____	**YES**	**NO**
39. Agonist and oxygen is always administered for asthmatic cases. _____ _____	**YES**	**NO**
40. Respiratory rate, SpO2 and blood sugar levels are always measured in asthmatic cases. _____ _____	**YES**	**NO**
41. Are ETT placement confirmation techniques documented? _____ _____	**YES**	**NO**
42. IV lines on priority 1 patients are attempted en-route to hospital. _____ _____	**YES**	**NO**

Thank you for your participation.

NAMIBIA UNIVERSITY OF SCIENCE AND TECHNOLOGY

13 Storch Street
Private Bag 13388
Windhoek
NAMIBIA

T: +264 61 207 9111
F: +264 61 207 2888
W: www.nust.na

FACULTY OF HEALTH AND APPLIED SCIENCES

DECISION/FEEDBACK ON RESEARCH PROPOSAL ETHICAL CLEARANCE

Dear Prof/Dr/Mr/Ms/Other(s): Brandon Diergaardt

Student No (if applicable):

Research Topic:	Developing a Quality Assurance System for Emergency Medical Care service delivery in Namibia
Supervisor (if applicable):	Ms Nadine Seymour
Co-supervisor(s): if applicable	Prof Omotayo Awofolu and Mrs Himeesora Kaimu
Qualification registered for (if applicable):	Master of Health Sciences

Re: Ethical screening application No: FHAS-REC: 00026

The Research Ethics Screening Committee has reviewed your application for the above-mentioned research project. Based on the recommendation of the expert reviewer, the research as set out in the application is hereby:

(Indicate with an X)

Approved: i.e. may proceed with the project	x	
Approved provisionally: i.e. may proceed but subject to compliance with recommendation(s) listed below		
Not approved: Not to proceed with the project until compliance with recommendation(s) listed below and resubmit ethics application for consideration		
IS MINISTRY OF HEALTH & SOCIAL SERVICES (MoHSS) APPROVAL REQUIRED?	YES:	NO: x

It is important to note that as a researcher, you are expected to maintain ethical integrity of your research, strictly adhere to the ethical policy of NUST, and remain within the scope of your research proposal and supporting evidence as submitted to the REC. Should any aspect of your research change from the information as presented, which could have an impact or effect on any research participants/subjects/environment, you are to report this immediately to your supervisor or REC as applicable in writing. Failure to do so may result in withdrawal of approval. Kindly consult your supervisor or HoD if you need further clarification.

We wish you success in your research endeavour and are of the belief that it will have positive impact on your career as well as the development of NUST and the society in general.

Ethical issues that require compliance/ must be addressed		
No.	**Ethical issues**	**Comment/recommendation**
1.	Gate keeper/s approval	To inform and get approval from the Allied Health Professional Council of Namibia and submit a copy of gate keeper's approval to the FHAS-REC secretariat*.

NB: May attach additional page as required *failure to so will invalidate research outcomes.

Full Name (reviewer): Ms Ndinomholo Hamatui **Signature:** **Date:** 08/09/2017

Full Name: ...Prof Omotayo Awofolu..... **Signature:** ..... **Date:** 8/09/2017.....
Chair: Ethics Screening Committee

Appendix I – Article: Identification of Quality Indicators for Emergency Medical Care Delivery in Namibia: A Comparative Analysis of International Quality Indicators.

Proposed to be submitted to the African Journal of Emergency Medicine.

Abstract

Introduction

Emergency Medical Services within Namibia is still at an infancy stage and lacks quality indicators to measure the effectiveness of prehospital emergency medical care delivery. Internationally, first-world countries have succeeded in identifying quality indicators to form part of an evaluating system to measure the success of prehospital care. This study aimed to identify quality indicators for emergency medical care in Namibia from international EMS quality assurance systems.

Methodology

This study followed a quantitative research design by employing a comparative desktop search to identify quality indicators.

Results

Of 1186 studies initially identified, only 12 articles were included for review of indicators. A total of 67 quality indicators were identified. *n*=39 (58%) Non-Clinical: 18 structure indicators, 18 process indicators and 3 outcome indicators; and *n*=28 (42%) Clinical: 0 structure indicators, 26 process indicators and 2 outcome indicators were identified for the Namibian EMS.

Conclusion

No universal standard exists for the development of quality indicators. Internationally, benchmark approaches of first world countries' quality assurance systems are employed for this process. The study yielded a set of non-clinical and clinical quality indicators for the evaluation of emergency medical care delivery in Namibia.

Introduction

Prehospital emergency care is considered a fast-growing sector in the healthcare industry. It has been evolving since the beginning of the Second World War and is considered an honourable profession today, Howel (2007). However, Emergency Medical Services (EMS) has been under scrutiny for the care delivered in the prehospital field. The continuous evolution of technology and modern-day medicine guides patient management and treatment in the direction of evidence-based practice for better patient outcomes. EMS plays a fundamental role in the chain of survival of the critically ill and injured and therefore, needs constant review and evaluation to stay abreast with current changes.

Each component of the EMS system requires Quality Assurance (QA) in order for it to be effective, co-ordinated and to ensure that timely and proper healthcare is being delivered to the sick and injured. Quality Assurance forms part of the modern-day EMS system and the development and implementation of it is seen as a necessity for any healthcare system (Maritz, Hodkinson & Wallis, 2010). El Sayed (2011) mentions that the constantly expanding scope of practice of EMS providers are scrutinized at the same time for the value that it has in the prehospital setting. This requires that EMS organisations implement quality assurance systems for better coordination of the interventions performed to reduce the cost and the possibility of litigation. Internationally, most EMS industries have reached consensus that QA should from part of EMS systems, even though it might not necessarily be identical (Moore, 1999). Quality indicators therefore form the bases on which the performance of an EMS system is measured and should be carefully identified.

The EMS system is a small but rapidly growing part of the Health sector in Namibia. However, the problem of not having a QA system in place may seriously affect efficient healthcare service delivery. In Namibia, the general quality management activities in the health sector only focuses on in-patient management activities and do not take into account pre-hospital Emergency Medical Care (MoHSS, 2014). Preliminary discussions with key professionals within the Allied Health Professions Council of Namibia (AHPCNA) and Directors of Ambulance Services in the Ministry of Health and Social Services (MoHSS) acknowledged the absence of a QA system and argue that the absence of such a system poses a number of challenges such as a dysfunctional operational system, delayed response times, poor treatment of ambulance crews and potential medico-legal litigation. It is therefore imperative for the Namibian Emergency Medical Services to develop processes of service quality improvement.

Methodology

The focus of this study was to conduct a comparative analysis of international EMS quality assurance systems to identify quality/performance indicators for emergency medical care in Namibia. A methodical strategy, using advanced searches was used to identify relevant studies that reported on EMS quality assurance systems that are related to evaluation or the measurement of EMS quality assurance and/or quality indicators. A qualitative desktop electronic database search was conducted to identify relevant publications via Google Scholar (2000 – May 2018), Medline (2000 – May 2018), Mendeley (2000 – May 2018), and HINARI (2000 – May 2018). The primary

search terms in the databases include a combination of: “Emergency Medical Services”, “pre-hospital emergency care”, “quality assurance”, “quality indicators”, “performance indicators”, “measurement”, and/or “evaluation”. The search was not limited to a specific continent, country or state. However, only English articles or English translated articles were considered.

Study Sample

The investigator attempted to identify as many studies addressing the theme. In addition to the studies identified through the data bases, efforts to identify other relevant publications were made by cross-referencing the reference lists of articles addressing the themes. The identification process and number of articles included in the comparative analysis can be found under Figure 1.

Inclusion Criteria

The inclusion criteria for the comparative analysis of QI’s were studies addressing the identified themes. These included articles that analysed, evaluated, discussed or promoted the development of quality indicators in the EMS/pre-hospital field. The identified or selected indicators were those included in the articles and those that the primary researcher felt would contribute to the improvement of service delivery in the Namibian EMS setting. In addition, peer-reviewed publications and EMS/ambulance service policy documents based on primary or secondary research on quality assurance and quality indicators were also included.

Exclusion Criteria

Some studies were excluded from the comparative analysis if they did not address the themes of the quality assurance, quality indicators or performance indicators specifically related to EMS/prehospital emergency care. Also excluded, were abstracts of which full text articles could not be accessed after an exhaustive search by the researcher himself and by the assistance of the university librarian. Non-English articles were also excluded.

Data Collection and Management

The primary researcher solely collected and held access to the data. After extrapolation the data was transferred onto an electronic data sheet (Microsoft Word® MSO, version 16.0.4266.1001) and was stored on a password protected laptop and additionally stored on a password protected USB external device. The articles were reviewed for eligibility for inclusion by reading the titles and abstracts. Quality indicators were extrapolated from the studies, synthesized and tabulated. The researcher then further divided the indicators into “Clinical” and “Non-Clinical Indicators”, designated each indicator according to the Donabedian framework of process, structure and outcome, and finally with one of the six quality dimension from the IOM if it had not already been categorized under any of the Donabedian Framework or the IOM in the articles.

Results

1186 articles were identified to be reviewed for potential inclusion. However, after scanning the titles and abstracts of the 1186 potential articles, 1108 were excluded as it did not address the main theme of the research study and was not related to the EMS profession. This left a number of 78 articles for full text review. In addition, 39 articles were then included for full text review after being identified from a review of the reference lists of the identified articles. Furthermore, 105 full text articles were excluded following review. The articles were excluded because it did not address the study theme of analysing, evaluating or promoting QI in the EMS setting, and the majority of the articles were inaccessible despite the assistance from the university librarian and were therefore excluded. Duplications of articles were also excluded from the study. Finally, a total of 12 full text articles remained and were included to conduct the comparative analysis, identify and extrapolate QI from. Figure 1 below outlines the process followed to identify the relevant articles.

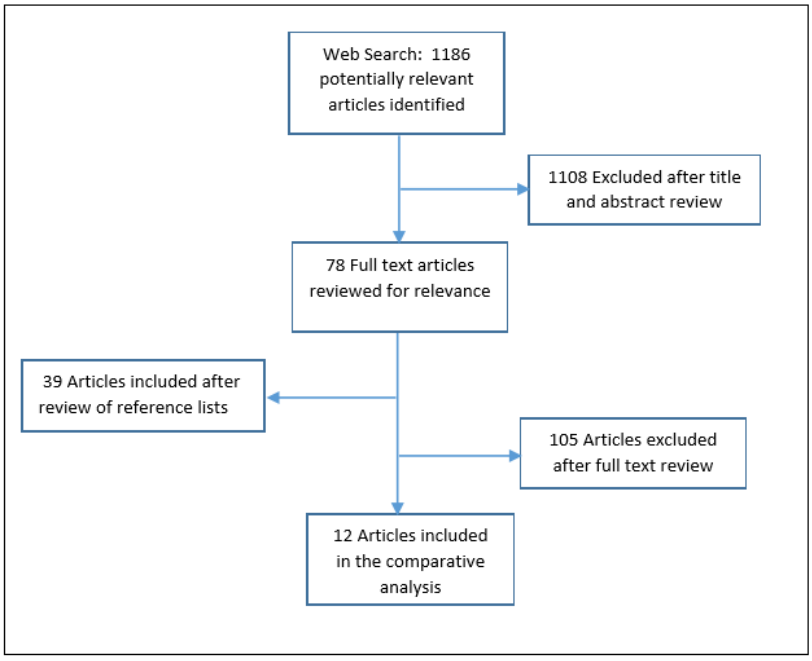


Figure 1: Identification of articles for Comparative Analysis

The articles reported indicators used in the United States of America (USA), followed by Australia, South Africa, Asia, Qatar, United Kingdom, Scandinavia and Korea. The articles were further reviewed for common themes of QI's to be extrapolated and those that would be relevant and beneficial to the EMS system in Namibia. Duplications of QIs were excluded and only those that assessed different outcomes were included. A total of 67 quality indicators were identified by the primary researcher which were designated as follows: Non-Clinical: 18 structure indicators, 18 process indicators and 3 outcome indicators; and Clinical: 0 structure indicators, 26 process indicators and 2 outcome indicators. The focus of the comparative analysis was to identify differences and similarities of QI's used, and then extrapolate the ones relevant to the Namibian setting.

Discussion

The formulation/identification of QI's can be a stringent process when there is a lack of research. In the absence of robust evidence-based indicators, it is most commonly followed by a process where experts suggest indicators guided by personal opinion and through experience within the field (MacFarlane & Benn, 2003).

Since EMS in Namibia is under-developed and research on the identification or implementation of quality indicators is relatively non-existent, the only acceptable option was to follow suit of other countries to identify quality indicators through a comparative analysis of international EMS quality assurance systems. This approach was followed by the Australians in developing a performance framework for their ambulance services. The frameworks were based on the Canadian Health Indicators Framework and the National Health Service in the United Kingdom. Similarly, the work extracted from the UK correlates with the Joint Commission on Accreditation of Healthcare Organizations developed in the United States of America (O`Meara, 2005).

It stands to reason that although the EMS systems differ between countries, there is some correlation when it comes to quality indicators. On review of the studies it was evident that first world countries such as the USA, UK, Australia, Asia and Scandinavia, and recently South Africa all employ the same subset of indicators to assess quality delivery even though it is measured in a different framework. The majority of the countries also use the Donabedian Framework as an identifier to classify the indicators according to structure, process and outcome. Similarly, the IOM six quality dimensions were also employed.

A great number of indicators (58%) identified from the comparative analysis fall within the Non-Clinical domain, while 42% constitute the clinical domain. Generally, the non-clinical domain of indicators has been dominating the indicator category when quality is being measured. From review of studies focusing on quality assessment, it is noticeable that the non-clinical indicators are more easily implemented because it does not require complicated structures or electronic systems for execution. These indicators also do not require high cognition and knowledge levels expected from that of ALS practitioners or senior/managerial personnel, but can be implemented by the lower level categories (BLS, ILS & ECT's) in the EMS (Howard, Cameron, Wallis, Castren and Lindstrom, 2019).

One can argue that there is an inter-linkage of the clinical and non-clinical indicators. The success of the EMS system cannot be solely measured on one indicator but should be seen holistically as a whole system with many factors that can affect the performance. It is clear that the study has identified a wide variety of indicators that covers a broad spectrum of metrics to measure the service delivery of emergency care within Namibia.

Conclusion

The literature review revealed that many high-income countries employ quality indicators to measure the quality care delivered in the prehospital field. Despite there being no universally set standard of developing quality indicators substantiated by evidence, EMS systems resort to benchmark approaches to identify quality indicators that suit their system locally. This allowed for the extrapolation of quality indicators for the Namibian setting. The study identified quality indicators that are relevant to the Namibian setting for implementation in EMS organizations to ensure improvement of service delivery.