Information Technology and Diffusion in New Zealand public health sector: District Health Board Case Study.

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Structured Abstract:

**Purpose** – The purpose of this study is to identify the influential agents that led to successful acceptance and diffusion of the Concerto - CWS at the Northland District Health Board.

**Design** – The paper draws on Rogers’s diffusion of innovation theory to interpret and analyse the factors that enabled an acceptance and a successful implementation of the innovation – CWS in New Zealand public health sector.

**Findings** – We conclude that human, for example, clinicians, and non-human factors, such as software package, simultaneously influenced the ready acceptance of the innovation. The reason for positive acceptance and full diffusion of the Concerto CWS as compared to iHealth is the increased functionality offered by Concerto and the ability of the innovation to provide clinicians with comprehensive patient information records over a period of time which, in turn, assists in making informed decisions regarding treatment, discharge, hospitalisation and recommendations for the future wellbeing of patients.

**Research limitations/implications** – The study has practical implications for the clinicians, the District Health Board Members and the public health regulators. The outcomes illuminate the ‘agents’ that positively influenced the diffusion of the Concerto. The regulators and the District Health Boards can use this as a benchmark to determine what leads to successful diffusion of IT innovation used in public health sector.

**Originality/value** – This study contributes to new knowledge by investigating the diffusion process of IT innovation with an intention of establishing the factors that enabled this process.

**Practical implications** – The study have practical implications for the clinicians, the District Health Board Members and the public health regulators. The outcomes illuminate the ‘agents’ that positively influenced the diffusion of the Concerto. The regulators and the District Health Boards can use this as a benchmark to determine what leads to successful diffusion of IT innovation used in public health sector.
**Keywords** - Clinicians, Innovation, Diffusion, Concerto, iHealth, Patient Data Clinical Management System Data

**Article Classification:** Case study

Submission category: Academic
Information Technology and Diffusion in New Zealand public health sector: District Health Board Case Study.

1. Introduction

It is evident the use of information technology (i.e. electronic medical records) offers many benefits to increase the efficiency and improve the quality of patient care, and to support health care professionals and decision making in management and health policy (Abernethy et al., 2007; Häyrinen et al., 2008). Most studies on health information system (HIS) offer insights based on US and UK public sector, only limited studies focus on New Zealand. These HIS studies have mainly concentrated on the type, content, structure and users of electronic medical records (EMRs)¹ and the institutions using them (Häyrinen et al., 2008; Jha et al., 2008), and have neglected to investigate implementation, acceptance and diffusion of HIS (Stead & Lin, 2009), particularly in a primary care setting. This leaves an important gap in the area of ‘what factors’ influenced the implementation, use and diffusion of HIS. Our study therefore addresses this gap within a New Zealand public health sector setting.

Our study attempts to offer insight from the clinicians by using diffusion of innovation (DOI) theory to explore and reveal how and why an innovation such as the clinical workstation was implemented and readily accepted by clinicians. A recent survey showed that New Zealand has the highest level of EMR adoption (Schoen, et al., 2006; Jha, et al, 2008). Health information system must be designed to support the needs of clinicians and their patients, because they are the biggest group of technology users in health care organisations. As a result, the needs of clinicians must be analysed first. The implementation of HIS (i.e. Concerto) will not succeed until clinicians are satisfied that the change will improve the efficiency of their work and improve the quality of patient care that they are able to provide.

The objective of this study is twofold. First, we gather primary data by seeding evidence directly from clinicians as to what factors and influences affect the implementation of Concerto. Second, we examine whether the influential agents have led to successful acceptance and diffusion of an innovation (i.e. Concerto). The successful implementation and diffusion of an innovation can make a huge difference to its effectiveness, safety and reason cost of HIS (Karsh et al, 2010). The paper draws on concepts from diffusion of innovation

¹ See Appendix I for a glossary of acronyms and terms used in this paper.
theory (Rogers, 2003) to move from dissemination to diffusion (Lapsley and Wright, 2004; Lee, 2004; Perera et al., 2003; Ward, 2013).

To the best of our knowledge no such study in New Zealand has been undertaken using DOI theory to understand the factors that may influence the ready acceptance of an innovation, such as the Concerto clinical workstation by clinicians. The study therefore contributes new knowledge by investigating the factors that influence the diffusions of IT innovation in the public health sector. Much of the prior research on the implementation of an innovation, (i.e. EMRs) in US and UK was confined to the ambulatory or hospital setting; few studies have been conducted at the District Health Board (DHB) level. Our study expands these efforts to take a close look at how an innovation is implemented and diffused in a health care organisation (DHB). Further, earlier studies were largely descriptive and under theorized. Our study adopts DOI theory to acknowledge the initiation and implementation of an innovation (i.e. Concerto), as we believe the implementation of an HIS (i.e. Concerto) is a transformative sociotechnical change, not a simple add on to an existing HIS. Further, the study will assist the regulators and the District Health Boards in determining what leads to successful diffusion of IT innovation used in public health sector.

The next section outlines prior literature on the use of IT-driven advances in the public health sector, followed by the theoretical perspective adopted to ground the study. The case organisation is then described, followed by the research method. The empirical evidence is then presented on the implementation of Concerto, informed by diffusion theory. The final section provides a discussion and conclusion on the research findings.

2. Review of prior studies

IT innovation is evident in New Zealand, which has developed a well-connected health care system (Bowden and Coiera, 2013; Doolin, 2002; Lowe, 2001). Bowden and Coiera’s (2013) New Zealand study reported that during the past 20 years, there has been a high level of IT-driven innovation usage in medical practice, for example, 97% of primary care practices are using an EMRs system, and 92% have electronic access to patient test results.

The term ‘EMRs’ refers to a computerised health information system where providers record detailed encounter information such as patient demographics, encounter summaries, medical history, allergies, and laboratory test histories (Ludwick and Doucette, 2009, p. 23).
EMRs can speed up patient workflows and improve the accuracy and availability of information needed. Adoption of EMRs in New Zealand was driven by a combination of factors in which the government played an important but indirect role (Jha et al., 2008). In July 2010 the National Health IT Board (NHITB) published the first National Health IT plan based on achieving the eHealth Vision:

To achieve high quality health care and improve patient safety, by 2014 New Zealand clinicians will have a core set of personal health information available electronically to them and their treatment providers regardless of the setting as they access health services.
Studies in information technology and the use of new technology have largely focused on how IT-led innovations have contributed to improvements in the public sector (Doolin, 2002; Lowe, 2001; Perera et al., 2003; Van Peursem et al., 1995). Most prior studies offer insight mainly from US and UK. These studies are mainly concerned with use of EMRs, for example, type, content, structure, to optimise the functionalities of EMRs (i.e. Häyrinen et al., 2008; i.e. Pandhi et al., 2014; Jha et al., 2008; Berg, 2001; Lobach and Detmer, 2007), or to improve doctor-patient communication (Kazmi, 2013), challenges, barriers and solutions of physician’s use of EMRs in ambulatory setting (i.e. Miller & Sim, 2004), the association between EMR and job satisfaction among physicians (i.e. Jones, et al, 2013), impact of EMR on healthcare structure, quality, process and outcomes (i.e. Holroyd-Leduc, et al., 2014; Renton et al., 2012). Recent studies on factors affecting implementation outcomes of EMR based on U.S. ambulatory setting have gained popularity. For example, Yoon-Flannery and his colleagues (2008) conducted interviews to determine perceived benefits of EMR as well as facilitators and barrier to successful implementation. They reported achieving the benefits of EMR depends on successful implementation and use. The effective communication, successful system migration, support and training lead to successful implementation. Ludwick and Doucette (2009) conducted a comprehensive review from 86 research papers to conclude design quality, feature functionality, project management, procurement and users’ previous experience affect implementation outcomes. However, these studies are largely descriptive and under theorized and have failed to include the factors which impact on implementation and diffusion of EMRs thus leaving a gap in the literature which our study will bridge. Furthermore, we are adding new knowledge to existing literature on use of HIS by providing a framework – the DOI theory to analyse the processes of implementation (from initiation to implementation) and explain the results from the user’s (Clinicians) perspective.
In New Zealand, studies in the health sector have been limited to the accounting systems and systems of accountability (Lawrence et al., 1997), performance management using a balanced scorecard (Northcott and France, 2005), health system restructuring (Gauld, 2004), and security issues around privacy and confidentiality of EMRs (Janczewski and Shi, 2002). Studies on the innovation used in the public health sector to improve performance has mostly concentrated on improving the financing and costing of patient care (Doolin, 2002; Lowe, 2001; Van Peursem et al., 1995). Protti, Bowden and Johansen (2008) conducted a comparative study on the use of computing technology in general practitioner practices between Denmark and New Zealand. This study focussed on perspectives of the health care systems, driving forces for EMRs, the environment which EMRs operate, functionality, use and benefits of EMRs. However, the study did not examine what factors and influence affecting the implementation of HIT. Further, to the best knowledge of authors there have been no studies in New Zealand investigating how and why an innovation such as the Concerto clinical workstation was implemented and accepted by clinicians. As such, we investigate the diffusion process with an intention of establishing the factors that enabled this process.

The use of information technology in patient care represents an innovative change and significant challenges for clinicians. Although clinicians have long been using computer based software to order and look up laboratory tests, the factors that influence their use of these systems and the outcomes and effectiveness of using them have seldom been reported (Lee, 2004). Since clinicians represent the largest group of technology users in health care organisations, their perceptions of computerised information are a key determinant in the successful implementation of a computer system such as the Concerto clinical workstation (Concerto CWS). The CWS has been introduced into many district health boards (DHBs) in New Zealand; however, the exact reasons for these implementations and the way in which they have been instigated are poorly understood. We therefore believe Rogers’ (2003) diffusion of innovations (DOI) theory can offer insights into why a particular innovation and technology such as Concerto may have been successfully diffused in New Zealand public sector healthcare organisations.

3. Theoretical framework: Rogers’ DOI
This section explains our choice of the DOI theory.

The normalisation Process Theory (NPT), Actor-Network Theory (ANT), and Diffusion of Innovation (DOI) have been used in previous research to explain the problems associated with the implementation of HIS in public health sector. However, they serve the different purposes. NPT is a theory of action, which looks at what people actually do and how they work (May et al., 2009) and emphasises on human agency. ANT theory is an approach to understand humans and their interaction with inanimate objects (Cresswell, Worth & Sheikh, 2010). This study uses DOI theory, as we seek to explain how an innovation (Concerto) spreads from initial stages to final implementation and how this innovation is internalised and leads to successful diffusion.

Lee (2004) suggests the success of technology innovation relies on the individual’s decision to adopt it or not; however, these individual decisions may not translate into adoption or acceptance by wider organisations (Ward, 2013). Rogers’ innovation diffusion model focuses on the process by which innovation or new knowledge is accepted, that is diffused or rejected by a particular group or organisation over time (Rogers, 1993). Diffusion is the ‘spreading’ of something throughout a population (Lapsley and Wright, 2004, p. 356). For diffusion to take place, Rogers (1983, 1995) points out there must exist, to begin with, an idea or innovation to be diffused. He also considers how innovations are shared and disseminated by individuals within and between organisations. Most studies into diffusion have been limited to mainly private sectors; however, diffusion also provides useful insights for the public sector (Lapsley and Wright, 2004). Prior studies in the health sector using Rogers’ (1993) model focus on the outcomes using innovations such as nursing interventions, standard of care or quality of documentation (Landrum, 1998; Lee, 2004; Lekan-Rutledge, 2000; Zerwekh et al., 2000). A recent study conducted by Lee (2004) examined the applicability of Rogers’ model to identify the major factors affecting nurses’ use of new technology in Taiwan. However, the study centred on characteristics perceived by users of an innovation; it did not include other innovative components proposed by Rogers, such as knowledge, decision, and communication channels. Our study will use Rogers’ DOI theory to look at the initiation and implementation of the CWS as well as the core elements of an innovation to determine why and which factors influenced the clinicians to adopt it.

Rogers (2003, p. 421) presents a five-stage model of ‘the innovation process in an organisation’ (see Fig. 1). This constitutes two broad categories: initiation and
implementation. According to Northcott and France (2005), initiation takes an organisation up to the decision to adopt a new technology or innovation. The implementation stage must then be completed in order for the innovation to become diffused and utilised.

3.1 Initiation and implementation

The initiation stage of organisation innovation constitutes ‘agenda setting’ and ‘matching’ in which the organisation first recognises a problem and then a need for innovation. This is then matched by a suitable innovation for the problem. An exploration of the initiation of the Concerto clinical workstation at the Northland District Health Board (NDHB) reveals why this programme replaced the iHealth clinical workstation. This revelation will expose the problems associated with iHealth and the recognition that Concerto was a suitable replacement for patient data records. As such, events that led to the implementation and use of Concerto is described and analysed in order to make a conclusion on the use and acceptance and full diffusion or otherwise of the CWS.

Rogers’ (2003) DOI theory suggests initiation of a new technology such as Concerto will not, in itself, secure the intended effect on organisational practices and outcomes. There needs to be a progression from ‘initiation’ to ‘implementation’ whereby a technology moves beyond its initial dissemination to become diffused within the organisation. Rogers (2003, pp. 417; 429) points out that:

Once an organisation has made a decision to adopt, implementation does not follow directly ... Routinising occurs when an innovation has become incorporated into the regular activities of the organisation and has lost its separate identity. At that point, the innovation process is completed.
The secondary adoption stage is critical to the effective implementation and use of new accounting technology. This stage is akin to the notion of institutionalisation (Burns and Scapens, 2000; Scapens, 2006; Seo and Creed, 2002) whereby a practice becomes part of the day-to-day routines of an organisation because it fits with prevalent values and norms. Secondary adoption is what differentiates mere dissemination from the complete diffusion and use of a technique (Lapsley and Wright, 2004; Northcott and France, 2005). The institutionalisation of Concerto relies on its diffusion and use within the organisations involved. DOI theory provides an informative framework for exploring this issue.

In Rogers’ DOI model (Fig. 1), the ‘implementation’ phase is initiated with redefining / restructuring of an innovation, whereby (i) it is modified and ‘re-invented’ to fit the organisation, and (ii) organisation structures are altered to incorporate the new technology. These aspects of the DOI model are relevant to this study as an analysis of the events surrounding the processes and implementation of the Concerto CWS at NDHB will establish how its objectives were served.

Rogers’ DOI theory provides a list of attributes that promote the diffusion and adoption of any new technology. They are (Rogers, 2003, pp. 229-258):

1. Relative advantage – the degree to which an innovation is perceived as better than the idea it supersedes.
2. Compatibility – the degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters.
3. Complexity – the degree to which an innovation is seen as difficult to understand and use.
4. Trialability – the degree to which an innovation can be experimented with, or implemented, in parts.
5. Observability – the degree to which the results of an innovation are visible to others.

We argue that perceptions of the presence of these five attributes will influence the rate and likelihood of an innovation being adopted. Further Rogers’ (2003) model is relevant to our research questions as the model is helpful in explaining the initiation and implementation of new technology, the Concerto workstation, as a replacement for iHealth. The next section provides a brief on the history of NDHB.
4. Case organisation

The Northland District Health Board provides various types of healthcare services to an estimated 3.65% (157,420 people)\(^2\) of the New Zealand population. Acute services are provided through four hospitals based at Whangarei, Dargaville, Kawakawa and Kaitaia, with elective surgery performed in both Whangarei and Kaitaia. Other supplementary services include outpatient and mental health services, a range of allied health services and a public health unit.

The Northland population is distributed across a region from Te Hana in the south to Cape Reinga in the north; over five hours travel from its northern to southern extremities and up to two hours west to east. Despite these extremities the NDHB strives to achieve its mission:

> Working in partnership under the Treaty of Waitangi, creating opportunities for improving health and wellbeing, and promoting independence of all the people of Northland. (NDHB Business Plan, 2011-2017)

As per New Zealand health regulations and Ministry of Health (MOH) requirements, the Board publishes its five-yearly Northland Health Services Plan (NHSP) with a 20 year horizon (see [www.nationalhealthboard.govt.nz](http://www.nationalhealthboard.govt.nz)). This plan aligns its vision and mission statements with the Ministry of Health’s strategic plans and government health policy.

The Board has five broad values (NDHB Business Plan 2008-2009):

1. People First - *Taangata i te tuatahi* - People are central to all that we do.
2. Respect - *Whakaute (tuku mana)* - We treat others as we would like to be treated.
3. Caring - *Manaaki* - We nurture those around us, and treat all with dignity and compassion.
4. Communication - *Whakawhitihitihitihitikorero* - We communicate openly, safely and with respect to promote clear understanding.
5. Excellence - *Taumata teitei (hiranga)* - Our attitude of excellence inspires success, competence, confidence and innovation.

Concerto was introduced to NDHB in 2008 to replace the iHealth. The introduction of Concerto was motivated by the use of technology for sorting patient information advocated by the MOH. The New Zealand public health sector has been through various reforms driven by the MOH since the 1990s, with the intention of improving the quality of healthcare services provided to its citizens (Van Peursem *et al.*, 1995). One of the major outcomes of the

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\(^2\) Statistics as at 2010.
reforms was the use of information technology (Lowe, 2001) for various types of record-keeping ranging from payments for services to patient data records (Abernethy et al., 2007).

Advances in the use of technology for storing patient information have seen a shift initially from paper based records to simple electronic records of admittance and discharge events, and subsequently to comprehensive records of multiple activities on individual patients, such as referrals from General Practitioners (GPs), services provided to patients during hospitalisation (daily care and injections, x-rays, etc) and discharge, follow-up information, previous medical histories, and inter-regional data transfer. This chain of IT-driven innovation with respect to patient information management will be explored within the context of the NDHB to establish the diffusion of Concerto and reveal the factors that enabled the diffusion.

5. Research method

The approach taken in this study is qualitative research involving a case study analysis (see Scapens, 1990; Yin, 1981, 2003). Data was gathered from multiple sources such as the NDHB’s annual report, five-year business plans and internal newsletters; government health policies and plans; and twelve semi-structured interviews with senior clinicians, project managers, IT trainers and a business project manager based at the NDHB in Whangarei. Information collected from documents provided evidence on the history and description of events that led to the implementation of Concerto. These publically available documents were those which had an authorising body and contained information on the NDHB and implementation of Concerto.

A total of 12 semi-structured interviews were undertaken. Eleven were face to face interviews lasting between 60 to 90 minutes, conducted between the months of August and October of 2013. These were taped and transcribed. One was an electronic based interview undertaken in December 2012. A sample interview questionnaire is included as Appendix II. The interviewees comprised one senior IT consultant, one IT training officer, one project manager, one business plan manager and eight senior clinicians based at Whangarei Hospital. Interviewees were selected from those who have been with the organisation in senior positions and have participated in the implementation of Concerto and are currently using the software, and a few who also provided hands-on training to junior and new staff at Whangaeri Hospital.
The topics selected for interviews were mainly on the initiation and diffusion of Concerto in the NDHB. The questions were open-ended to encourage interviewees to respond in their own style. The open-ended nature of interviews enabled the researchers to carry out exploratory field research and gave the interviewees opportunities to provide detailed descriptive accounts of their experiences using Concerto (Kvale, 1996). Further, the researchers were able to use various documents, including parliamentary and media documents to compare interviewees’ responses. Most responses from the interviewees were corroborated by these documents. The aim was to generate a rich source of field evidence. The use of multiple data sources allows a more comprehensive and valid portrayal of the phenomena compared to a single source of data (Jick, 1979; Modell, 2005; Perera et al., 2003). It enables us to capture a contextual understanding of the social phenomena under study, it also created challenges in terms of analysing and making sense of empirical evidence collected from various sources. To overcome this problem, the analysis was initiated by preparing tables listing issues frequently raised in interviews in order to answer our research questions.

Several themes, including initiation and implementation of Concerto, hands-on training and user support, use of Concerto including easy use and access, and greater functionality including greater and in-depth individual patient information, improved electronic discharge summaries, direct links in patient context to other applications, access to results and other information from Auckland hospitals, were drawn from the responses. The data representing the themes was clustered together at this stage. The documentary evidence collected was subsequently matched with themes (Tsamenyi et al., 2006). In the last part of the analysis, we drew on our theoretical framework to make sense of the data.

6. Findings

This section reports the results. It provides an explanation of why and how the Concerto clinical workstation was initiated and then describes its implementation.

Almost all New Zealand hospitals provide clinical workstations for clinicians to interact with patient information (see www.ithealthboard.health.nz/ and www.nationalhealthboard.govt.nz/). For example, in 2008 the NDHB implemented the Concerto clinical workstation as a tool to provide a one-stop shop to access patient data. This was undertaken as a part of its five year strategic plan (2007-2012) and imbedded in its key value of ‘People
First - *Tangata i te tuatahi* - People are central to all that we do’ (NDHB Business Plan 2008-2009).

Table I presents the summary of our key findings with respect to i) the question of why replace iHealth with Concerto and ii) the processes of implementation.

**Table I.** Influences on implementation and use of Concerto

<table>
<thead>
<tr>
<th>Time period</th>
<th>Phases of developments</th>
<th>Influence</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>Initiation of replacement of iHealth</td>
<td>• iHealth’s limited patient information suite and inadequate discharge summaries</td>
</tr>
<tr>
<td>2009</td>
<td>Business requirements documented and development of RFT</td>
<td>• Plan from National Health IT Board and Ministry of Health</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Input from clinicians</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• NDHB - Steering committee</td>
</tr>
<tr>
<td>2010</td>
<td>Concerto went live</td>
<td>• Training staff and clinicians</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Collaborative effort</td>
</tr>
<tr>
<td>2010-2013</td>
<td>Concerto fully integrated package - ability to access information from Alpha Patient Administration System (PAS)</td>
<td>• Clinicians’ workload ease</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Snapshot on individual patient paperless records storage</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Multiple functions</td>
</tr>
</tbody>
</table>

6.1 *iHealth*

The NDHB used the iHealth clinical workstation to display patient information prior to the introduction of Concerto (NDHB Business Plan 2007). According to comments made by senior clinicians and the Concerto project manager, iHealth had limitations in terms of ‘comprehensive’ patient data records and also did not provide comprehensive discharge summaries. These, therefore, were supplemented by paper based records:

> When a patient was being discharged and we viewed an electronic discharge summary using iHealth, it did not provide full details, e.g. cumulative laboratory reports, and we had to paper trawl to find the whole picture. (Senior Clinical Nurse Specialist)

Similar comments were made by 80% of the interviewees, thus endorsing the limitations of iHealth.

Another limitation mentioned during the interviews was that iHealth was not an integrated package. Clinicians used Alpha to supplement patient data from iHealth and this was time consuming and led to delays in the decision-making process. During the interviews one of the clinicians mentioned:

> iHealth was past its useful life as it provided limited information and I had to pull on patient notes and this added on time as an administrative duty. (Senior Clinical – Child Health)
This comment is interpreted to mean that iHealth was no longer suitable for accessing patient data and slowed the provision of healthcare, adding on administrative duties.

It was also highlighted during the interviews that maintenance of iHealth as a patient information tool was getting to be problematic as new software packages were introduced in the market. Furthermore, according to the National Health Board’s strategic plans (2008), the DHBs in New Zealand were required to adopt a paperless patient medical record. The limitations of iHealth as a comprehensive patient clinical information tool therefore provided an opportunity for the NDHB to replace iHealth with Concerto.

According to Rogers’ DOI, for an innovation to be implemented there has to be ‘an agenda setting’ and ‘matching’ in which the organisation first recognises a problem and perceives a need for innovation, then matches the innovation to the problem (see Nath and Sharma, 2014; Northcott and France, 2005; Rogers, 2003). In the context of the NDHB, iHealth was not able to meet their needs for comprehensive patient information records, hence the problem was recognised and Concerto was perceived to be the tool to solve that problem. The next section provides a descriptive analysis of the implementation of Concerto.

6.2 Concerto

The NDHB was the driving force behind the implementation of the Concerto CWS (NDHB Newsletter, November 2009). This was in line with the MOH’s strategic plan to adopt a paperless patient data clinical management system. In 2008, the NDHB formed a steering committee comprised of 10 members. Four were IT and business specialists and the other six were senior clinicians. During our interviews and from internal documents such as newsletters and the business case plan, it was established that this team was selected by the NDHB senior management to represent the various areas of the NDHB. This cross sectional selection has an advantage in that it would ensure the participating clinicians, internal to the NDHB, would also be the early adopters and hence be influential, as users, in adopting the innovation (Rogers, 2003).

Archival records, such as the Business Plan and Business Case (2008-2009) indicate that during March to October in 2009, the Steering Committee met with the vendors of Concerto to discuss its functionality, configuration and the expectations of the NDHB. One of the interviewees suggested:

The business case plan had proposed three phases of implementation, these were i) replacement of iHealth core functionality, and improved electronic discharge summaries, ii) new functionality,
inclusion of electronic referral and electronic whiteboard, and iii) inclusion of electronic ordering of laboratory and radiology tests and medications. (Technical Project Manager and Senior IT Specialist)

The need to include the above mentioned features is an indication of the ‘out-datedness’ of iHealth. The question raised here is who initiated the inclusion of these features.

The Business Case Plan (2009) states the Steering Committee successfully negotiated the purchase price, and received approval for implementation from the Ministry of Health. Upon receiving approval, the Concerto clinical workstation was tested for various purposes. One of the interviewees commented:

During the implementation phase the Concerto was tested for its functionality, user acceptance and performance. (Technical Project Manager and Senior IT Specialist)

This commentary is an indication the Steering Committee was influential in securing Concerto as a Patient Data Clinical Management Tool, ensuring that Concerto met the requirements of the clinicians and it was a step towards achieving the National Health Board’s strategy of having a paperless system.

The Concerto clinical workstation was implemented in the NDHB in February 2010 (Business Case Plan 2010, NDHB newsletter). A project team³ was formed to oversee the implementation of Concerto. This team was selected by senior management. Membership comprised senior clinicians, members of the Steering Committee and IT specialists and trainers. The members of this team, therefore, were in a position to influence the implementation and the data storage capability of the system. During the interviews a few of the interviewees narrated:

… before going live, a clinical data repository (CDR) was developed and populated with historical data of all laboratory results and radiology reports. The CDR was then integrated into the Concerto, thus centralising patient records. (Project Manager; Senior IT Specialist; Senior Clinician)

Another interviewee stated:

There was a back-loading of approximately four million laboratory and radiology records between April – October 2010. (Senior IT Specialist)

These commentaries indicate the project team members were instrumental in ensuring the adaptability of the Concerto CWS.
6.3 *Concerto Clinical Workstation training*

The Concerto CWS went live on 26 September 2011. Prior to the implementation, the users of the innovation, the clinicians, were provided with in-house training in using the system. This was a task overseen by the project team. During the interviews, several interviewees reiterated:

… we were given hands on training by the IT specialists on using Concerto for discharge summaries, locating patient history, locating laboratory and radiology results and much more. Each session lasted 45 minutes and we were given hands-on practice. (Interviewees - Senior Clinicians, at least four)

One interviewee explained:

The sessions were specific and tailor made for the needs of the group that attended the session. (Senior IT Trainer)

The inference is that the sessions were promoting the ‘compatibility’ aspects of Concerto with the needs of the users (Perera *et al*., 2003; Rogers, 2003). One of the interviewees suggested the:

Clinicians attending the session were very pro-active in using Concerto. (Senior IT Specialist)

Another suggested:

We asked questions during the session to ensure the functions available in Concerto served our needs and then we used these functions to trial our needs.

The pro-active approach and trialling approaches indicate that the users were testing the complexity of the Concerto clinical workstation.

During the interviews, we were informed ‘super users’ were identified during the training sessions. These users were the ones who were proficient in using Concerto CWS and their purpose was to guide those who needed help and those who were new to the NDHB in their departments once the system was implemented.

6.4 *Using Concerto CWS*

This section describes and analyses the use of Concerto after it went ‘live’ in September 2011. The purpose is to bring into Rogers’ DOI theory perceptions of secondary adoption
where the focus is on individual use or otherwise of the innovation. In this secondary adoption stage we will be able to determine whether the innovation (Concerto) was fully diffused or not.

During the interviews the interviewees were asked to explain their experiences with iHealth and Concerto. The overall response from all 12 interviewees was:

The Concerto clinical workstation is like a “one-stop shop” for patient information.

Table II provides a summary of the clinicians’ responses to their experiences using Concerto and iHealth.

<table>
<thead>
<tr>
<th>No. of interviewees</th>
<th>Functionalities</th>
<th>iHealth responses</th>
<th>Concerto responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 out of 12</td>
<td>Login</td>
<td>Lengthy process to login. Need separate iHealth login and password then network AD login.</td>
<td>Easier and faster to login - uses same user authentication as network AD login.</td>
</tr>
<tr>
<td>7 out of 12</td>
<td>Access to patient records</td>
<td>Limited enquiry features, need to resort to paper records or other systems. Need to shuffle through various systems - longer to locate patient data.</td>
<td>Has additional enquiry features - can access almost all required patient information e.g. Emergency Department visits, Inpatient visits, Outpatient events, Surgical bookings, Theatre events. Therefore easy access to patient data and records for patients under care.</td>
</tr>
<tr>
<td>8/12</td>
<td>Customisation</td>
<td>Not available.</td>
<td>Can tailor own clinician homepage to view patients in 'work ward'.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Can select own patients from outpatient and inpatient lists.</td>
</tr>
<tr>
<td>11/12</td>
<td>Link to other applications</td>
<td>Not available.</td>
<td>Provides direct link in patient context to other applications e.g. digital images, dictation, etc.</td>
</tr>
<tr>
<td>12/12</td>
<td>Discharge summaries</td>
<td>Limited information on discharge summaries.</td>
<td>Improved electronic discharge summaries.</td>
</tr>
<tr>
<td>12/12</td>
<td>Access to GP</td>
<td>Not available.</td>
<td>Transmission to GPs in PDF format. GPs now see the information in the same format as the patient and hospital clinicians</td>
</tr>
<tr>
<td>12/12</td>
<td>Access to MIMS medication list</td>
<td>Not available.</td>
<td>Access to MIMS medication list. Improved medication/script information.</td>
</tr>
<tr>
<td>12/12</td>
<td>Ability to insert other relevant patient information</td>
<td>Not available.</td>
<td>Ability to insert relevant laboratory and radiology results. Audit trail of EDS document contributors. Automatic inclusion of ACC information.</td>
</tr>
<tr>
<td>12/12</td>
<td>Access to patient lists</td>
<td>Not available.</td>
<td>Access to patient lists: Proposed theatre list, Theatre list, Emergency Department patients list.</td>
</tr>
</tbody>
</table>
The responses indicate the clinicians’ experiences using Concerto were more advantageous than using iHealth. It can therefore be construed the additional functionality offered by Concerto was the significant characteristic that enabled the acceptance of Concerto. It is reasonable to state these functions suited the individual needs of the clinicians and hence the clinicians were pro-active in their use of the innovation.

The next section provides an interpretation of the results and analysis within Rogers’ DOI framework.

7. Discussion

This paper has explored and interpreted the implementation of the Concerto clinical workstation at the NDHB. The paper also discussed how the clinicians perceived the usefulness of this innovation. Rogers’ (2003) DOI theory is used to inform our findings. We discuss our findings in relation to the two research questions outlined in the introductory section which are discussed in turn.

7.1 Research question one: What factors and influencers affecting the implementation of Concerto?

The research evidence indicated that the Concerto clinical workstation was a replacement patient data clinical management system for iHealth, which was dysfunctional in that the system was no longer able to provide the diverse range of patient data required by the clinicians for prompt decisions regarding patient treatment. Within the context of the DOI theory, the dysfunctional aspect indicated the existence of a problem that needed a solution. The solution offered by the NDHB was the adoption of Concerto. As such, the processes of choosing Concerto to replace iHealth are interpreted using the first phase of Rogers’ (2003) DOI framework. The Concerto clinical workstation’s initiation and the implementation processes were greatly influenced by the forces such as management and senior clinicians within the NDHB. It is therefore apparent that through participation in decision-making and training, the ownership of Concerto was passed onto the members/individuals within the NDHB and this in itself, according to Rogers’ DOI, is one of the key aspects of diffusion of an innovation (Abenethy et al., 2003), as it empowers the individuals to take a sense of ownership. In this case, the clinicians involved in the ‘steering committee’ and ‘project team’
championed the Concerto clinical workstation. According to Rogers’ DOI theory (2003), the participation of organisational members in the innovation process, reinvention, gives a sense of ownership of the innovation, and the involvement of an innovation champion (Rogers, 2003, pp. 429-430). The study confirms the previous studies results that show successful implementation of health information systems are a result of support from senior management and of championed by clinicians (Poon et al., 2004; Fenton, Amatayakul, & Work, 2006; Miller, Sim & Newman, 2003).

In light of the above discussion it is concluded that the Concerto clinical workstation was fully diffused as a patient clinical management tool by its primary adopters. The inclusion of the clinicians in the decision-making processes ‘opened up the pathway to secondary diffusion’. The next section provides a discussion on the secondary adoption and full diffusion.

7.2 Research question two: Whether the influential agents have led to successful acceptance and diffusion of the Concerto?

In relation to our theoretical framework from the evidence, we note Rogers’ (2003) DOI theory provides a list of five attributes that promote the diffusion of and adoption of new technology. These are (1) relative advantage, (2) compatibility, (3) complexity, (4) trialability and (5) observability. Rogers underscores the presence or absence of these will influence the rate and likelihood of an innovation being adopted. He identifies forces contributing to the full diffusion and routinisation of adoption (Rogers, 2003). We will therefore use the five attributes as a framework to address research question two and the issues raised by this question to establish the routinisation and full adoption of the Concerto at NDHB.

In consideration of the first DOI attribute, relative advantage, also termed by Hussein et al. (1981) and Firth (1996) as ‘performance gap’, the research evidence strongly indicates the Concerto clinical workstation system was perceived by the clinicians as being superior to the iHealth patient data clinical management system. There was a general consensus that the innovation, Concerto, provided them with easy, faster access to a comprehensive set of individual patient records, a feature that was missing in iHealth. This, therefore, filled in the performance gap inherent in iHealth.

In regards to the second attribute; compatibility, the research evidence indicates this attribute was significantly fulfilled by Concerto. Evidence of this was determined by the clinicians’ descriptions of the processes involved during the implementation phase and the usefulness of patient data traced and recorded in the Concerto clinical workstation. For
example, the clinicians described Concerto as a one stop shop when it came to locating information on patients during hospital admittance, discharge, and referrals. It is to be noted that clinicians need such information when attending to individual patients and Concerto provided them with the required information. Concerto provided a greater compatibility with clinicians’ needs as opposed to iHealth.

The third attribute is complexity. According to the clinicians, Concerto was user-friendly thus indicating it was not a complex tool to use. This therefore provides a signal that the Concerto clinical workstation as a patient data clinical management tool was gaining acceptance and was becoming a routine operational activity.

The fourth attribute, trialability, was also fulfilled during the implementation phase. Clinicians and the IT project manager tested the technical and functional aspects of Concerto to ensure it met the daily requirements of the clinicians. Furthermore, the software vendor and project team members were in constant dialogue during the various testing and implementation phases. The clinicians and the IT specialist trialled the system before it went live and this was followed through with training sessions. The patient data clinical management system, Concerto clinical workstation, is in use and the usage is championed by the clinicians.

The fifth and final attribute, observability, is clearly evident with respect to the use of Concerto via the positive outcomes in terms of the clinicians’ ability to view patient clinical information in one place, and to produce and send detailed discharge summaries to patients’ GPs. As per the comment from one of the clinicians, Concerto provides a ‘snapshot’ of a patient’s medical history at a point in time and this enables informed decision-making in times of critical needs.

8. Conclusion and future research

Our analysis, informed by Rogers’ (2003) theory of DOI, shows the Concerto clinical workstation as a patient clinical management system was fully diffused and significantly contributed to the work of the clinicians. The Concerto clinical workstation was perceived by its users, the clinicians, and implementers, the NDHB management, as providing greater relative advantage, compatibility, trialability and observability with low complexity and hence this tool was successfully adopted by its users. The factors that led to this success were the human elements such as the clinicians, the IT specialist, the business project manager and the NDHB management, in that they identified the limitations of iHealth and offered
Concerto to overcome the limitations. The inclusion of clinicians in the decision-making not only empowered them but also provided a bonus: that the clinicians championed the innovation (Gallivan, 2001; Lee, 2004) and took it to the floor level. The functionality, capacity and scope for reporting results and viewing outcomes of clinical data added towards the full diffusion of the Concerto clinical workstation. As such our study brings to light that the efforts of humans as individuals, the skills they possess, combined with technological progress can lead to successful adaptation of innovation if the goals of the individuals are aligned to and congruent with the goals of the institution they serve. In this case the NDHB was striving to achieve its strategic plan and value of putting people first and the clinicians were also pursuing the same value which was, putting their patients first.

This research can be replicated within other DHBs in the New Zealand public health system so that comparisons can be made to determine which factors enable and hinder successful diffusion of innovations such as an electronic patient data clinical management system.
References


### Appendix I. Glossary of acronyms and terms

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AD</td>
<td>Active Directory</td>
</tr>
<tr>
<td>CDR</td>
<td>Clinical Data Repository</td>
</tr>
<tr>
<td>Concerto CWS</td>
<td>Concerto Clinical Workstation</td>
</tr>
<tr>
<td>DHB</td>
<td>District Health Board</td>
</tr>
<tr>
<td>DOI</td>
<td>Diffusion of Innovations Theory (Rogers)</td>
</tr>
<tr>
<td>DRG</td>
<td>Diagnostic Related Group</td>
</tr>
<tr>
<td>EDS</td>
<td>Electronic Discharge Summaries</td>
</tr>
<tr>
<td>EMR</td>
<td>Electronic Medical Record</td>
</tr>
<tr>
<td>GP</td>
<td>General Practitioner</td>
</tr>
<tr>
<td>IT</td>
<td>Information Technology</td>
</tr>
<tr>
<td>MIMS</td>
<td>Medical Information Management System</td>
</tr>
<tr>
<td>MOH</td>
<td>Ministry of Health</td>
</tr>
<tr>
<td>NDHB</td>
<td>Northland District Health Board</td>
</tr>
<tr>
<td>NHITB</td>
<td>National Health Information Technology Board</td>
</tr>
<tr>
<td>NHSP</td>
<td>Northland Health Services Plan</td>
</tr>
<tr>
<td>PAS</td>
<td>Patient Administration System</td>
</tr>
</tbody>
</table>
Appendix II. Sample interview questionnaire

**Concerto Patient Data Management System**

**Outcomes of Concerto Clinical Workstation (CWS) introduction and implementation**

This questionnaire is intended to be used as a means of assessing the improvements or otherwise of managing performance of clinicians and other associated staff in using the Concerto Work Station as compared to using the iHealth workstation (the previous CWS).

**Part A**

**General:**
1. Please state your job or job Title.
2. Please state the number of years/months you have used:
   a) iHealth
   b) Concerto
3. Briefly explain the purpose of using:
   a) iHealth
   b) Concerto

**Part B**

For each of the questions below, please explain the reason for your answer in detail.

1. Do you prefer using Concerto to iHealth (the previous CWS)? Please explain why?
2. Which CWS is simpler to use? Please explain.
3. How does Concerto compare to iHealth as a CWS in providing information for you to perform your job/role? Please explain.
   State your job/role:
   Briefly describe your role and the type and nature of information you require to perform this role.
4. Was the iHealth CWS able to provide you with your information needs in performing your job effectively and efficiently? Please explain.
5. Has the Concerto CWS improved your accessibility to the information you need to perform your job compared to iHealth CWS?? Please explain.
6. Which CWS provided increased functionality (e.g. more patient information) to make your job/role easier? Please explain.
7. How did you locate individual patient information before Concerto (e.g. did you use iHealth, Alpha, paper notes etc.)? How often did you use information other than iHealth?
8. How did you locate information about patient lists (e.g. outpatient lists, theatre lists, proposed booking lists etc.) before Concerto?
9. Describe any workflow or process changes you have made following the implementation of Concerto (i.e. what do you do differently now because you use Concerto?).
10. Can the Concerto clinical workstation be improved? Please explain.
11. Is there anything else regarding any other aspect of the implementation and use of the Concerto CWS which you feel would benefit this research? Please explain.

Thank you for participating in our project.