

## **Consumers' perspectives of wireless cardiac monitoring: Results of a small New Zealand telehealth project.**

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### **Abstract**

*Cardiovascular disease is a major cause of death in New Zealand. Telehealth, which relies on information and communication technology to provide health services, can support cardiac monitoring in people's homes. This has the potential to overcome the barriers of distance and time. However, successful cardiac monitoring depends on the use of technology being acceptable to the consumer. This qualitative study with seven participants aimed to understand the consumer's perspectives of using wireless cardiac monitoring by looking at the human factors involved. New Zealand consumers were both similar and different from other consumers. Key issues identified were feeling safe while being monitored and being both pleased and concerned about seeing their cardiac rhythm. Specific findings related to wireless monitoring included skin care to attach the sensor, that monitoring equipment be discrete and not restrict the consumer's life. Training to use the equipment and to understand the data from the cardiac monitor was highlighted as necessary to gain the maximum benefit of this example of telehealth.*

### **1. Introduction**

Cardiovascular disease (CVD) is the number one cause of morbidity and mortality globally, accounting for 31.5% of female deaths, and 26.8% of male deaths [1]. Almost two thirds of CVD related deaths occur outside the hospital, with most victims not surviving long enough to receive medical help [2, 3]. Telehealth, which is defined as the delivery of health services through telecommunication equipment, is considered a way of providing health services in a manner that overcomes barriers to care such as time, cost, and distance [4]. The World Health Organisation (WHO) resolution on e-health describes telehealth as "the cost effective and secure use of information and communications technologies in support of health" [5]. As healthcare costs continue to increase, resources within the health sector are being redirected from hospital based care to provide increased primary and home based care, in which telehealth plays an increasingly prominent role [6]. More importantly, telehealth has been shown to reduce cardiac disease hospitalisation rates through early recognition and intervention for adverse cardiac events, as well as helping to manage and treat chronic cardiac conditions [3, 7]. Beck, Daughtridge and Sloane [8] consider that when consumers have full access to information and are able to be involved in decisions related to their care, they will be more compliant with prescribed care and more willing to undertake health changing behaviour. They can do this from within their community environment as professionals will be able to assess the efficacy of treatment without having to treat them in an in-patient setting [9]. In addition, people who have better understanding of their health or illness have been found to have better outcomes than those who are passive consumers of healthcare [10].

### **2. Benefits of Telehealth**

There is evidence that telehealth can provide significant benefits to consumers. Artinian [4] suggests that telehealth allows health care to be provided in an alternative, less threatening environment than that of a clinic or hospital, which can lead to improvements in care outcomes and quality of life as a result of receiving care in one's own home environment. Telephone consultations to support home care were found to result in less travel time and inconvenience to consumers [11]. In addition, telehealth can increase access to healthcare by allowing for more flexibility in arranging health consultations between consumers and clinicians [4]. However, the mode of telehealth can make a difference as de Lusignan [12] found when video consultations were perceived to have no benefit over the use of telephones, with participants becoming less willing to engage in video consultations, preferring the telephone consultations instead.

Successful wireless monitoring is dependent upon the ability to transmit clear, high quality real time data from the consumer, wherever they may be, to the health care provider, without the information being corrupted or lost. This has the potential to increase access to health care and improve the quality of care provided to certain populations, reducing inequalities present between rich and poor, and rural and urban populations, within and amongst countries [13]. Miller [10] states that healthcare professionals and advanced equipment for diagnosis and treatment are often concentrated into urban areas, so telehealth has the potential to make some of these resources more accessible to rural communities. There is also potential to reduce cost in an industry under ever increasing fiscal pressures [14]. However, and perhaps more importantly are the benefits perceived by the users of the technology, which can be measured in consumer satisfaction [13, 14].

In a systematic review of consumer satisfaction with telehealth it was discovered that people were often enthusiastic about improvements in care, such as increased access to specialists, reduced waiting times and reduced travel times, though some reported concerns regarding the delivery of care through telehealth, in particular the change in communication [13]. This is a significant finding, and suggests that it is important to understand the effects of telehealth consultations on consumers' health and perceptions of their care, as well as their expectations of interactions with health professionals.

### **3. Human Factors and Telehealth**

Human factors assist in exploring the consumer's perspective associated with telehealth initiatives. Human factors in relation to telehealth are described as "the study of the user experience ... and the effort to maximise the positive elements of telehealth system design, implementation, and operation" [6, p. 446]. To gain insight into the consumer's experience, developers of telehealth may utilise a variety of methods to gain feedback including focus groups where consumers report their thoughts and feelings about a product; field trials; simulations, where users may use or directly interact with a product to assess its validity for everyday use; and questionnaires.

Brennan[15] insists that any telehealth service must be designed and implemented with the end user as the focus of development, for whether a telehealth service may be functional and useable will depend upon the age, culture and competency of those users [16]. Human factors that can define competence include "literacy, dexterity, vision, hearing, learning ability, memory, training, experience, and language barriers" [16, p. 23]. Users can include consumers, health professionals, administrators, and technical staff, so there will be a wide range of users with differing levels of competency. A review of the current literature identified a gap in understanding the use of wireless cardiac telehealth monitoring from the New Zealand consumer's perspective.

### **4. Wireless Cardiac Monitoring**

Well known heart monitoring devices (i.e. Holter) work by the consumer having usually three small patches or stickers called electrodes attached to the skin, which are wired into an electronic box that records the electrocardiograph (ECG). The cardiac monitoring can be continuous, intermittent at set times, or user activated, usually in response to symptoms, such as feeling dizzy or experiencing palpitations. In wireless ECG monitoring, either continuous or intermittent data recorded from the consumer is remotely sent through to a professional at some other location, analysed, and a response may be sent through some information and communication technology medium to inform the consumer of action that needs to be taken. The service that is provided may not change, but the pathways that monitoring and care is communicated does. Types of information and communication technology used may include telephone, internet, and advanced high speed data networks to transmit digitised data [17].

A clinical trial evaluating the benefits of wireless ECG monitors for consumers reported that the use of wireless technology increased and improved communication and interaction between consumer and health provider, in addition to decreasing waiting time for treatment [2]. The ability to be intermittently or continuously monitored can support interaction between consumer and health professional as the consumer may be being able to transmit and access data at any time from any location, which enables them to act as "responsible consumers of their own health", gaining control of when they record and send data, and understand the significance of doing so [2, p. 101]. The use of cardiac monitoring telehealth can allow for earlier recognition of a problem by the consumer and health professional and therefore earlier intervention for cardiac abnormalities [18].

Wireless ECG monitoring has the potential to be less invasive and easier to use than existing methods such as the Holter monitor. In 2010 Fensli et al.[19] evaluated consumers' perceptions of wireless ECG monitoring on hygiene, ease of use during physical activity and skin reactions. Consumers reported that a wireless monitor reduced the stigmatisation they felt compared to that experienced when wearing alternative models that were not wireless. Some participants remarked that they felt like a medical instrument when using a wired model, and felt less able to undertake activities of

daily living due to the restrictive nature of the design and the wires. This is important as the person's ability to continue on with everyday activities of daily life with minimum inconvenience has been found to influence their acceptance of technology [18].

## 5. Methods

The aim of this small telehealth project was to better understand the New Zealand consumer's perspective of using wireless ECG monitoring. An invitation for participants was made through a database of consumers and from this seven participants with a diagnosed heart condition were recruited. Participants volunteered to attend for up to two hours. During this time they were asked to wear a wireless cardiac monitor for an hour, perform a number of activities aimed at replicating everyday functional tasks and participate in a focus group where they were asked about their perceptions and experience. The tasks participants were asked to do included walking up and down stairs, sitting down, and movements used at home such as writing, reading, dressing, shaving/appling makeup or combing hair.

In addition, participants were asked to complete a qualitative open ended survey via email three months after the focus group. The survey started by asking participants to reflect back on their experience at the time and since and consider if there was anything they wanted to add. Questions included: In what ways was the ECG monitoring equipment convenient or not to wear/use? What are the advantages/disadvantages of being able to see the ECG reading on the screen? What concerns about privacy and/or security were there? And Do you think wireless ECG monitoring would impact on your relationship with your health providers, and in what way? Participants were also invited to add any further comments. The survey provided individual responses and gave participants the opportunity to reflect upon their experience before responding.

The wireless cardiac monitor in this project was suitable for short or long term use, and either intermittent or continuous use. Use would be likely to depend on the patient's diagnosis and setting, such as rurality and distance from health care. The monitor utilised one sensor, about twice the size of one of the usual electrodes. This was attached to the anterior aspect of the chest, where once activated it transmitted the heart's electrical activity to a receiver hard-linked to a mobile telephone. The mobile telephone had unique software installed which allowed the heart rhythm to be viewed by the user and transmitted via either 3G or wireless networks to a server which can be viewed in real time or at a later time point by a health professional, such as a General Practitioner (GP). However, the focus of this project was on the consumer's perception of the wireless monitor and not on any technical aspects, such as transmission of data.

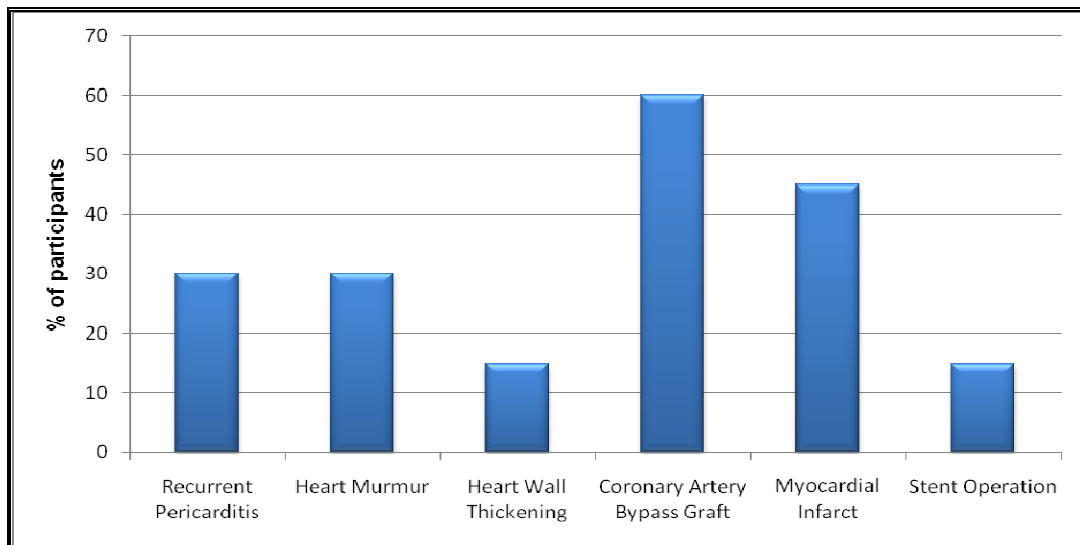
The findings were analysed using a similar method to Glaser's grounded theory analysis [20]. Information was coded to conceptualise the data into patterns, open coding was then used allowing identification of the core categories of behaviour that were relevant, problematic, or both for the study participants. This involved reading the words spoken by the participants in describing their experiences, to generate core categories for analysis, and these core categories were analysed.

## 6. Findings

The participants comprised two women and five men aged from 42 to 82, all with a known history of cardiac conditions. Figure 1 shows a breakdown of their past cardiac history, with several participants having co-morbidities which are why the percentages add up to more than 100. Core categories were identified from the data and these are described next using illustrative quotes from participants.

### 6.1. Benefits of Being Monitored

Participants considered that they would feel safer being monitored. Some comments focused on the benefits of being continuously monitored. One participant remarked that "the advantages are you are monitored 24/7 by your GP". Another commented on the advantage should anything be wrong with their heart, of knowing "your ECG reading goes direct to the GP if unusual circumstances occur". Participants were also positive about the potential time savings they could make from being wirelessly monitored with comments including "it saves a lot of trouble", and "saves going in to see the doctor. One suggested that this saving in not having to go to an appointment would "ease the anxiety around going to the doctors". Participants felt that the use of telehealth would not change their relationship with their healthcare provider, other than to become more connected to them, which they discussed as a positive thing.



**Figure 1 - Past cardiac history of participants**

## 6.2. Visibility of Cardiac Rhythm

Having the cardiac rhythm visible was seen both positively and negatively. It was considered positive, as long as sufficient training was provided to users: “If trained it would be great to use”. Participants also said that given the correct training so they interpret the ECG, being able to see the recording would have enabled them to be less anxious about their health and may support them to get on with life as they could determine what was occurring with their heart throughout the day by looking at the screen. However, some participants felt that being able to see their cardiac rhythm on the screen could increase their anxiety and self-diagnosis, saying: “Wonder if I would become neurotic about my own heart rhythms as I can see the screen” and felt that they would have been more comfortable to have the data sent directly to their health professional so they did not have to view it, saying: “Why do we need to see the screen at all?”

## 6.3. Skin Care

Skin care, specifically for those with a hairy chest was an issue. A participant reported that the sensor would not stick to his hairy chest. He felt that he would have to maintain a shaved patch of skin on his chest. No participants reported experiencing any skin irritation or discomfort from wearing the sensor during the project.

## 6.4. Wireless Monitoring

All participants found the wireless cardiac monitoring did not restrict their movement or them completing the assigned activities. In addition, because there were no wires, participants reported that the sensor was no problem to wear at all and they felt that it was easily concealable underneath their clothing. The sensor transmits a signal to the receiver on a mobile telephone. The placement of the mobile on the body was discussed by participants as the phone needed to be in close proximity to the sensor to receive the signal. Some participants held the phone in their hand, which was noted as not being practical in everyday living situations. Either a breast pocket or an inconspicuous holder that could be placed comfortably on the body were solutions suggested. Participants thought the amount of training required to use the equipment confidently would be significant. The equipment included the sensor being attached to the chest and the mobile readied. For example, participants said “I would need considerable training around using the equipment” and concern was expressed about “knowing how and when it should be used”.

## 7. Discussion

This project found New Zealand consumers similar to other consumers regarding the issues they identified in the use of telehealth. The participants were overall positive and satisfied [13, 14]; they recognised similar benefits of telehealth, of it potentially saving time in visits to see health professionals [4, 9, 11], waiting time [2] and supporting early intervention if something untoward was noted [18]. However, concern about changing their relationship with their

health providers was not raised, which is a point of difference from the findings of Mair and Whitten [13]. This may be because this project only involved the short-term use of wireless cardiac monitoring rather than longer term use of telehealth, where communication and the ongoing consumer-health professional relationship may be affected.

The length of the present project may have also influenced issues around skin care and the impact of wireless monitoring on activities of daily living, such as hygiene. However, the study by Fensli et al, [19] which trailed monitoring for three days did not expose skin issues, and a longer study is required to identify if skin care with the sensors or electrodes may cause skin irritation over a longer period of time.

While the literature raises consumer's concerns around stigmatisation [19] the present project participants did not indicate this as an issue. This may be because of the less intrusive nature of wireless monitoring where no wires are required that meant that the equipment fitted under their clothes quite easily.

The participants in this study were mixed in their appreciation of being able to view their cardiac rhythm. While Beck, Daughtridge and Sloane [8] consider full access to information about health information would help consumers be more autonomous and work in partnership with their healthcare, the participants in this study expressed concerns about understanding what they were viewing. A lack of understanding would also be a barrier to consumers being actively involved in their health care which would mitigate the advantages suggested by Miller [10] and Rubel et al. [2], where active involvement improves health outcomes. The ability of consumers to play an active part in their care would therefore depend upon the ability of the health professionals to provide the necessary training to understand what the signals on the screen mean, and upon the competence of the consumer in learning this skill [16].

Despite this project being about the consumer's perception of wireless cardiac monitoring, the technology was still highlighted in the focus group, mostly in relation to the convenient placement of the mobile telephone and it allowing potential users the ability to function in their everyday life. As everyone is different, consumer input is critical for this, and further study, of a longer duration and with a larger group is recommended to fully explore the impact on consumers.

In this study all equipment was supplied and any costs covered. Patients having to buy or being charged for use of equipment could be a possible barrier. In addition, in New Zealand mobile phone charges could be a major deterrent to usage and acceptability of telehealth, especially if continuous monitoring was required.

This project was limited by its sample size of seven self-selecting participants. A larger study is needed, with a wider range of participants that includes the competence factors of literacy, dexterity, vision, hearing, learning ability, memory, training, experience, and language barriers that Kaufman-Rivi, Collins-Mitchell and Jetley [16] identify.

## 8. Conclusion

The project was small with a sample size of only seven participants, but still provides a useful beginning to understanding the New Zealand consumer's perspective of wireless cardiac monitoring. Telehealth, such as the use of wireless cardiac monitoring has potential benefits for consumers, from saving time and travel costs to visit an in-patient setting, to providing continuous monitoring and reassurance. A wireless format was also found to allow freedom to perform activities of daily life without the hindrance of wires. A broad human factor approach may provide the tools to understand the experience of consumers of telehealth, and by focusing on the consumer during every step of planning and development of telehealth services, outcomes will maximise their acceptance and use of telehealth and quality of life.

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