

Business Research Project:

***The emerging role of telehealth
in a New Zealand ambulance
service***

Master of Business Administration (MBA)

Victoria University of Wellington

October 2014

Words: 11,700

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EXECUTIVE SUMMARY

Telehealth systems – using ICT to manage health from a distance – have been developing for decades, including within the ambulance sector. The author undertook this research to better understand how telehealth could improve patient outcomes, improve effectiveness, or create efficiencies for the St John ambulance service. To achieve this, current literature was reviewed and a small group of experts were interviewed whose experience lies in either the ambulance service or the health sector. Key recommendations are described below:

- It is of strategic importance to design ambulance telehealth systems with interoperability and interconnectivity – this will maximise health sector integration and governmental support.
- Telehealth solutions should be based on simple, well-established, easy to use, and ubiquitous technologies. This reduces fear, limits technical challenges, enables technology adoption, and improves chances of success. Of all available technologies, video-calling provides the most opportunity at present.
- Consistent with the 111 Clinical Hub model, St John should centralise specialists to provide telehealth support. This approach is cost effective as only a small number of specialists is required. It also supports effective clinical decision-making as this group routinely make complex decisions.
- It is realistic for St John to integrate video-calling as a telehealth solution into the 111 Clinical Hub. As a patient-to-clinician tool, 111 Clinical Hub staff could use video connections to call back low acuity patients to perform a secondary triage. As a clinician-to-clinician tool, paramedics could video-call the 111 Clinical Hub for clinical

support. This would increase the richness of communication, and enable better clinical decisions to be made.

- While it is unclear the role that remote monitoring will play in improving an ambulance service, it is clear that medical alarms will evolve to have much greater functionality, including sharing of biometric information. St John needs to make a strategic decision as to whether it wants to play the role of monitoring those with long-term conditions – and therefore being responsible for taking action when there are any signs of deterioration – or whether that should be the role of general practitioners (GPs).
- When designing telehealth solutions, St John must consider whether it is creating unequal access to healthcare and, where created, take actions to mitigate these inequities.
- It is important that St John clearly communicates any new telehealth interventions – resistance to change must be anticipated and therefore strong communication strategies must be part of the design process.
- There is limited evidence to support telehealth solutions in terms of improved patient satisfaction, improved patient outcomes, or greater efficiencies. With the impending implementation of electronic patient report form (ePRF) there is opportunity to evaluate a telehealth solution in these terms.
- It's important to note that, regardless of the telehealth system adopted, no single solution will be effective – real improvements will require multiple integrated systems.

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INTRODUCTION

Ambulance services continue to face an increasing demand in terms of volume of calls and consumer expectations, despite financial losses year on year. For decades there has been a natural progression toward using information and communications technology (ICT) to provide healthcare from a distance. With continuous ICT improvements, wide acceptance of ICT, and increasing demand on health sectors, there has been organic development of telehealth systems.

This research attempts to understand how telehealth could improve patient outcomes, improve effectiveness, or create efficiencies for the St John ambulance service –New Zealand’s largest ambulance service. To achieve this, current literature was reviewed and a small group of ambulance and health sector experts were interviewed.

The literature and views of experts were compared to identify any consistencies or deviations from each other. Furthermore, the experts’ views were analysed for new insights.

LITERATURE REVIEW

The literature uses various terms with similar meaning including, telemedicine, telehealth, telecare, e-health, and e-medicine. Argued to be a broader and more inclusive term (Bashshur, Shannon, Krupinski, & Grigsby, 2011), this report uses ‘telehealth’ as it is used consistently by the Ministry of Health (MoH), who defines it as “the use of information and communications technologies along with appropriately trained health professionals and other health workers to deliver health services and transmit health information over distance” (Ministry of Health, 2014).

Telehealth can be categorised by levels of data synchronicity as either (1) store-and-forward – transmitting medical data for review at a later time, (2) remote monitoring – using devices to monitor patients from a distance, or (3) interactive – using technology for real-time remote communication (The Cochrane Collaboration, 2010).

Telehealth can also be categorised by its functionality: (1) consultation – between two clinicians or between a clinician and patient; (2) diagnosis – not mutually exclusive from consultation, but is the interpretation of the information gathered; (3) monitoring –for patients with long-term conditions requiring ongoing care; and (4) mentoring – guidance, typically from surgeons or other specialists, to perform new or complex procedures (Bashshur, Shannon, Krupinski, & Grigsby, 2011).

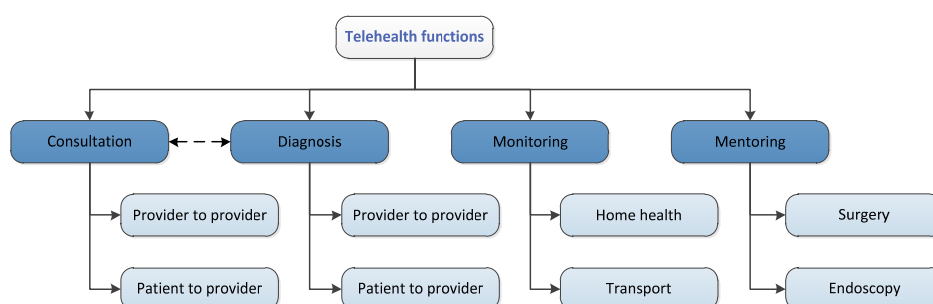


Figure 1: Telehealth functions. Adapted from www.medicalnetworksllc.com/services/telehealth_telemedicine

Drivers for Telehealth

The population of people aged 65+ years is expected to reach 21% of the total population by 2031, up from 13% in 2009 (Ministry of Social Development, n.d.). This trend is global. For example, Australia, Japan, and Norway all face increasing ambulance demand, primarily through an ageing population (Fitzgerald, Toloo, & Romeo, 2014) (Hagihara, Hasegawa, Hinohara, Abe, & Motoi, 2013) (McArthur, Gregersen, A, & Hagen, 2014).

Demand for St John's emergency ambulance service (EAS) has increased by 3.2% over the last five years – attributed to growing and ageing populations with increased chronic health needs, In 2013 its EAS had an \$11 million deficit (St John New Zealand, 2013). Increasing demand combined with limited resources place significant pressure on St John to innovate to improve effectiveness and efficiency.

While the need for more efficient models of care is a significant driver for the health sector investment, recent enablers have made it possible, such as significant advances in ICT, patients' and health professionals' growing comfort with ICT, and the belief that telehealth has financial benefits (Servello, 2014) (The Parliamentary Office of Science & Technology, 2014).

Government Strategies

The Government is working on a number of fronts to develop telehealth programmes. The National Health IT Board's (NHITB's) priority programmes for 2012 to 2014 include e-prescriptions, e-referrals, and shared care patient portals (IT Health Board, 2014). The NHITB has also established the New Zealand Telehealth Forum to promote the use of telehealth and maximise the benefits of the Government's broadband programme (IT Health Board, 2014).

The Cabinet Social Policy Committee (June 2013) agreed to develop a national telehealth service that will provide an improved frontline telehealth service for the public and reduce pressure on after-hours primary care, ambulance services, and hospital emergency departments (EDs) (Ryall, 2013). Due to take effect in 2015, this free 24-hour service will combine multiple Ministry-funded telephone advice lines into an integrated information and communication service (Ministry of Health, 2014).

The development of patient portals also highlights the Government's focus on sharing of information through ICT. By the end of 2014, the aim is for all New Zealanders and the health professionals caring for them to have electronic access to their health information (Ministry of Health, 2014). People will be enabled to proactively manage their health, efficiencies will be gained by reducing the number of face-to-face consultations (IT Health Board, 2014), and health professionals will be able to make better decisions because they will have a more complete picture of a patient's medical history (Ministry of Health, 2014).

New Zealand Ambulance Services

There are a number of telehealth activities and developments within St John, including its 111 Clinical Hub, 12-lead electrocardiogram (ECG) transmission facilities, medical alarms, electronic patient report form (ePRF) development, CPR app, and possible remote monitoring.

111 Clinical Hub

In May 2014 St John began its 111 Clinical Hub pilot in Auckland to handle non-emergency calls to the ambulance service. Using a process called secondary triage, a paramedic or nurse asks a series of questions to establish the best way to get the patient to the right level of care, which could be advice to self-care, referral to a general practitioner (GP),

or dispatching an ambulance. The goals are to better utilise existing resources (i.e. for emergencies) and to reduce unnecessary transports to EDs (St John New Zealand, n.d.) (Nordqvist, 2014). While enabling an interactive patient-to-clinician consultation, it also provides paramedic-to-clinician consultation for clinical support.

12 Lead ECG Transmission

In some areas 12-lead ECGs (used to diagnose heart attacks) are transmitted by paramedics to hospitals so that a cardiologist can determine whether thrombolysis (administering clot-dissolving medicine) is appropriate. This transfer of information significantly reduces the time it takes to get treatment from a medicine that can significantly improve patient outcomes (Ranchord, Prasad, Matsis, & Harding, 2009). This demonstrates the effectiveness of telehealth as a real-time tool for clinician-to-clinician consultation and diagnosis.

Electronic Patient Report Form

Due to be completed in 2015, St John is developing an electronic patient report form (ePRF) to be used on a portable electronic device; this replaces its existing paper-based system and is believed to improve the quality and safety of care (St John New Zealand, 2013). Former Health Minister Tony Ryall said the new system will allow crews to forward patient information electronically to an ED before reaching the hospital and, in a world-first move, GPs will be sent a summary of their patients' ambulance callouts. The tablets will also allow paramedics to take photos of the scene or injuries for specialist advice (HIIRC Admin, 2014). While St John is developing ePRFs at a cost of \$10.6 million, the MoH is contributing \$2 million and ACC \$500,000 (Castaneda, 2014). This demonstrates the value that the Government sees in sharing health information.

The use of ePRF plays multiple roles in telehealth: as a store-and-forward system, such as notifying GPs of ambulance findings or referring patients to a healthcare professional; and as an interactive clinician-to-clinician tool, where patient information and other media are relayed to another health professional for consultation, diagnosis, or mentoring.

Cardiopulmonary Resuscitation Application

St John has a cardiopulmonary resuscitation (CPR) application (app) for mobile devices that provides instruction on performing CPR. It also provides a shortcut to call emergency services, where an ambulance will be sent and the caller is given guidance to perform CPR (St John New Zealand, n.d.). This is an interactive and mentoring application of telehealth.

Remote Monitoring

St John is New Zealand's leading provider of medical alarms; used mainly to support independent living for older people. Pressing an emergency button alerts St John, who immediately calls the person back and sends an ambulance, if required (St John New Zealand, n.d.). This demonstrates the positive role of a remote monitoring telehealth system for ambulance staff—as the system is activated it transitions into an interactive telehealth service as the patient is called back.

There is intention to develop biometric technology to remotely monitor a patient's vital signs, or to enable people to self-manage chronic conditions (St John New Zealand, 2013). Benefits to improve ambulance efficiency or effectiveness are not described.

International

In addition to the telehealth activities within New Zealand ambulance services, the following describes various activities abroad that affect ambulance services.

ePRF System

As discussed, New Zealand is about to introduce an ePRF system, which is well-established technology used globally, for example in Australia, Canada, England, Finland, and the United States. In 2012, of 20 ambulance services surveyed across the United States and Canada, 14 had adopted ePRF systems (Landman, Lee, Sasson, Van Gelder, & Curry, 2012).

Landman et al. (2012) discuss that ePRF systems have the potential to improve ambulance record availability and legibility for ED clinicians, as well as to improve ambulance service quality assurance, outcomes research, and billing. However, there are no findings regarding the benefits. They found that ambulance services are moving to ePRF systems primarily to improve quality assurance and the biggest concern of those surveyed was resulting increased job cycle times (the time for an ambulance to complete a job).

An article analysing job cycle times following the implementation of an ePRF system in Helsinki, Finland found that they returned to baseline levels after three months (Kuisma, Väyrynen, Hiltunen, Porthan, & Aaltonen, 2009). A limitation of articles on ePRF is that there was little discussion on the impact of managing ambulance demand or improving patient outcomes. There were no insights, beyond what St John is implementing in New Zealand, as to how else ePRF could be used in telehealth.

Patient Handovers

According to a 2013 article, the characteristics of optimal handovers from ambulance crews to ED staff fall into three general categories described by Manser et al. (2010): (1) information transfer, (2) shared understanding, and (3) working atmosphere. The article discussed that electronic transfer of information is promising as it provides a 'common

language' (Jensen, Lippert, & Østergaard, 2013). However, a literature review was unable to find any evidence of effect on patient outcomes.

A 2012 article in Queensland Australia found that in some cases, despite the presence of electronic patient records, handovers were verbal and did not include the electronic record. They discuss that handovers need standardisation so that vital information is not missed (Bost, Crilly, Patterson, & Chaboyer, 2012).

Neither of these articles discusses whether telehealth had any impact on effectiveness of care. The first article demonstrates that electronic records can improve the effectiveness of clinician-to-clinician communication through the use of a common language. However, the second article highlights that – even when the technology is in place – it doesn't automatically provide the espoused benefits.

Telephone Triage

Telephone nurse triage is a well-established practice – in 2008 most Australian and all New Zealand residents had free, 24-hour access to telephone advice (St George, Cullen, Gardiner, & Karabatsos, 2008). While typically not the role of the ambulance service, a positive trade-off is assumed to be a reduction in ambulance demand.

In 2010, across four pilot sites in England, a 24-hour telephone service was established to meet the demand for greater access to urgent advice, care, treatment, or diagnosis. It was expected to: increase efficiency by ensuring people go to the right place first time; increase satisfaction with access to urgent care; reduce unnecessary ambulance calls; and reduce inappropriate use of the ED. The result has been a 2.9% increase in ambulance incidents and increased overall activity in the urgent care and emergency systems. One conclusion that

managers drew is that one service cannot do everything, and efficiencies can only be gained with a coordinated effort (Turner, O'Cathain, Knowles, & Nichol, 2013) (Kmietowicz, 2013).

The lesson here is that complexity of these systems can yield unpredicted results and that the New Zealand Government's new telehealth system should be approached with caution.

Sharing of Patient Information

Ambulance staff gaining access to patient records from the field is commonplace overseas. In 2009 a trade publication stated that 20 ambulance services in the United States had access to standardised patient information from the field (Ullman, 2009). Given the Government's development of patient portals, New Zealand ambulance services should not be far behind.

12 Lead ECGs

While it's already occurring in New Zealand, the transmission of ECGs to cardiologists is well-established with the first transmission of a 12 lead ECG from a moving ambulance demonstrated in 1987 (Grim, Feldman, Martin, Donovan, Nevins, & Childers, 1987). This shows that ambulance services have had significant experience in using interactive telehealth for clinician-to-clinician consultation and diagnosis to improve patient outcomes.

Teleconsultation

Due to legislative requirements in Germany, half of its ambulances are crewed by doctors, and doctors must attend the scene whenever paramedics perform invasive procedures or administer medications. This approach can result in significant delays while paramedics wait for doctors to attend. In response to this, in 2012, a mobile telehealth system to support paramedics was piloted in four German ambulance services. Using audio communication, real-time vital data transmission, ECG transmission, picture transmission, and video-

streaming from a camera embedded inside the ambulance, paramedics could consult with ambulance doctors in a teleconsultation centre (Bergrath, Czaplík, Rossaint, Hirsch, Beckers, & Valentin, 2013). While this pilot is patient-focused, i.e. reducing delays in treatment, it does not discuss improved patient outcomes; however it is looking to gain efficiencies in an expensive delivery model.

Future of Telehealth

Several articles discussed telehealth systems either in development, or hypothetical systems of the role of telehealth in the future.

Seamless Flow of Information

A 2012 paper in the Journal of Medical Systems proposes a new model of ambulance dispatching and clinical handover communication, which includes automatic provision to ambulance of patients' online health records, and automatic and real-time transmission of ambulance findings with the nearest hospital (El-Masri & Saddik, 2012). It seems that this model is not too far from reality in New Zealand with St John's planned ePRF system and ambulance staff being close to having access to patient health records.

Stroke Thrombolysis

Current therapy for ischaemic strokes may involve thrombolysis (dissolution of a blood clot), if identified early. Despite being the second most common cause of death worldwide, there are few strategies to address strokes before patients arrive at hospital. It has been discussed that, given recent advances in ultrasound technology to diagnose large vessel embolic stroke in the pre-hospital environment, thrombolysis could be initiated by paramedics (Hölscher, et al., 2013). Another article agrees with this vision describing that mobile or

wireless telehealth may permit earlier diagnosis and management by paramedics in ambulance (Timpano, et al., 2013).

Echography

A 2013 article discusses how echography, an evaluation tool for patients with shock following trauma, could be performed by paramedics. It's proposed that, by using a mobile system, paramedics send clear, real time ultrasound images of a patient's abdomen to the destination hospital, reducing time to get potentially life-saving interventions at hospital (Ito, Suganoa, Takeuchib, Nakamurac, & Iwatad, 2013).

Telecardiology

Hsieh, Li & Yang (2013) discuss recent 'revolutionary progress' in telecardiology – monitoring or diagnosis of patients' cardiac activities at a distance via ICT – has been made with the use of mobile computing and cloud computing. The authors discuss the barrier of limited access to appropriate specialists and envisage national or global e-consultation programmes helping on-site practitioners deliver appropriate treatment. Real-time consultation and diagnosis can be practiced via an e-platform for clinical, research, and educational purposes (Hsieh, Li, & Yang, 2013).

Moderating the Growth in Demand

Like ambulance services, EDs are looking for strategies to moderate increasing demand. It's argued that strategies are required to manage some patients in their homes, which may include greater reliance on paramedic assessment, home monitoring. home-based interventions, and telehealth (Fitzgerald, Toloo, & Romeo, 2014). This highlights that telehealth is an enabler for paramedic assessment and management.

Ambulance Services in the United Kingdom

The Scottish Ambulance service, one of three Scottish ambulance services, released an initial agreement for establishing an ambulance telehealth solution for unscheduled care. While several of its seven objectives are currently occurring elsewhere, e.g. shared patient care records, one initiative not mentioned elsewhere in this report is to provide a telehealth interface to support video connections to healthcare professionals within the ambulance environment (The Scottish Ambulance Service Board, 2013).

In April 2014, England's Association of Ambulance Chief Executives released its Future National Clinical Priorities for Ambulance Services in England. One of its seven clinical priorities is the 'frail elderly and falls' as falls are one of the most common primary presenting complaints to ambulance services, made worse by an ageing population. As part of its strategy it believes that opportunities and efficiencies could be realised through further developments in telehealth (National Ambulance Service Medical Directors, 2014).

Home Telehealth

A 2006 article on current state and future trends of telehealth observed a shift of tools and services from clinician-to-clinician to patient-to-clinician. It also noted that evaluation studies are rare (Koch, 2006). Albeit from 2006, these findings are consistent with this researcher's experience in writing this report.

RESEARCH DESIGN

Research was conducted to answer: what opportunities are there for telehealth to improve patient outcomes, patient satisfaction, or efficiencies within a New Zealand ambulance service?

Research Methodology

Qualitative research was used as the overarching research strategy. Qualitative research tends to be inductive (with emphasis on the generation of theories), interpretive (with emphasis on the ways individuals interpret their environment), and constructive (which views social reality as a constantly-shifting emergent property) – although, research does not need to prescribe to all three of these approaches to be considered qualitative (Bryman & Bell, 2011).

The research which this paper reports on was inductive – it did not test a hypothesis; it attempted to generate new insights. It is also constructive as the ambulance service is intrinsically linked to a constantly changing social landscape.

Building on these two points, this research took a phenomenological approach to qualitative research, which is strongly aligned with the interpretive approach of qualitative research. Phenomenology is “a philosophy that is concerned with the question of how individuals make sense of the world around them and how, in particular, the philosopher should bracket out preconceptions in his or her grasp of that world” (Bryman & Bell, 2011, p. 18).

This research used interviews as the method of data capture. In phenomenology, the interview serves the purpose of “exploring and gathering experiential narrative material, stories or anecdotes that may serve as a resource for developing a richer and deeper understanding of a human phenomenon” (van Manen, 2011).

“The purpose of the phenomenological approach is to... identify phenomena through how they are perceived by the actors in a situation” (Lester, 1999). This perspective fits with the research methodology as the researcher was interested in individuals’ perspectives.

It is noted that the research did not completely align to the philosophy of using a phenomenological lens; the researcher was trying to understand the *future* role of telehealth and not trying to explicitly understand the *historic* experiences of participants. What the research did was explore the opinions of relevant experts – it was their experiences that made interviewees experts; the future is impossible to ‘predict’, but the past experiences and body of knowledge of the experts was hoped to generate insights into the future.

In addition to the reasons mentioned above, another driver for using a phenomenological method is that it is argued to be particularly effective at challenging assumptions as it brings to the fore the experiences and perceptions of individuals from their own perspectives (Lester, 1999). This ability was a must for this research. Ambulance services are under pressure to develop new ways of doing things – telehealth provides fresh opportunities that were previously technically impossible, and therefore, unlikely to have been given significant thought.

Research Method

The research method was interviews. Seven people with expert knowledge in either the ambulance service or the health sector were interviewed for their views on the role telehealth will play in a New Zealand ambulance service. These individuals were selected by the researcher as they were considered experts in telehealth, the ambulance service, or the health sector.

An effort was made to ensure interviewees represented a broad range of organisations and sectors, including St John, Ministry of Health (MoH), National Ambulance Sector Office (NASO), District Health Boards (DHBs), primary care, and tertiary care. There was relative success in obtaining broad representation however the researcher was unable to obtain persons to represent the NASO or the MoH.

As previously highlighted, the research method used was qualitative interview. Compared to quantitative interviews, qualitative interviews are less structured, more flexible, and more interested in the perspective of the interviewee. Often qualitative interviews digress from the main topic, which is positive as it can result in unique insights that inflexible quantitative interview methods aren't looking for.

Interviews were semi-structured. An interview guide was developed (appendix 1) and referred to during interviews, which ensured interviews had direction, but it allowed discretion in the questions asked and in the way that interviewees answered. The semi-structured format also ensured consistency, as generally the same questions were discussed, enabling greater comparison of answers between interviewees.

The interview guide was provided to each interviewee ahead of their interview. This provided participants with context for the interview and understanding of the type of questions they would be asked and time to consider the questions – it was believed that this approach would maximise the insights generated by participants.

Access

The researcher has had some level of prior contact with most participants; others were recommended by colleagues, etc. In most cases participants were first contacted by email, which included a letter request for a personal interview (appendix 2). Most prospective

candidates either agreed or disagreed to interview by email and did not require a follow up telephone conversations as was initially planned.

Data Collection and Analysis

Interviews were recorded using an audio recording device and by using hand-written notes taken at the time of interview. Within a few days of each interview the researcher summarised key findings. The audio recordings, hand-written notes, and summaries were analysed. Audio recordings will be kept as a reference up until the life of the research project (October 29, 2014), at which point they will be deleted.

Interviews were anticipated to last 60-90 minutes whereas the longest was 57 minutes, with an average interview time of 41 minutes. Each interview took place in a different location for which both the interviewee and researcher agreed on in advance. This was often at the person's place of work, but also included a café, and telephone interview.

The small scale of the research, i.e. seven people interviewed for up to an hour each, enabled the researcher to identify key themes without requiring sophisticated techniques. Key themes were written up as headings and interviewees' comments were broken down to sit within a key theme. This allowed the researcher to compare and contrast viewpoints.

How the Analysis will Answer the Research Question

As highlighted, by categorising interviewees' responses according to key themes, the researcher was able to analyse responses for new opportunities, which provided insight into the role of telehealth in a New Zealand ambulance service. There was no expectation that this research would provide a tangible solution; it was believed that this research would serve as a guide of areas in telehealth within St John ambulance service that could be explored further.

Credibility of Research

Interviewees were selected based on relevant subject matter expertise, which gives their perspectives legitimacy and the research credibility. To promote these values, interviewees are clearly identifiable throughout this article. Also, in phenomenology, an individual's context is as important as their views, and therefore it's important that views are linked to an individual. The interviewees are as follows:

- Dr John Bonning – Clinical Director, Emergency Department, Waikato Hospital
- Michael Brooke – Operations Director, St John
- Darrin Goulding – Strategy and Communications Director, St John
- Dr Charlotte Harris – Medical Director, Auckland PHO
- Dr Tony Smith – Medical Director, St John; Intensivist, Intensive Care Unit, Auckland Hospital
- Tanya Waisbrod – Telehealth Strategy Manager, St John
- Dr Robyn Whittaker – Programme Leader, Health Informatics and Technology Research, National Institute for Health Innovation (NIHI), University of Auckland; Public Health Physician, Research and Innovation, Waitemata District Health Board

Research Approval

An application for approval of the research project was made to Victoria University of Wellington's Human Ethics Committee (HEC), which was approved by the course controller and research supervisor, Dr David Stewart, Senior Lecturer, School of Management, Victoria University of Wellington.

In addition, Peter Bradley, Chief Executive Office, St John was sent an introduction for student / employer letter (appendix 3) and an agreement for employer / student relationship form (appendix 4), which was signed and agreed to by the researcher and Mr Bradley.

And finally, the research underwent a St John locality review and was authorised to proceed as it met most of the locality review process and was considered 'of interest' to St John. This required a final memorandum of understanding agreement to be signed by the researcher and research supervisor.

Resources

In addition to the interviewer and interviewee, interviews required an appropriate venue, the interview guide, a consent form for personal interview (appendix 5), an audio recording device, and paper for the researcher's handwritten notes.

The researcher was required to travel once to conduct a few interviews. These costs were small and at the expense of the researcher. One interview took place in a café and the researcher paid for light refreshments. This was not promised in exchange for interview, but is a courtesy to thank the participant for their time.

RESULTS

The interviews had several key themes, covering design criteria, barriers and risks, store-and-forward systems, remote monitoring, video-calling, clinician-to-clinician consultation, seamless sharing of information, and diagnostics.

Design

Telehealth design was not in the interview guide, but was discussed by most interviewees. Therefore, these themes are described below in more detail.

Dr Robyn Whittaker said it's difficult to design telehealth systems that reduce hospitals' admissions, but the approach for St John should be working with hospital specialists. For example, there are of well-known cardiology patients where intensive monitoring and support in the home could reduce their frequency of using the health system.

Dr Whittaker explained that the general trend is to move medical tasks historically performed in hospitals into community facilities; to move tasks that were performed in community facilities into primary care; and move tasks that were performed in primary care into people's homes. Innovation in this area is where St John should focus.

Constant Refinement

Mr Darrin Goulding said that during development, telehealth systems should be improved by constantly repeating and refining the process. For example, repeatedly using role-playing exercises, or analysing the number of key strokes in an attempt to minimise unnecessary typing. Similarly, Ms Tanya Waisbrod believed that if interfaces are clunky and difficult, then staff may not accept the new technology – just one additional step could make the difference in terms of user acceptance.

Mr Goulding went on to say that it's important to design systems with a control cycle so that they can be improved upon. "You can make a whole lot of bad decisions but you can learn from them," he said. But this requires adequate resources to support change management and refine the technology over several years.

Customer Needs

Ms Waisbrod discussed the need to understand the technology being developed, such as the intended outcome and what is the right medium to be sending that information.

When discussing ePRF and arrival boards, Mr Michael Brooke made similar comments, saying it is 'critical' to develop technologies around what EDs want.

Centralising of Specialist Skills

Mr Goulding explained that systems that centralise specialists make the most efficient use of scarce resources. Dr John Bonning made similar comments, using Retrieval Services Queensland (RSQ) as an example of specialists who are centralised and regularly making complex decisions, maximising the value of expensive resources. But he also saw decentralisation as an issue where patients are less likely to be known to the doctor who is trying to make informed decisions.

Simplicity

"Don't get fancy pants. Use ubiquitous stuff. Have simple decision rules. Walk before you can run." This statement by Mr Goulding exemplified his view on keeping telehealth systems simple. Having access to lots of information doesn't necessarily provide the best outcome. Decisions should be based on quick rules of thumb.

Ms Waisbrod had similar views. It's not always about choosing the 'shiny' or 'technically complicated' solution, but about exploring opportunities in existing technologies. Dr Whittaker made a similar comment in terms of simplicity in that extra information creates complexity – and any complexity needs to be outweighed by the good that extra information provides.

Like Mr Goulding, several interviewees commented on using ubiquitous technologies. Dr Charlotte Harris saw value in using ubiquitous technology as a more cost effective approach. Dr Bonning discussed value in using video cameras on existing mobile devices to get clinical support for complex incidents. And, in a similar comment, Dr Tony Smith pointed out that most mobile devices have the technology available now and it is only a matter of using them for patient-to-clinician or clinician-to-clinician consults.

When asked whether ubiquity of technology was important in developing a telehealth solution, Dr Whittaker made the point that it depends on expectations and appetite for risk – is it more important to be innovative and leading or to maintain trust in your brand?

Interconnectivity and Interoperability

Despite a number of big players trying to achieve the difficult task, Ms Waisbrod emphasised the importance of telehealth systems having interconnectivity and interoperability. “If we're going to be delivering services to the same patients that they're [other healthcare providers] taking care of, which we are, then we need to be sharing information about that patient so that [patients] get the best care. Because that's what they're expecting already.” Ms Waisbrod emphasised that these developments need to be done in collaboration as “none of this stuff is going to be done in isolation.”

Barriers and Risks

There were a range of themes discussed in terms of barriers and risks of telehealth, including technological limitations, who's responsible for the data, capacity of existing staff, fear of change, costs, older people, expectation management, remote care, overreliance, and unequal access.

Limitations of Technology

Ms Waisbrod believed there will be value in using data from biometric devices to inform interventions, but is further away than people think. In practice, biometric monitoring requires a lot of infrastructure, both in terms of the device and the monitoring agent to be able to deliver a meaningful service. It also requires a lot of 'bespoke levers' and monitoring vital signs is 'tricky'. "When the trigger points happen, when it alerts, when a managing by exception occurs, that's where it gets complicated," she said.

While Mr Brooke did not see any barriers in terms of available devices to perform biometric monitoring, he supported Ms Waisbrod's view, saying that the key difficulty is being able to take those measures and put it into an algorithm to work out when an action is to be triggered and what action should occur.

Dr Whittaker had a view on this too and pointed out that overseas research shows that it is difficult to identify people who need biometric monitoring and then provide them with the type of service that makes an impact on hospital admissions.

Responsibilities

Ms Waisbrod highlighted two areas of risk for those who monitor biometric data. First is that they may be legally responsible for taking action when an anomaly is identified. And

second, managing the enormous amounts of data is complex and it would be difficult to create an environment that can adequately mitigate its risks.

Capacity

Each talking from a different perspective in health, Dr Bonning, Dr Whittaker, and Dr Harris all raised capacity as a huge barrier – but had differing views on whether this fear is real or perceived. In general, the comments were that if the ambulance service were to introduce an initiative that further increased their workload, it is unlikely they would be able to support it. As a potential workaround, Dr Whittaker said that St John should work collaboratively find ways to reduce the frequency that high-user patients present to the health system.

Fear of Change

Dr Harris commonly hears GPs concerns regarding telehealth developments, such as using video-calling for remote consultations, or allowing patients to view their medical records through online portals. Fears include, setting the technology up, increased workload, managing patients from a distance, patient privacy, and security. Dr Harris said “everyone darts to the complete negative of it.” Society recently had similar fears with online banking – which it can’t do without today. Many of the privacy concerns come from fear of change, despite these technologies being well-established internationally. “Once you see that it actually works and that people are successful using something, then everybody wants it,” she said.

Dr Whittaker’s philosophical view on doctors using teleconferencing for remote consultations is that, “some [clinicians] are much more open to the idea of video consultations and some are fairly adamant that it's not going to work for them.”

However, Mr Brooke didn't believe there will be significant resistance to telehealth. New Zealanders have always been technology savvy; it was an early adopter of cell phones and EFTPOS. He quantified his view by saying it won't be an issue provided the technology is useful to patients and isn't too complicated. For example, there are many people using medical alarms as it is simple and makes people feel safe at home. He admitted though that some people will never adopt these technologies.

Costs

Dr Harris highlighted that a barrier to telehealth systems is their development costs and explained there is still debate about who's going to pay. Mr Brooke made the same point when discussing biometric devices. The health system is financially constrained. Developments need to show value for health, as a system, by freeing money up elsewhere, which will likely be in primary care. The decision to divest money from one activity to invest in another is a hard one because benefits are longer term, which is difficult to justify when you're in a 'here and now' budget.

Older People

Ms Waisbrod highlighted barriers on older people. A large proportion aren't engaged with technology and are reluctant for others to access their health information. Younger people are almost flippant with their privacy.

Expectations

Ms Waisbrod believed that expectation management is important, both for managers' and consumers' understanding that telehealth is not a panacea. Dr Bonning had a similar view saying public expectation is huge and that people need to be told what to expect.

On a slightly different thread on expectations, Mr Brooke believed that – since ambulance is the mobile part of primary care and ICT is going to be important – ‘telehealth’ per se is not special. To support this view he mentioned Telecom changing its name to Spark – the future is not actually about being ‘tele-anything’ as it’s seen as ‘sunset technology’.

And on another thread, Dr Whittaker and Ms Waisbrod stated that health ICT systems are way behind the public’s expectation – the public incorrectly think that health information can be transferred quickly and easily and be accessible to those who need it.

Remote Care

Risks associated with providing care at a distance was a common theme. Mr Goulding said there is a natural risk aversion that comes with telephone triage systems. There will always be risk in remote care that increases with each step that clinicians are removed. It’s a challenge trying to introduce automated systems into complex clinical environments that are highly variable and where there is imperfect information – therefore, telephone triage systems are designed to be risk averse to mitigate risks created by this variability.

On a similar theme, Dr Bonning said that centralised systems like St John’s 111 Clinical Hub are less likely to know the patient, which presents a risk. Dr Whittaker also made a comment on decentralisation, saying that specific contexts need to be considered, and different contexts may require local adaptations.

Overreliance on Technology

Dr Bonning was concerned that there is potential for overreliance on technology saying it could unjustifiably slow paramedics down.

Unequal Access to Healthcare

Dr Whittaker said that the uptake of technology can be rapid, but is not universal. There is risk of unequal access to healthcare when systems are dependent on technology, such as mobile devices and the internet. Some will not be able to access technology due to affordability – creating a socioeconomic divide – and some cannot rely on it, such as those in areas without reliable high-speed internet – creating a geographic divide.

Store and Forward

There were a number of discussions around using telehealth systems for the store-and-forward of information, which was discussed from various perspectives, such as that of EDs, GPs, and ambulance.

Emergency Departments

Dr Bonning described the value of paramedics sharing photos taken on their mobile phones with EDs. For example, photos from a motor vehicle crash could indicate injury severity.

General Practice

When the ePRF system is introduced, it will automatically send GPs a copy of patient reports. Dr Harris described this as good practice for any health professional that has contact with a patient. This way everybody is ‘on the same page’ and information is stored at the medical home, which is the GP.

Dr Harris highlighted that paramedics – who regularly go into people’s homes – are in a unique position compared with other health professionals. They are in a position to identify

issues in the home that might be causing health issues and can use technology to inform GPs of their concerns.

Dr Smith saw the ability to send ePRFs to GPs as being incredibly valuable. For example, the ambulance service attends and treats a diabetic patient for hypoglycaemia four times in six weeks; ePRF ensures the GP knows and therefore can better manage the condition.

Ambulance

In terms of using telehealth to improve an ambulance service, Ms Waisbrod believed that having access to patients' medical records is the most obvious opportunity as it could enable more accurate diagnoses. However, Ms Waisbrod pointed out that, even if ambulance staff have access to personal information records, for whatever reason, they won't necessarily use it.

Dr Harris likened paramedics to after-hours doctors saying both would be better served by having easy access to patient information. It would be a big step in making 'life and death' decisions. Patients could be treated faster or more appropriately – for example, paramedics following doctors' care plans may manage at home where they may otherwise have been transported to hospital. This access to information would improve patient outcomes and create efficiencies by not wasting clinicians' time.

Dr Smith believed that ambulance access to shared care records or discharge summaries will only have a 'moderate influence'. There will always be a group that needs transporting and a group that doesn't require transport. For some in the middle it will be 'helpful', but 'not transformational'. What would be transformational is having access to discharge summaries after incidents. Allowing paramedics to know the diagnosis and what happened with patients they cared for allows them to know if they were on the right track with their management.

Secondary Triage

In terms of secondary triage, Mr Brooke said access to patient information is the area St John should be following because, at the moment, it doesn't have any.

Mr Goulding said it would generally be useful, but "ninety percent of the historic information would be of no use." Decisions need to be based on basic information, such as age and symptoms.

Ms Waisbrod's view of secondary triage is that St John provides 'signposting', saying: "We're directing [patients] to whatever care they need to receive for their condition. It's around supporting people to help themselves."

Similarly, but without calling it signposting, Mr Brooke believed the 111 Clinical Hub, along with ePRF, will be ambulance's biggest telehealth development. Ideally, when low-acuity patients call 111, staff would have the ability to know all alternative pathways and refer into the most appropriate one. This requires a directory of services (DoS) –a database that lists all available alternative pathways. This isn't yet well-established, but would be a 'game changer'.

Ambulance Data

In addition to sharing information with GPs, Dr Smith stated that the biggest benefit of ePRF for St John will be the data. For example, to know how many patients with asthma it went to last year or how many patients with asthma an individual went to last year.

Remote Monitoring

Mr Brooke is confident in the capabilities of today's biometric devices. The difficulty is having an algorithm that identifies when action needs to be taken and what that action should be.

Ms Waisbrod appeared to have a different view in that biometric monitoring technology hasn't been 'nailed'. As an example, falls-detection devices are on the market, but accuracy is an issue. Ms Waisbrod believes the 'utopia' would be a fully integrated health system with an algorithm for every possible thing that could go wrong whereby if something were to occur then someone would do something about it. These interventions would be based on the data from biometric devices, but "the speed at which this is going to take is probably slower than some people think".

Mr Goulding made similar comments to both Mr Brooke and Ms Waisbrod – over the next five years many devices providing biometric information will appear – the question is what to do with that information.

Mr Goulding applied a consumer lens to the evolution of biometric devices and questioned the value of biometric monitoring when it's driven by materialistic concerns. For example, pharmaceutical companies are driven by demand for lifestyle drugs, such as Viagra, as opposed to cures for African diseases. He takes this theme one step further saying that biometric devices will largely be lifestyle devices – like a new app on mobile phones, people "are going to get bored with it really quickly" and only a few will be used.

Ms Waisbrod discussed the evolution of medical alarms, which don't provide any information beyond the activation. The next basic evolution is mobility – being able to notify rescuers where the patient is. And then there is potential to add on telehealth functionality, such as biometric monitoring. Over time "you've got an escalation in the value of the information that you're getting". Eventually you'll have a device that can monitor your vital signs, tell if you've fallen, and video-call your doctor, and the house will have sensors to know if lights had been turned on, whether the person got out of bed, or whether the fridge door has been opened.

This is similar to Mr Brooke's view that the next step for biometric monitoring is simply using more of the existing devices. For example, adding in-home devices that detect falls or movement, or remind people to take their medicines.

Dr Harris had similar ambition for medical alarms describing their ability to provide a person's location, but also to be a 'health passport' that instantly provides medical information to rescuers.

Ambulance

Dr Whittaker discussed that, in order to better manage ambulance service demand, it's important to identify high-user groups and play a role in either managing some patients in the home or monitoring them to prevent acute exacerbations – both approaches attempt to reduce the frequency of transports to hospital.

While not being as specific, Dr Smith provided some examples of how biometric monitoring could be used that align with Dr Whittaker's views – such as checking for rapid weight gain as a sign of heart failure.

Ethical Considerations

There are some ethical considerations with biometric monitoring. Dr Harris, Mr Brooke and Ms Waisbrod all discussed that those receiving information from biometric devices may be obligated to take action.

Another ethical consideration Dr Harris described is gaining consent to use data. For example, there may be research conducted with the data to develop specific interventions. However, it may require ethical approval each time.

Video Calling 111

All candidates were asked for their opinion on the public being able to video-call when calling 111.

Dr Smith envisaged a system whereby patients use video-calling to call 111, which could “change either the urgency of the appointment or who the appointment was with”. For example, seeing the breathing rate of patients with shortness of breath. However, there will always be calls that require an urgent response regardless of this technology, such as chest pain. While there is utility in video-calling, it would require ambulance call-takers, who have no clinical background, to have clinical qualifications. This is an expensive change. This is not an issue if used only in the 111 Clinical Hub, where staff would call low-acuity patients back using video-calling.

As existing 111 calls are taken by non-clinical staff using strict algorithms, Mr Brooke said that video-calling does not have a role as it provides call-takers with new information that the system doesn't require. Although, he said it is entirely possible to develop a different form of medical prioritising system.

Mr Goulding raised the issue of information overload for call-takers who would need to distinguish relevant information from ‘noise’, such as constantly-jerking video.

While unsure how much consumer demand there'd be, Dr Harris said there's diagnostic value in being able to see the patient and it could inform whether an ambulance should be dispatched. However, it needs to be simple to use in an emergency. Dr Whittaker had a slightly different take and felt the public would use it if it was going to help and not going to cost.

Dr Bonning said that the technology has to be good and not be overused; i.e. only used for more substantial emergencies.

Dr Whittaker raised the issue of taking videos with non-consenting people being filmed; “there is the potential for some people to be quite unhappy with that as an invasion of their privacy”.

Clinician-to-Clinician Consultation

There was broad discussion on using telehealth for remote clinician-to-clinician consultation, including paramedic consultation with expert paramedics, internal doctors, and hospital doctors.

Dr Smith said there is utility in paramedic-to-clinician consultation, but not taken as far as Germany’s restrictive approach. Dr Smith was reluctant to take decision-making away from paramedics, but sees a role for incidents that: are unusual; require paramedics to go outside of their scope of practice; or are isolated and the transport decision has a lot of implications.

Like Dr Smith, Mr Brooke said the German model isn’t particularly good and that St John needs “a bit more independence for staff”. Despite this, clinician-to-clinician consultation will come and will simply be an extension of St John’s existing platform – for example, ePRF tablets will be able to share live videos or share photos. All staff should be able to receive remote clinical support when they feel constrained and it would be very easy to have live information, including patients’ vital signs, fed to paramedics at a clinical support desk. The next step could be referral to specialist doctors for particularly complicated situations, but this would be extremely rare.

While highlighting that she is not clinical, Ms Waisbrod said clinician-to-clinician consultation, such as sending photos of wounds to clinicians for advice, could lead to better

patient outcomes. However, having access to patient information would likely add more value than this service.

Dr Whittaker discussed connecting ambulance staff to specialists or EDs to get input on what else the crew can do and what else might be appropriate in terms of managing that patient.

In terms of using clinician-to-clinician consultation for mentoring, Dr Harris said there would be significant value for remote areas. While unsure how often it would occur, the example given was a patient that needs amputation at the scene – being able to video-call direct with a specialist to guide the procedure would be incredibly important.

Dr Bonning had a different view on using telehealth for mentoring. It's more important that paramedics take patients to the nearest hospital without delay rather than being guided to perform invasive procedures. While not for invasive procedures, he supported the provision of remote clinical support – specifically used for “getting the right patient, to the right place, at the right time, by the right means, with the right people”. As an exemplar, RRSQ has centralised doctors and nurses providing remote support. And, given they're an expensive resource, doctors should be used for “making high-end decisions involving the care of complex patients”.

Seamless Sharing of Information

The idea of a seamless flow of information was raised by all interviewees.

Ms Waisbrod discussed that a ‘patient centric’ ambulance service would be drastically improved if there was a fully-integrated, interoperable platform where everyone could access relevant patient information. ePRF will play a significant role in this, but “it's one part of the wider, fully-connected care ecosystem.” Mr Goulding made similar comments – there

should be an integrated information system for health, but it is incredibly difficult as each PHO and DHB has separate ICT systems.

Dr Whittaker said it would be beneficial for everyone if the ambulance service and EDs were better connected in multiple telehealth ways and he imagines EDs would be better prepared if they knew what to expect and who the patient was.

Dr Bonning argued that EDs don't generally need ambulance information in advance as EDs are designed to manage patients without notice. Despite this, telehealth may allow EDs to better prepare for patients, particularly for patients who need specific resources. For example, paramedics sending an ECG of a clear STEMI allows EDs to activate the catheter lab and get the patient early definitive care.

Ms Waisbrod made similar comments. EDs want to know what patients are coming in so that they can plan for their arrival. This does not need to be real-time biometric monitoring, but high-level information being taken from the ePRF.

Mr Brooke discussed that, with ePRF and Mobile Data Terminal (MDT) systems, existing notifications over the radio will become a thing of the past. Eventually, ambulance information will automatically be transmitted to EDs who can look up detailed patient information on their computers or quick-reference information on 'arrival boards' – large screens that provide live, high-level information about patients being brought in by ambulance. Despite seeing value in this approach, Mr Brooke is unsure whether this would provide significantly more value than existing radio notifications. This is because ED staff may not have time to view the information or – for the sickest ambulance patients – there may not be anything recorded as the crew might not have had the time.

Dr Smith made similar comments in that arrival boards will only have small benefits. Knowing what's coming into the ED would allow more planning, particularly in smaller EDs with more limited resources, but it won't be 'transformational' or suddenly start saving lives. However, as per Mr Brooke's comment, the sickest patients would likely have the least amount of information as paramedics would be too busy attending to the patient rather than documenting information.

From a primary care perspective, Dr Harris said it's valuable to know what patients are coming in ahead of arrival. Knowing the patient and the complaint allows doctors to find relevant information ahead of that patient's arrival and be better prepared for the consult. This can speed up the overall process and create a more 'lean operation', particularly when it is unplanned care and the practice is fitting the patient into an already-busy, fully-booked workload.

Diagnostics

There were several discussions on the role of using telehealth for diagnosing in the ambulance.

When discussing existing 12-lead ECG transmission, Mr Brooke said that paramedics will eventually stop transmitting these to doctors to confirm diagnosis as paramedics can accurately recognise a STEMI.

Primary Care

Mr Brooke said that it's important to have effective systems that accurately identify low acuity patients. This would enable the 111 Clinical Hub to better manage patients remotely or allow frontline paramedics to better manage patients in the community. However, Mr Brooke did not express any views on specific diagnostic tools to improve the status quo.

On a supportive theme, Dr Whittaker described that tests that could previously only be done in labs are now becoming mobile and can be used in primary care or by mobile care workers.

CT Scanners

Dr Bonning strongly opposed the concept of ambulances with CT scanners. Besides being a ‘firm non-believer’ in stroke thrombolysis, it's the wrong thing to do as it will result in too much ‘stay and play’ – paramedics should spend less time with patients and get to hospitals sooner.

Dr Smith was not adverse to the possibility, but said it's a long way away from being practical and it is hard to imagine how it could be deployed more effectively than having the nearest ambulance take the patient directly to an appropriate hospital.

X-Ray

Dr Smith raised the possibility of taking plain x-ray in ambulances and transmitting it for diagnosis, which would be cheaper and have more utility than a mobile CT scanner. Diagnosing fractures in the prehospital environment could have significant transport implications, particularly in rural and remote areas.

Ultrasound

Like his view on CT scanners, Dr Bonning said ultrasound in ambulances would not be of significant value and would increase the time it takes to get patients to hospital. In the ED, it takes 30 seconds to perform an ultrasound, and – if there's internal bleeding – patients get sent to an operating theatre. The skill to perform ultrasound and the cost are also current barriers for ambulance services.

Dr Smith said that, as the technology gets smaller and cheaper, St John could eventually afford to buy ultrasound devices. If introduced, paramedics would receive limited training on how to place the probe, but the ultrasound would be transmitted to paramedics at a clinical support desk who would report their findings back to the crew.

Dr Smith said this would have a meaningful impact on patients. Auckland's rescue helicopter doctors use ultrasound – identifying abdominal bleeding in the prehospital environment and booking an operating theatre before getting to hospital can shorten time to theatre by 25 minutes. This is because operating theatres are typically full, and this is the average time until the next theatre becomes available. While it's not known if 25 minutes is clinically significant, Dr Smith said if you've got shock, a shorter time to the operating theatre is better. "It seems intuitively the right thing to do".

DISCUSSION

The following discussion takes a broad view of the overall research and compares interviewee comments with the literature review, identifies new insights, and makes suggestions for future research.

Literature Review

It is clear from the literature reviewed that a Government strategy is to create integrated health information systems. It was apparent that all interviewees agree with this sentiment – as highlighted by Ms Waisbrod, interconnectivity and interoperability are key. However, Mr Goulding and Ms Waisbrod, through their strategic lenses, described the complexity of current health ICT infrastructure, emphasising that integrating health information systems is incredibly difficult. The strategic importance is that ambulance telehealth systems must consider interoperability and interconnectivity from design – this will ensure wider health sector integration and governmental support.

Similar to an initiative of the Scottish Ambulance Service, St John could provide video connections to healthcare professionals within ambulance's Clinical Control Centre. There are two ways that video connections could be used by St John – one is to allow the public to video-call 111 and the other is to allow 111 Clinical Hub staff to video-call low-acuity patients. From an operations management perspective, Mr Brooke highlighted that allowing the public to video-call 111 would not work with the existing system, which has strict algorithms, and video may confuse the issue. And from another non-clinical perspective, Mr Goulding had concerns of information overload. While it is unsafe to allow video-calling to 111 with the current system, those with clinical backgrounds tended to see efficacy in terms of clinical decision-making – staff would be better able to determine patients' acuity and

determine the most appropriate care, which could range from sending an ambulance to advising the patient to self-care. It seems a technology along these lines is imminent and realisable. It could be achieved by ensuring the 111 Clinical Hub can access the most common video-calling software or applications for computers and smart device and would be used for patients who have the technology and are willing to use it. This low-tech and low-risk approach would allow St John to learn more about this technology.

Germany's remote paramedic-to-doctor consultation system shares a range of information, including audio-visual and vital signs, so that doctors in a centre can remotely instruct paramedics to provide treatment. While needed because of Germany's restrictive paramedic practice, it's feasible that similar levels of connection could have value in New Zealand. The 111 Clinical Hub already provides paramedic-to-paramedic consultation and would easily be able to share video and vital signs once ePRF is implemented. Dr Whittaker, Dr Harris, and Dr Bonning said there was value in remote consultation with a doctor. However, while Dr Bonning said this should not be used for invasive procedures as paramedics will spend unnecessary time on scene, Dr Harris said there could be rare cases – such as amputations – where paramedic-to-doctor consultation would have value. Both Mr Brooke and Dr Smith – who know and understand St John's 111 Clinical Hub strategy – felt that decision-making needs to remain with frontline paramedics, but paramedic-to-paramedic and paramedic-to-doctor consultations would be valuable when incidents are complex, have significant transport implications, or other situations where paramedics felt they needed support. So while there was general agreement that remote support for paramedics using telehealth would be good, opinions about what that would look like differed. It is the researcher's view that – like using video-calling for low acuity patients in the 111 Clinical Hub – St John could utilise video-calling for remote clinical support. Staff will soon have a capable device with ePRF and it is simply enriching the level of existing communication.

In New Zealand and abroad there were several examples of using telehealth for diagnostic purposes, ranging from 12-lead ECG transmission (common in New Zealand and internationally) to mobile CT for stroke and echography for trauma (isolated examples overseas). While unsure what the solutions were, Mr Brooke was interested in telehealth that accurately identifies low acuity patients, or allows paramedics to manage patients in their homes – views which align St John strategies that Mr Brooke leads. Dr Bonning and Dr Smith had differing views on mobile CT scanners and ultrasound. Dr Bonning felt that these diagnostic tools would result in unnecessary delays in getting patients to the hospital. Dr Smith was open to mobile CT, but not convinced it would happen any time soon or that a dedicated ambulance would be more effective than having paramedics drive to the most appropriate hospital. Dr Smith said ultrasound is possible as technology becomes cheaper and smaller, and believed it can improve patient outcomes. A diagnostic tool not covered in the literature review that Dr Smith raised was x-ray, which he said would have more utility than mobile CT and would be particularly useful in rural and remote areas which tend to have significant transport implications. Ultimately there were differing views on the diagnostic equipment that were interesting, but did not provide clear direction. However, the most useful insight was Dr Smith’s description of training a small group of paramedics to interpret ultrasound frequently rather than training all paramedics to use it rarely – paramedics would share ultrasound imagery using telehealth infrastructure to centralised paramedics, i.e. the 111 Clinical Hub.

Based on the literature review, it’s envisioned that remote monitoring will improve the health of those with long-term conditions and that it could play a role in reducing the demand on ambulance services. Interviewees also believed it could play a role for the ambulance service, but how this would be achieved is less clear. Ms Waisbrod and Mr Brooke discussed that biometric monitoring will be an extension of existing medical alarms – although they had

contrasting views on how far away the technology is with Ms Waisbrod saying it will take longer than some people think. For Ms Waisbrod, the ‘utopia’ of remote monitoring is being able to monitor vital signs of particular groups, and then use the data to inform an intervention. Dr Harris saw personal medical alarms doubling as a GPS and ‘health passport’ to provide instant patient information for paramedics, which is consistent with the idea that remote monitoring is an evolution of medical alarms. And Dr Whittaker said that by monitoring a particular group of patients with long-term conditions, ambulance could respond to early signs of deterioration and reduce the frequency of hospital admissions. While the medical alarm will evolve to have much greater functionality (such as, biometric monitoring, GPS tracking, and audio-visual connectivity), Dr Harris, Mr Brooke and Ms Waisbrod all discussed that those receiving information from biometric devices may be obligated to take action. This seems to be a key issue for St John; while St John is a mobile healthcare provider, does it want to play the role of monitoring those with long-term conditions, or is that the role of GPs?

New Insights

Many of the interviewees discussed that, for telehealth to be successful, it needs to be based on simple algorithms and be easy for staff and consumers to use. Mr Goulding emphasised that even complex algorithms cannot manage the variability that comes with managing patients, and therefore they need to be based on simple rules. Mr Goulding and Ms Waisbrod commented on interfaces needing to reduce key strokes – even one more touch on a key board can make a difference in user acceptance. Rather than being highly innovative, interviewees thought technology should be ubiquitous. It therefore is not surprising that Ms Waisbrod stated the most commonly used telehealth technology is video-calling – this is well-established, easy-to-use technology that can be found in most mobile devices and computers.

This provides St John with reasonably clear direction: see how ubiquitous technologies can be used to manage patients remotely, with video-calling being most ubiquitous. In terms of using telehealth to improve clinical decision-making and clinical support, this is the area that St John should focus on. As mentioned in the previous section, there is pragmatic opportunity to explore this within the 111 Clinical Hub as a way to call back low acuity patients and/or a way to support clinical staff.

Dr Whittaker made resounding comments on the risks of designing telehealth systems as *the* primary interface for accessing health, which could result in socioeconomic or geographic inequities. In a country that does have significant pockets of unequal access, this must be considered in designing telehealth solutions.

Doctors Bonning, Harris, and Whittaker all discussed that capacity is an issue for any new systems – it is interesting that St John employees did not make similar comments, which may highlight a lack of awareness. Interestingly, doctors' fear of change was raised by Dr Harris and Dr Whittaker, two doctors who are pushing telehealth in various forms; capacity, cost, privacy, and security being among the common concerns. This reveals the importance for St John to clearly communicate with the health sector regarding new telehealth interventions. St John needs to expect resistance to new approaches and have clear communication strategies to allay these fears.

While some raised concerns about centralisation, it repeatedly came up as a way to maximise the use of specialists' skills and knowledge, which is consistent with the 111 Clinical Hub model. From a clinical decision-making point of view, it's better to have a smaller group of people routinely make complex decisions than to have all staff trained in a particular skill and use it infrequently. This centralisation may create or require specialist staff – and specialists are often paid a premium. Therefore, there is an element of efficiency in

centralisation by having specialists routinely make complex decisions. Telehealth enables centralisation.

Future Research

There are a few limiting factors of this research. This research study has a very small population size and the researcher selected the sample population – both of these research designs may have resulted in bias.

Also, as part of good practice in New Zealand research, it is important to have Māori review the research design that was omitted from this research. It would be insightful to have Māori perspective in terms of the future role of telehealth in a New Zealand ambulance service.

There are clear gaps in ambulance telehealth research in that there is little quantitative or qualitative evidence that demonstrates that telehealth systems can improve patient outcomes, improve effectiveness of the ambulance service, or create efficiencies for ambulance services. This is despite most – including this researcher – believing there is value, in one form or another, to provide healthcare remotely using ICT systems. For example, the literature review found that ePRF is routinely evaluated in terms of the time it adds to a total job-cycle time – which is incredibly important from an operational management perspective – whereas there's opportunity to study telehealth in other terms, such as patient or paramedic satisfaction, improved patient outcomes, the frequency of adverse clinical incidents, or improved procedural adherence. The research method and methodology used were not going to answer this question, but it reveals that further research could be done in this area.

SUMMARY

Telehealth systems – using ICT to manage health from a distance – have been developing for decades, including within the New Zealand ambulance sector. This research attempted to understand how telehealth could improve patient outcomes, improve effectiveness, or create efficiencies for the St John ambulance service. To achieve this, current literature was reviewed and a small group of experts were interviewed for their insights.

There were several key findings from this research, including: using a strategic approach to align with government policy; using well-established technologies; centralising specialists; using video-calling; enabling new diagnostic equipment; making a strategic decision whether to monitor patient information; ensuring equitable access to healthcare; developing effective communication strategies from design; playing a role in sharing evidence on telehealth; and remembering that no single solution will be the panacea.

It is clear that a Government strategy is to create integrated health information systems. The strategic importance is that ambulance telehealth systems must consider interoperability and interconnectivity from design – this will ensure wider health sector integration and governmental support.

Telehealth solutions should be based on well-established, easy to use, and ubiquitous technologies, as opposed to those that are complex or innovative. This will ensure less fear, less technical challenges, greater adoption, and ultimately greater success. It is therefore no surprise that the most common form of telehealth application is video-calling. This provides St John with clear direction; if looking for new ways to provide care at a distance, use everyday technologies, and don't try to reinvent the wheel. Of all available technologies, video-calling provides the most opportunity at present.

Consistent with the 111 Clinical Hub model, centralisation of specialist support is an effective approach to providing telehealth. This is a pragmatic approach that allows St John to have a small number of specialists who routinely make complex decisions. Centralisation ensures staff routinely provide support and therefore develop and maintain an ability to make complex decisions. It is also cost effective as training and support is limited to a core group that is based in one or two locations as opposed to thousands of staff throughout New Zealand, and – while specialists may attract premium wages – there is an element of efficiency having those specialists routinely making complex decisions.

Following on from the above two points of video-calling and centralisation, there are realistic opportunities for St John to integrate video-calling as a telehealth solution into the 111 Clinical Hub – a centralised site whereby specialists use video connections to perform remote assessments and provide remote care. By ensuring the 111 Clinical Hub can access the most common video-calling software or applications for computers and smart devices, its staff have quickly improved the richness of communication. As a patient-to-clinician tool, 111 Clinical Hub staff could use video connections when they call back low acuity patients to perform a secondary triage, enabling staff to more accurately determine patients' acuity and determine the most appropriate care. As a clinician-to-clinician tool, the 111 Clinical Hub could utilise video-calling for richer clinical support. With the introduction of ePRF, paramedics will soon all have a device capable of video-calling and sharing live patient information. Regardless of whether it's used as a patient-to-clinician or clinician-to-clinician tool, the technology already plays a significant and increasing role in remote healthcare. St John could easily adopt this low-tech technology with a low-risk approach.

In terms of using diagnostic equipment, an insight was that paramedic-to-clinician consultation would support the introduction of new telehealth technologies. By having the

benefits of a centralised, specialist workforce, St John could introduce new diagnostic equipment with less training and on-going support.

It is unclear the role that remote monitoring will play in improving an ambulance service. What is clear is that medical alarms will evolve to have much greater functionality, including sharing of biometric information. However, those monitoring the information may be responsible for taking appropriate action when there are any signs of deterioration, and St John needs to make a strategic decision whether it wants to play the role of monitoring those with long-term conditions, or whether that is the role of GPs.

An astute point made during the interviews was the danger of using telehealth systems as *the* primary interface for accessing health as it could result in socioeconomic or geographic inequities. In a country that does have significant pockets of unequal access, this must be considered in designing telehealth solutions.

Fear of change takes shape in many forms. Regardless of how strong the belief in St John may be that the new development is a good thing, it is likely to create discomfort for many. It is important that St John clearly communicates with the public and health sector regarding new telehealth interventions – resistance to change must be anticipated and therefore strong communication strategies must be part of the design process.

There is limited evidence to support telehealth solutions in terms of improved patient satisfaction, improved patient outcomes, or greater efficiencies. With St John's upcoming implementation of ePRF, there is a real opportunity to evaluate in these terms, as opposed to job-cycle times, which is how success appears to have been commonly measured to-date.

The final and most significant conclusion drawn is that, regardless of the telehealth system adopted, no single solution will be effective. As highlighted by the NHS 111 case, real improvements will require multiple integrated systems.

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APPENDICES

Appendix 1: Interview Guide

The emerging role of telehealth in a New Zealand ambulance service

- (1) The following serves as an interview guide for a university research project.
- (2) This guide is used to provide structure for the interview. However, as it is only a guide, it is likely the interview will deviate from these questions as each conversation naturally unfolds.
- (3) Interviewees will be sent this guide prior to the interview to provide context – it is not expected that interviewees will have answers for every question.
- (4) All questions are asked in the context of a New Zealand ambulance service.
- (5) The Ministry of Health (2014) define telehealth as “the use of information and communications technologies along with appropriately trained health professionals and other health workers to deliver health services and transmit health information over distance”.

Interview guide

1. Are you aware of any telehealth developments that could be used to improve ambulance services? What are they and what benefits will they provide?
2. How significant of a role do you see telehealth playing in the ambulance service?
3. What do you view as the priority areas for ambulance services? What role could telehealth play in addressing those priorities?
4. Telehealth can be divided by its function: consultation, diagnosis, monitoring, and mentoring. Which function of telehealth do you believe would be most beneficial in a New Zealand ambulance service, and why?
5. What is the most important telehealth development that a New Zealand ambulance service should focus on?
6. What reactions do you believe the public will have in interacting with telehealth systems in a New Zealand ambulance service?
7. What barriers or risks do you see associated with telehealth systems?
8. In countries like Germany, it is common practice for in the field paramedics to consult with doctors using telehealth applications. What value do you see in using this type of innovation in the New Zealand ambulance service?
9. Another application that has been talked about in the industry is enabling video calling for 111 calls. What value would you place on this type of application?
10. How do you think telehealth could improve patient diagnosis?
11. If you could dream a little, without consideration of practicalities or cost, what is your wildest idea for telehealth?

Appendix 2: Letter Request for a Personal Interview



Letter request for a personal interview

[Date]

[Name]

[Title]

[Employer]

[Address]

Dear [name]

I would like the opportunity to interview you as part of my MBA Business Research Project. The research is concerned with the future role telehealth in St John ambulance; what opportunities are there for it to improve patient outcomes, improve patient satisfaction, or provide a more efficient service. The interview is designed to take between 30-90 minutes.

The opinions and statements that you make during the interview may be attributed to you personally; however, you may withdraw from the research before September 29, 2014. The findings derived from this study will be shared with St John and may be included in academic conferences. Interview recordings and transcripts will be kept in a locked office, and will be destroyed at the conclusion of the research. The research findings will be shared with St John and may be included in academic conferences.

Victoria University of Wellington has granted ethical approval as a teaching activity and this project has been reviewed by the Course Coordinator.

With your permission the interview will be recorded and a draft copy of the report will be provided for your approval before the project is submitted for examination. You will receive an electronic copy of the final report. If you for any reason would like to make contact regarding this research please contact one of the following:

Jared Stevenson	027 209 6986	stevenson.jared@gmail.com
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Dr David Stewart	(04) 463 5150	david.stewart@vuw.ac.nz
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Yours sincerely

Jared Stevenson

Appendix 3: Letter of Introduction for Student/Employee



Letter of introduction for student/employee

Friday, 22 August 2014

Peter Bradley, CEO
St John
2 Harrison Road
Mt Wellington
Auckland 1060

Dear Peter Bradley

As you know, I am employed by St John in the role of Regional Clinical Development Manager, Central Region, and I am also a student of Victoria University of Wellington studying for the MBA degree. As part of my studies I am required to undertake a Business Research Project and would like to conduct research within the organisation.

The Research Project is to understand the future role telehealth in St John ambulance; what opportunities are there for it to improve patient outcomes, improve patient satisfaction, or provide a more efficient service. Approximately three people within St John will be interviewed for their perspective on this topic. A similar number of people outside of St John will also be interviewed.

I acknowledge that there is a potential conflict of interest, and this will have to be carefully managed. To this end I have prepared an agreement between the company and myself so that expectations are managed and progress is monitored.

Yours faithfully,

Jared Stevenson

Appendix 4: Agreement for Employee/Student Relationship



Agreement for employee/student relationship

Agreement between Jared Stevenson and St John concerning Business Research Project for the Victoria MBA programme.

This agreement is for the study of **the future role of telehealth in a New Zealand ambulance service** undertaken by Jared Stevenson. The agreement covers the student to interview up to six people who will share their views on telehealth from St John.

Jared has two roles, namely that of a student at Victoria University and that of an employee at St John. Therefore the student will make clear when they are operating as a student and when they are operating as an employee. A plan and timetable will be submitted to the sponsor outlining the access that is requested and the time that is involved. The student agrees to act professionally and with integrity throughout the research process.

The data collection and the research paper remain the intellectual property of the student.

The student will obtain written consent from staff before being interviewed and they will be given a copy of the draft report to approve. The student agrees to submit a draft copy of the research project for the sponsor's feedback and any concerns will be discussed before the report is submitted for examination.

Signed:

Student: Jared Stevenson

St John: Peter Bradley, CEO

Date:

Date:

Appendix 5: Consent Form for Personal Interview



Consent form for personal interview

Personal Interview CONSENT FORM

I agree to be interviewed by Jared Stevenson for the purposes of his MBA Business Research Project and consent to the use of my opinions and information. I understand that the opinions or statements that I make during the interview may be attributed to me personally, and that I may withdraw from the research before September 29, 2014. I am also aware that the findings derived from this study will be shared with St John and may be included in academic conferences.

I have been informed of the purpose of the research and the confidentiality conditions.

I understand that raw data collected during the interview will only be available to the researcher, name, and his supervisor, Dr David Stewart.

I have been informed that I will receive a draft copy of the Research Project to correct and approve before October 11, 2014.

Name:

Date:

Signed: