

Reduction in Diabetes-Related Hospital-Bed Days for Adults Using Wireless Technology- A Case Report

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Abstract

Diabetes is one of the chronic diseases that reduce life expectancy by increasing the risk of serious complications such as heart disease, kidney failure, stroke and blindness. Diabetes may aggravate or worsen an existing disease condition leading to increased frequency of hospital admissions and prolonged hospital stays. In New Zealand, as in other developed countries, Type II diabetes is influenced by demographic trends and the increasing prevalence of excess weight and obesity [1]. The diabetes epidemic is particularly marked in Maori and Pacific ethnic groups [1]. A large proportion of the Maori population of New Zealand live in the northern region of New Zealand where diabetic prevalence is higher than the national average.

Analysis of the last five years' Northland Hospital admission and discharge data showed that percentage bed occupancy by patients admitted for adult diabetes, either as primary or secondary reasons for admission, increased slightly between financial years 2001 and 2005. Several research studies indicate that diabetes can be well managed in the community by effective care co-ordination between primary and secondary level care providers [2,3,4]. This assists in making hospital beds available for other acutely ill patients. Effective care co-ordination between health care providers can be enhanced by using an innovative wireless technology and devices such as "push to talk or hand-held Personal Digital Assistants (PDAs) over cellular network". A small hand-held wireless device is capable of exchanging precise and clinically relevant information to multiple users through a secure cellular network with a push of a button. This paper describes the extent of the diabetes-related bed days in the Northland hospitals and the potential benefits of this wireless technology in care co-ordination between primary and secondary providers in a rural community.

1. Brief Description of Northern Region

The Northern Region of New Zealand is the next area north of the Auckland Region, which is home to New Zealand's largest city of Auckland. The Northern Regional Council consists of the Far North, Kaipara and Whangarei District Councils (refer figure 1). The total population of this region is 148,470 [5]. Approximately, 23 percent of the population is aged under 15 years compared to the national average of 22 percent [6]. Similarly, 14.4 percent of the population is aged 65 years and over compared to the national average of 12.3 percent [5]. These figures indicate that the health-related needs for this region will be higher because of prevailing chronic conditions such as heart disease, arteriosclerosis, hypertension, cancer, diabetes and asthma in older members of the population. Further, average median per capita income for this region is NZ\$20,000 compared to the national average of NZ\$24,400 [6]. The Northern Region has a higher unemployment rate for people aged 15 years and over: 6.5 percent compared to 5.1 percent in the total population. The per capita income is also lower than that across New Zealand [6]. However, access to telecommunication services is not far behind the national average. Approximately 71 percent of households have access to cell phones (mobile), compared with 74 percent of national average and 52 percent of households have access to the Internet compared with the national average of 61 percent [6].



Figure 1: source: www.wdc.govt.nz

Figure 1: The Northern Region of New Zealand

2. Background: Diabetes Prevalence in Northland

The Northland District Health Board (NDHB) was established in 2000 to provide health services through its hospitals and community services in Whangarei, Kaitiaki, the Bay of Islands and Dargaville. Control and management of diabetes became one of the prime concerns in the Northern Region through these hospitals and community networks. Diabetes is one of the chronic diseases that reduce life expectancy by increasing the risk of serious complications such as heart disease, kidney failure, stroke and blindness. Diabetes can aggravate or worsen an existing disease condition, leading to increased frequency of hospital admissions and prolonged hospital stays. In New Zealand, like other developed countries, Type II diabetes is influenced by demographic trends and the increasing prevalence of excess weight and obesity [1]. The diabetes epidemic is particularly marked in Maori and Pacific ethnic groups [1]. The occurrence of diabetes is more than three times higher in Maori and Pacific ethnic groups than in European ethnic groups, and Maori and Pacific people are five times more likely to die from diabetes than their European counterparts [1]. The estimated lifetime risk of being diagnosed with diabetes is 25 percent or more for Maori and Pacific ethnic groups than the European population and this reduces their average life expectancy by 12 years [1]. According to the Ministry of Health (MoH) forecast [1], new diagnoses of diabetes will double by 2011. The relative increase will be greater in Maori and Pacific ethnic groups, contributing to health inequality between ethnic groups. Approximately 32 percent of people in Northern Region are of Maori descent [5]. The Northland Diabetic Strategy 2005 highlighted that 43 percent of its population is suffering from diabetes. Based on the MoH data cited above, the occurrence of diabetes is likely to be higher in Maori ethnic groups.

In the Northern Region, a preventable hospitalisation for diabetes is approximately twice the national average whereas hospitalisation of Maori in the same category is three to five times higher [7]. Further, Maori are affected by this disease at a younger age than those in other ethnic groups. Childhood obesity is another matter of concern in New Zealand as in other developed countries. Nationally, 31 percent of all children are overweight or obese, compared with 62 percent and 41 percent of children from Pacific and Maori ethnic groups, respectively [7]. There is no research available on childhood obesity in the Northern Region. Childhood obesity can lead to an early onset of diabetes and is a strong predictor of adult obesity. Thus, Type II diabetes and related complications could markedly increase over the next decade [8]. This means diabetes prevention and control could be even more critical in the future, requiring a feasible and sustainable strategy to cost-effectively overcome such a key social issue.

3. Methodology

3.1. Study Design

A non-experimental, descriptive and retrospective study design was used to conduct diabetes -related trend analysis.

3.2. Process of Obtaining Data

The Costpro SQL (Structured Query Language) database is the case management system used by the NDHB. This database holds hospital inpatient, outpatient and discharge-related data. These data are transferred from source files into the Costpro database to meet various administrative and clinical reporting needs. Administrative reporting consists of cost and revenue analysis of hospital care. Clinical reporting consists of quarterly, biannual and annual reporting on Hospital Benchmark Information (HBI), clinical analyses for improving the clinical services and need analysis reporting. These data are audited daily by qualified nursing and medical professionals using the hard copy of patient record in conjunction with Information Management Services and the Coding Department of Information Systems. Thus, this database provides audited clinical and administrative information, which has been used to perform trend analysis in this study.

3.2.1. Inclusion Criteria

The data were extracted using the criteria below while designing SQL data output. The following criteria were used for data extraction:

- Beds used by adult admissions in medical, surgical, geriatric and orthopaedic departments were included. Two major speciality codes medical and surgical using M&S (medical & surgical) codes were used for data extraction. The details of the Health Speciality Codes (HSC) are available at <http://www.nzhis.govt.nz> [9].
- Financial Year: time between 1st of July to 30th June is used to calculate annual financial statement of health services.
- LOS (length of stay): measures the duration of a single episode of hospitalisation. Inpatient bed days are the total days calculated by subtracting the admission day from the day of discharge (<http://www.nzhis.govt.nz>) [9].
- Diabetes Patient: A patient with either the primary or secondary condition of diabetes, above the age of 15 years, admitted for surgical or medical treatment. Up to five secondary diagnoses were explored using diabetes codes and were derived from the ICD-10 codes. The Australian version of this code was used as this has been implemented in the database.

3.2.2. Exclusion Criteria

- Patients aged 15 years or under were excluded from analysis, which focused on adult patient with diabetes, who used either medical or surgical beds.
- Adult psychiatric patients were not included in this analysis as treatment and management of their cases differs significantly from that of non-psychiatric adult patients with diabetes.

Any research requires a homogeneous sample to reduce the compounding effects of study variables [10]. Bed utilisation by diabetic child and psychiatric patients needs separate analysis that takes underlying clinical conditions into consideration.

3.3. Data Analysis

The data extracted using SQL view were imported into a spreadsheet for analysing bed use by patients with diabetes. The outliers, such as long LOS, which was greater than 300 days, were filtered and removed from the analysis.

4. Result

4.1. Analysis of Trends in Diabetic Admission in NDHB Hospitals

Analysis of trends in diabetic-related adult admissions and their hospital bed utilisation was carried out to determine the extent of the problem and assist in the development of a strategy for its prevention and control in the Northern Region. Data for patients admitted with diabetes as either the primary or secondary reason for their admission, were collected for the Financial Years (FY) 2001 through to 2005 without separating ethnic groups. NB: The clinical cost and workload for managing diabetes as either the primary or secondary reasons for hospitalisation do not differ significantly from one another.

Trend analysis showed a slight increase in the number of adult diabetes related admissions (see in figure 2, Case-weight Analysis, FYs 2001 to 2005). The mean length of stay (LOS) was approximately 4.0 days with SD=9.31, for all financial years since 2001.

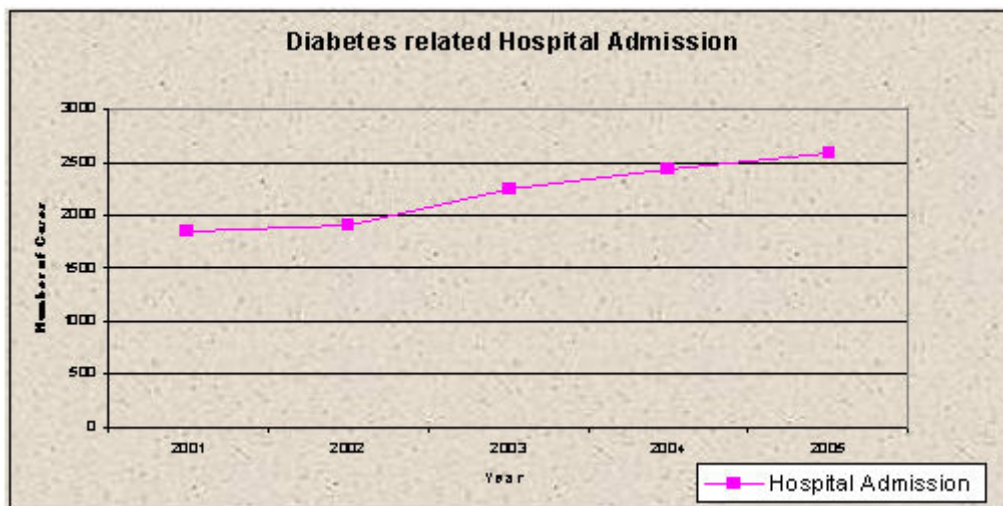


Figure 2: Diabetes-related admission in NDHB. Analysis excludes children aged 15 years or under

Further analysis was conducted on the use of hospital beds by patients who were admitted with diabetes as a primary or secondary reason for admission between the FYs 2001 to 2005 as noted in methodology above. This analysis showed that the bed occupancy due to diabetes within the Northland hospitals was 9.3 percent in FY 2001 and increased to 14 percent by the FY 2005, an increment of 5 percent over this period as presented in figure 3.

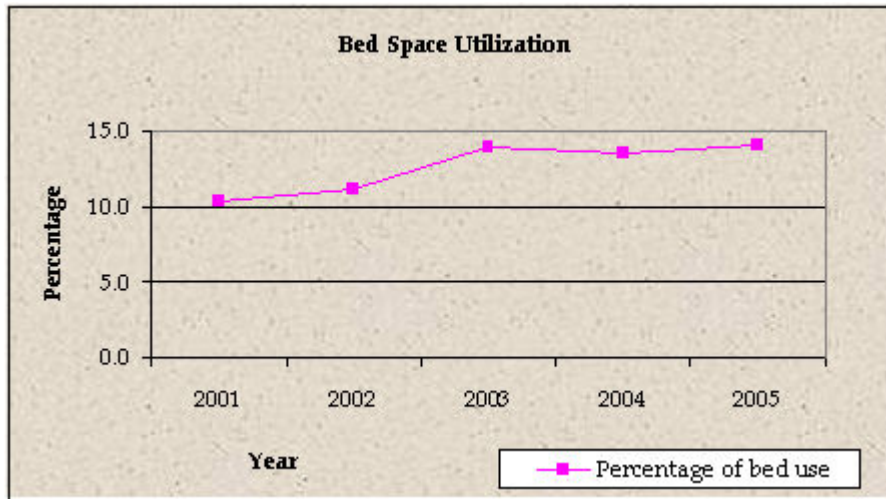


Figure 3: Bed utilisation in NDHB hospitals

Health service utilisation was further divided into two major adult health service categories - medical and surgical - because the surgical admission of patients with diabetes might or might not be entirely avoidable whereas the frequency of re-admission of patients with diabetes in a medical specialty can be minimised or reduced through effective care co-ordination strategies. Analysis of admissions between FY 2001 and 2005 showed that medical admissions with a secondary diagnosis of diabetes ranged from 65 to 70 percent of all diabetic admissions with the rest being admitted for surgical reasons with secondary diagnosis of diabetes.

5. Discussion

Diabetes is a chronic disease, which requires costly treatment from both a social and economic perspective [8]. The complications of diabetes can put additional financial pressure on national health funding. A shortage of clinical practitioners in many clinical areas and the an increasingly aging population with attendant cancer, diabetes and other chronic diseases further strain the health care system. This situation, coupled with a high-need age group and low-income areas, can pose a challenge to controlling and preventing chronic disease like diabetes.

In addition, the traditional practice of providing health care through an acute care setting is not holistic but rather a fragmented care approach in the case of chronic disease management [11]. Managing a patient with chronic disease requires a partnership between the patient and several levels of health care providers: hospitals, general practitioners and community services including district nursing. That is, a care network including health care professionals working at the grass-roots level. In addition, patients must also proactively participate with the proposed management plan on an ongoing basis [11,12]. Rivers and Tsai [13] have indicated that well-managed and co-ordinated care assists in reducing the rates of frequent hospitalisation of patients with chronic diseases, freeing hospital beds for other patients. This in turn facilitates cost-effective quality care with better management of healthcare resources.

According to Konstvedt [14], the criteria for targeting a disease specific management plan in the community include:

- A preventable complication of a chronic disease that can be managed in the community to reduce emergency department visits and inpatient admissions.
- A chronic disease condition which can be managed in an out-patient situation which tend to be less technical and non-surgical. Therefore, non-surgical diabetes can be managed within the community through a regional co-ordination plan considering chronic disease.
- The ability to develop practice guidelines and a care pathway for managing a chronic disease condition that incorporate a good quality, meaningful health outcomes and reasonable strategies for intervention.

The current diabetic strategy in Northland is aimed at reducing the incidence of diabetes at early ages, slowing down disease progression and improving the quality of life for those who have already been diagnosed with diabetes. This strategy, known as STAND (Successfully Taking Action for Northland Diabetes), is integrated with cardiovascular disease management because one of the underlying causes of the coronary heart disease (CHD) is impaired glucose tolerance [7]. STAND will be a major part of the Northland Chronic Disease Management Strategy. The STAND focuses on seven major areas:

- Implement healthy lifestyle promotion services such as healthy eating and physical activities and co-ordinate such activities through the community providers (Primary Health Organisations) in the Northland Region.
- Develop a co-ordinated approach to reducing diabetes through life-style clinics, which assess families and children at risk.
- Implement patient-centred care plans by predicting patients at risk of diabetes and CHD early through PREDICT and initiate appropriate management and treatment plans. However, continuous audit is required to achieve quality in care such as patient compliance, satisfaction, and uptake of new knowledge.
- Review existing services dealing with the diabetes.
- Develop and support an effective co-ordinated workforce.
- Develop information system based on the STAND and national diabetes database at MoH.
- Develop a district-wide co-ordinated approach through the employment of a diabetic strategy co-ordinator.

Implementation of the STAND strategy would be strengthened by the inclusion of information communication technology (ICT) such as wireless, mobile telemedicine systems within the STAND implementation plan. ICT may cost-effectively complement and contribute to an effective management strategy for coordinated care. The next section discusses the role of wireless technology within care co-ordination.

5.1. The Role Of Wireless Technology Within Co-ordinated Care

One focus in managing patients with chronic diseases is the development of self-compliance with respect to treatment and clinical management. This requires proactive patient involvement in following clinical instructions on an ongoing basis. It can be difficult at times for patients to follow complex clinical instructions without assistance. Such difficulties can be minimised by establishing an effective communication between patient and grass-root level health care professionals such as district nurses [15]. This can be achieved with the use of simple wireless communication technology.

Wireless technology such as the mobile phone has been introduced in New Zealand DHBs to maintain care co-ordination and continuity between primary and secondary level care providers. Wireless technology is already in use to some extent for booking home visits and providing basic instructions to patients with chronic disease. However, this process could be strengthened by connecting patients in the communication loop with primary and secondary level (patient, district nurse, diabetic nurse specialist and medical professional) care providers to discuss healthcare problems and take appropriate preventive measures. In addition, this technology promotes evidence-based practice (EBP) by facilitating patient input to moderate a clinician's decision [16]. A patient's involvement in clinical decision-making improves patient satisfaction with clinical judgments and facilitates cost-effective care.

A recent expansion of third generation 3G-based wireless networks can be used as a platform for acquiring and transmitting healthcare information between providers and patient through a secure cellular network. Because this system can be used in any geographical location that has 3G network coverage, telecommunication devices known as "push to talk over cellular network" (PoC) or small hand-held devices (PDA) can be used as powerful tools in such co-ordinated activities. A 2005 study [17] indicated that 3G wireless technology has been successfully implemented in several clinical areas. For example, a tele-trauma system, which was developed in the US provides continuous real-time voice and video along with medical data input between an ambulance and a level I trauma centers [17]. This system was found to be effective in managing patients with trauma and reducing related mortality and morbidity prior to reaching hospital. Similarly, automated telephone disease

management (ATDM) with telephone-based nurse follow-up was used in improving the diabetes treatment process and its outcome in the US [18]. This approach included automated calls to patients identified through medical records as diabetic. The automated call was designed to use hierarchical structured messages with a human voice for clinical assessment [18]. During the tele-assessment, patients were able to report diabetic-related information such as self-monitored capillary blood glucose along with their management actions. There was weekly telephone follow-up with patients based on ATDM assessment reports where nurses provided education about self-care, discussed symptoms, monitored medication adherence, and promoted appropriate use of preventive medical care. In addition, nurses were able to set appointments for regular check-ups such as cholesterol levels, eye, foot checks, etc [18].

The major advantage of such wireless devices/technology is their capability to reduce manual information processing. Because precise and clinically relevant information can be conveyed cheaply over the cellular network, a significant amount of costs related to care co-ordination can be saved. The cost of travel by healthcare providers, e.g., to undertake district nurse home visits, can be minimised.

In summary, a mobile telecommunication system using 3G networks offers several advantages in health care. They are: immediate exchange of information with remote sites such as ambulances and the closest health centres; support for patient self-management allowing them to maintain normal life in the community; reduced cost and hardship due to travel between places; and ability to diagnosis early and develop management plans [17]. In addition, this also avoids unnecessary transportation to secondary and tertiary levels of care facilities and related hospitalisation, which assists in cost-effective use of healthcare resources [17]. Figure 4 below illustrates how communication could be established using 3G network between patient and healthcare providers.

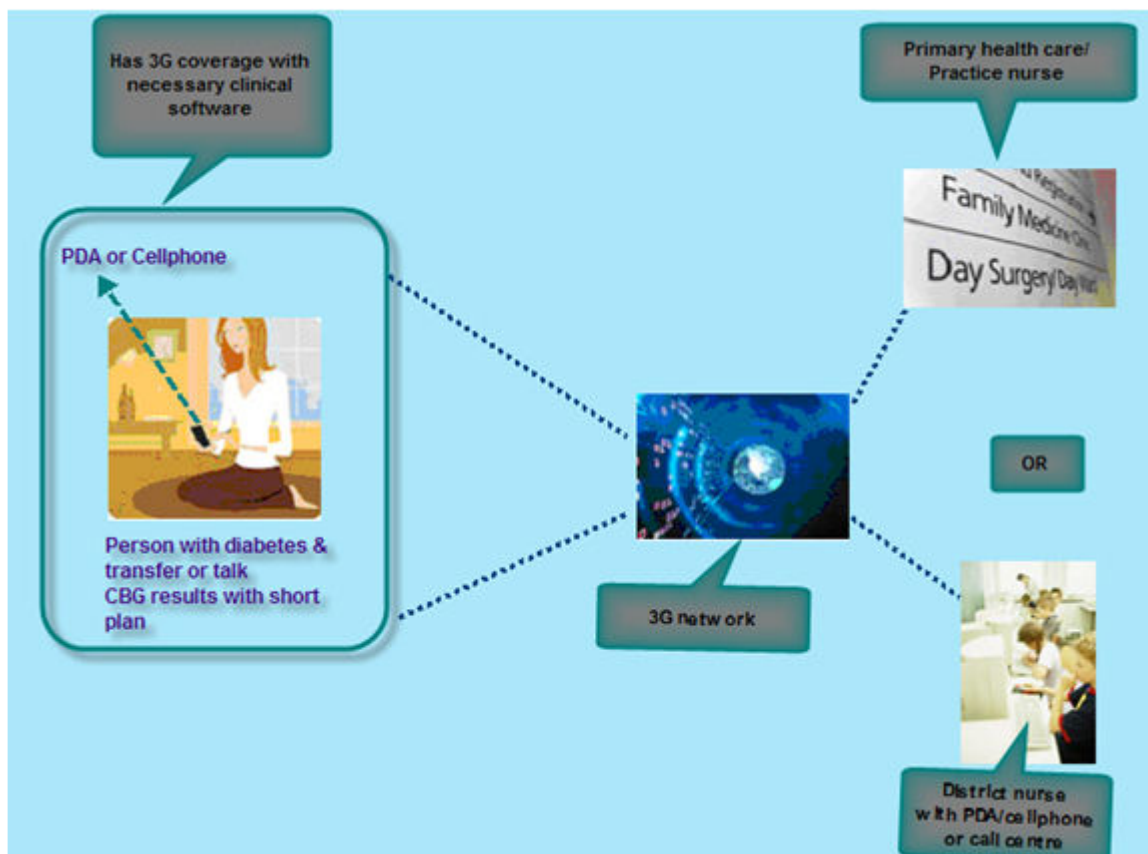


Figure 4: Scenario of 3G networking between patient and healthcare providers

The information exchanged between various health care providers can be securely loaded into the computer system through cellular network for more research and subsequent improvement in the co-ordinated care outcome. Further, this information can be useful in developing a care pathway illustrating the role of various

care providers at primary and secondary care level. Current use of telecommunication devices such as cell phones and access to Internet in the Northern Region is only slightly behind the New Zealand national average. Thus, it is recommended that a review take place of the existing wireless communication technology within the region for maintaining care co-ordination and continuity.

A constraint in using such a system is the patient's location, which must be one that has 3G wireless network coverage. In addition, prior to implementing wireless technology in managing chronic disease like diabetes, a detailed study must be done of the target population and their socio-economic attributes particularly, age, education and readiness to accept new technology. The study on social attributes on the use of technology in a given area will provide insight into the suitability of such proposed technology in managing patients with chronic disease. The need for additional infrastructure requirements for interface and information content design and its limitations will also have to be explored depending on the outcome of the above study. Also worthwhile to consider is the promotion through school curricula of positive behavioural change and motivation towards use of new approaches to fulfill healthcare needs.

6. Conclusion

This analysis has highlighted the increase in diabetes-related hospital care and bed utilisation in the Northern region of New Zealand. Firstly, the diabetic related mean length of hospital stay was approximately 4 days with SD=9.31 in NDHB hospitals. Secondly, diabetes-related bed occupancy within Northland hospitals was 9.3 percent in FY 2001 and increased to 14 percent within 5 years. Thirdly, medical admissions with a secondary diagnosis of diabetes was 65 to 70 percent with the remainder admitted for surgical reasons between FY 2001 and 2005. An effective care co-ordination plan could reduce the number of diabetes-related emergencies and inpatient encounters, particularly related to medical admission. This helps in releasing beds for other acutely ill patient who are in need of the limited beds. The small innovative wireless hand-held device could be useful in managing effective care co-ordination between primary and secondary level healthcare providers. Further study is required to establish the suitability of this approach for the target population. Such an approach would play a role in meeting the EBP principles required to provide high quality of care and achieve patient satisfaction. This report highlights the needs for complementing HIS with STAND. In addition, better communication infrastructure would enhance awareness and support for patients managing their own health care more proactively.

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