

Data Warehouse – Unlocking our Health Service’s Data

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Abstract

Health information managers must provide a wide range of information services to an even greater diversity of stakeholders. The data warehouse approach provides a flexible means of obtain data from a wide range of information systems and data sources both within and outside the organisation. Administrators and clinicians can have access to information from the core processes of the hospital rather than access to information from disparate information systems. This paper provides an insight into the problems faced by the health information manager in integration of information and we provide Barwon Health as an exemplar of this approach.

1. Introduction

Health Information Managers and other Health Information System Professionals today are faced with growing requirement of Information on demand. This thirst for Information and data is almost unquenchable with a wide range of stakeholders demanding Information tailored to their specific needs. Governments are demanding Information on organisational key performance indicators (KPI) and clinical measures outlined by their funding models in order to report to the parliament and the public. Clinicians are demanding information from the internal processes of the organisation that support clinical outputs that is measures of their success. Similarly, line managers are demanding information on the internal organisational performance of the clinical and operational KPI. In every case the underlying premise is development of tailored information that is able to support the stakeholders of the organisation in managing the organisational and process complexity. Indeed, the complexity of the modern hospital has dramatically grown with the rise of technology and medical innovations making it impossible to capture the current state of the organisation. This is not peculiar to the health industry with many industries battling to understand, manage and control the complexity of the modern organisation. Central to addressing this problem is the development and implementation of enterprise system that is capable of connecting the organisation, its processes and resultant flow of information. This process orient view is a hallmark of the organisational wide (enterprise) information system that supports the practices of the organisation. Indeed, managers from the CEO down are demanding health information management services tools that allow them to understand the current status of the organisation (both at a micro and macro level) and its current projectory in meeting the strategic, economic and operational targets set by the diverse range of organisational stakeholders.

The essential role of an information system is taking input data sources and developing information report outputs utilising some information processing. Although theoretically simple gaining the right input data from the plethora of sources

and processing the data into the required information report is not that simple. What data? What output? Who is the information for? What format, scope detail? These are common questions faced by the health information manager every day. In order to address ready access to information managers need to develop strategies that bring together the data repositories of the organisation that allow for the easy extraction of information reports to support the organisational aims and processes of the organisation.

In this paper we examine the Barwon Health solution which has developed a data warehouse in an effort to amalgamate and integrate components of the patient electronic records from a diverse range of information repositories within the organisation. Central to this paper is the growing vertical and horizontal information visibility of the modern health care network and corporate strategic advantage and patient outcomes that follow. The paper is structured as follows. In section 2 we provide an insight into the problems of information management and systems within the health care domain. In section 3 we provide an insight into typical Australian health care organisation: Barwon Health, Geelong. While Section 4 we provide a rationale behind the development of the Barwon Health Data Warehouse project whilst in section 5 we provide a conclusion to this work.

2. Information Management and Systems in Health Care Domain

In large organisations, especially Health Care organisations, information management and their policy are often evolutionary by nature. This is more prominent in government organisations that have seen the dramatic rise of technology within many diverse areas of health care. Prime examples are hospitals that have provided patient care for long periods of time (over one hundred years in some cases) where the gathering, coding and storage of data at a patient level has provided clinicians with accurate data for decision making and allowed managers to gain an understanding of the operation of the patient process. Information Technology has provided the means to take this data and generate higher level information for both the manager and clinicians and has led to implementation of information technology into selected areas of hospitals.

The uptake of Information Services in the Health Care industry has traditionally involved the purchase of stand alone best of breed solutions for individual departments. These are often championed by managers attempting to provide a solution to their perceived problem. Moreover, they are often configured by these departments to store and manipulate data according to their solution requirements. In many cases these are specialised and focused information services. This has led to the development of *island of information technology* (Applegate et al 2004) where business units are supported by the use of information technology. These vertical channels of information and data (or silos of information and data) provide excellent examples of information technology providing managers and clinicians in a limited area with high level information for both for making business decisions and better patient outcomes. Indeed, it can provide data at a single patient level as well as providing performance data for the management of the business unit. However, the islands of implementation often restrict the visibility of data and information for the whole organisation. With a growing demand for information by both corporate management and outside government organisations the level of information visibility must be addressed. In this case we often have the data that is in a wide range of repositories owned by business units in the organisation but coded with their

particular need. Hence, the development of systems that provides horizontal data and information visibility is now becoming central to health care provision and management.

2.1 Extracting Value from the Information Repositories

There is a growing demand for information reporting by both corporate management and government organisations. Organisational wide data gathering and information management provides a repository of data but it requires report extraction that is meaningful for all stakeholders. Clinical staffs now want to examine their data to assist in managing their patient's clinical needs and outcomes. However, different information systems with varying complexities of extraction tools can make it impossible for all but the most technical to be able to integrate data. This process of reporting writing is a time consuming process, not sustainable for most clinicians, and not supported by the staffing level of Business Analysts and Health Information Manager's at BH.

2.2 Barriers Integration

While Health Care has been relatively slow to take up Information Systems relative to business Hospital Information Systems are now becoming integral to the running of a health organisation for both clinicians and administrators (Magruder et al 2005). Indeed, this has seen the development of health information systems that are implemented based on the needs of clinicians and/or administrators.

This can often be traced to the group or personnel who have championed the system or those who have either the political power or access to financial resources of the organisation. The uptake of Information Systems by hospitals has been traditionally based on dedicated stand alone systems based on clinical functional areas. These are systems that are developed with a specific purpose in mind and often focus on the clinical process. These single focus systems often provide a solution to the clinical problem but it is often not scalable to the needs of the organisation as a whole. Often the information system sponsor does not even consider the long term implications of data and information sharing needed within the organisation nor understand the implication of providing system integration. This problem is further exacerbated when clinicians attempt to developing information from a number of clinical processes where the integration is essential of data. Often the barriers encountered by clinicians commonly include:

- A lack of understanding by clinicians that their data is available;
- Timeliness of data availability (quasi operational data often required with short deadlines);
- Cohesion of data from disparate systems; and
- Data recording incomplete or not appropriate requiring a change management process.

Moreover, when consider the administrators within the hospital system the information systems that are used to manage the hospital often have fundamental different objectives. A core element of the administrative process in the development of appropriate billing systems that is capable of reflecting the clinical processes of a patient. Moreover, the disjoint between the administrative systems and clinical systems are important drivers in developing the integrated or enterprise information

system approach. However, there is not always strategically or financially viable for the organisation to create the enterprise system due to:

- Database design / language variation that make it technically difficult, impractical because of data redundancy or financially unviable to integrate systems;
- Internal resource limitation of the organisation;
- Software vendor costs; and
- Software vendor “worlds best practice” not meeting the flexible needs of the organisation.

Indeed, the pure financial cost of replacing system at an organisational level is not always appropriate. However, the development of a data warehouse approach may provide a method to bring these systems together at data level.

3. Barwon Health

Barwon Health (BH) is the largest regional Health Care provider in Victoria, Australia (Barwon Health 2005). It provides health services to the general community at 21 sites centred on Geelong. The health service extends from the northern suburbs of Geelong, south down the Surf Coast to Anglesea, Torquay and Lorne. The services provided are wide ranging and include: Acute Care; Nursing Home; Rehabilitation; Community; and Mental Health. Barwon Health was created with the amalgamation of five regional health services in 1998, and has continued to grow Barwon Health 03 / 04 Annual Report. The multiple Information Systems that were inherited have in part been amalgamated by the implementation of a new Enterprise Patient Administration System in 2002 and the introduction of the BH patient registration number. Other major systems have Health Level Seven (HL7) standard messaging interfaces to deliver operation information. However there remain numerous systems and processes where data is not contained in the Patient Administration System. This presents a challenge for BH of both change management issues converting staff to store data in appropriate systems and the issue to be followed up in this paper of a Data Warehouse optimised for report writing containing Clinical Information from major systems.

3.1 Barwon Health Data Warehouse System Overview

The size and origins of BH makes it understandable that Information Systems (IS) are not fully integrated. Investigation during the planning phases of the Data Warehouses (DW) uncovered eight main systems for incorporation into the DW.

- PIMS: Patient Management Information System is the Patient Administration System used to maintain demographic data throughout Barwon Health. At the major Acute, Community and Rehabilitation Centres it is the source or data for admissions, appointments, clinical contacts and surgical operations.
- CORDiS: Clinical Operating Record and Discharge Information System is the information repository utilised by the clinicians during their daily patient rounds. Residents and Registrars communicate clinical Information for their rounds, as well as operation notes, outpatient letters, pharmacy prescriptions and other data for medical trainee logbooks. Discharge summaries delivered to General Practitioners electronically are a timely method of Information

delivery appropriate to the Twenty First century. The database has been built with filemaker pro.

- The BOSS: Is a Diagnostic order entry system as well as a results delivery database. The predominant usage at BH currently is results delivery for only Pathology and Medical Imaging diagnostic tests. The short to medium term management intention is to investigate the broadening of the use of this application.
- MCATS: The Accident and Emergency system retains data on emergency department presentations and admissions. Data has not been easy to retrieve from the PICT database and as a consequence of the lack of feedback has possibly been the perceived data quality issues currently experienced.
- ICU: Intensive Care Unit maintains specific clinical information on their patients. Portions of this information such as Mechanical Ventilation Hours are required for Government reporting and are recorded primarily in no other system. The database is currently an MS Access database that is being rewritten as an MS SQL database
- Combo PC: The Clinical Costing / Cost Modelling tool compiles data from business areas to be evaluated, compiled and reassigned to patient events. The detailed information is then available to hospital management, clinicians and the Health Department on services provided at an individual or aggregate level.
- PJB: Community and District Nursing contacts and events are recorded. It includes specific treatment plans for patients such as palliative care patients and associated services such as carer respite.
- Merlin: Is the Pharmacy dispensing system. The database contains both pharmaceutical inventory by product and clinical strength as well as patient prescription data.

In table 1, we have an overview of the functionality of the systems managed with Barwon Health. Clearly, from these systems we can see that there is a wide range of disparate information systems. However, these systems are central to the successful operation of the hospital.

System	Function	Data Type
PiMS	Patient Administration System	Demographic, appointments, contacts
CORDiS	Discharge System	Discharge planning, operation notes
The BOSS	Diagnostic Data	Pathology and Radiology Diagnosis Data
MCATS	Accident and Emergency	Presentation & Triage data
ICU	Intensive Care Unit	ICU data including Mechanical Ventilation
Combo PC	Clinical Costing	Episode costing
PJB	Community and District Nursing	Contacts and home visits
Merlin	Pharmacy	Prescribed Pharmaceuticals

Table: 1 Information System Overview of Functional Systems of Barwon Health

3.2 Data Retrieval

For the most part data retrieval from individual systems is available in predefined formats such as stored procedures and authored reports from unique IS. This has proved to be an effective tool for operational use, but less so for clinical decision making and management reporting. BH has over the last five year expanded that capability so that (Health Level Seven Messaging Standard) HL7 messages of specific transactions from one system update other systems, for instance an admission in PiMS triggers an event in CORDIS that allows clinicians to enter operation, clinical condition or discharge data. When the need for systems to share data has not been a plausible option for financial or technical reasons, a system pick up of over overnight flat file incorporation and presentation in a report to combine data from two systems. In this way we have been able to for instance provide access to (Victorian Department of Human Services {DHS} KPI) data on Emergency Department Twelve hour admits (soon to become eight or twenty four hours per DHS requirements) from our Patient Administration System, which is not integrated with our Emergency Department System. While this information is an advance on single system data it is still not sufficient for clinical or management needs in 2005.

4. Why Data Warehouse Development?

Why put the time and resource into creating a DW? Purely and simply access to data. Initial Planning for the Data Warehouse compiled a list of eight of BH's major databases, and three hundred fields were a minimum dataset to start with. The fields included patient demographics, presentation, admission and separation data as well as clinical outcomes like diagnosis and pharmaceuticals. During the DW project the number of systems was adjusted to three systems for phase one of the project; PiMS, MCATS and PJB. Access to this limited amalgamated data has facilitated the decision making of further fields and systems to be incorporate into the DW.

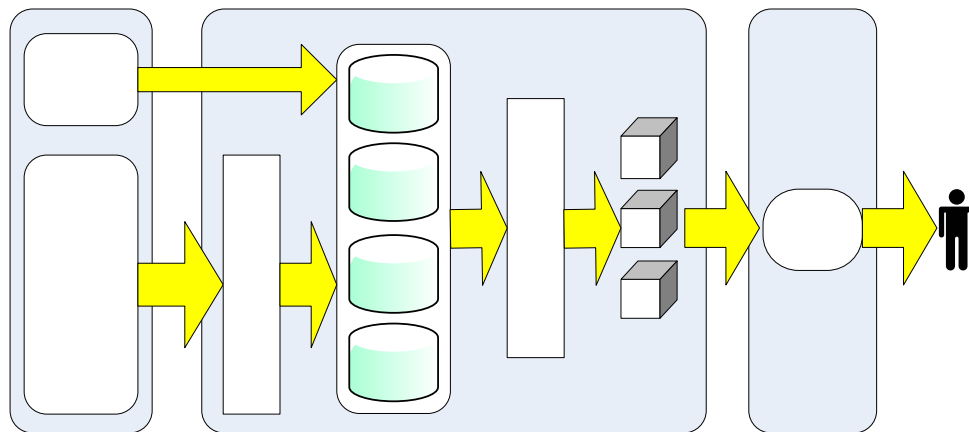
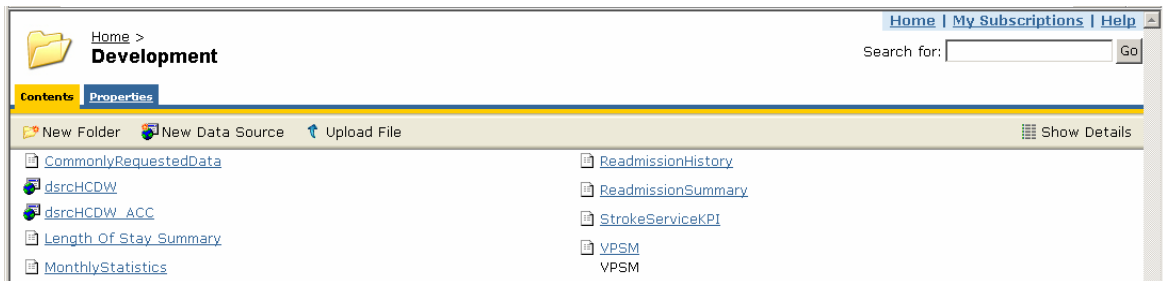


Figure 1: Management & Reporting of Aggregated Clinical Data ETL in the DW planning

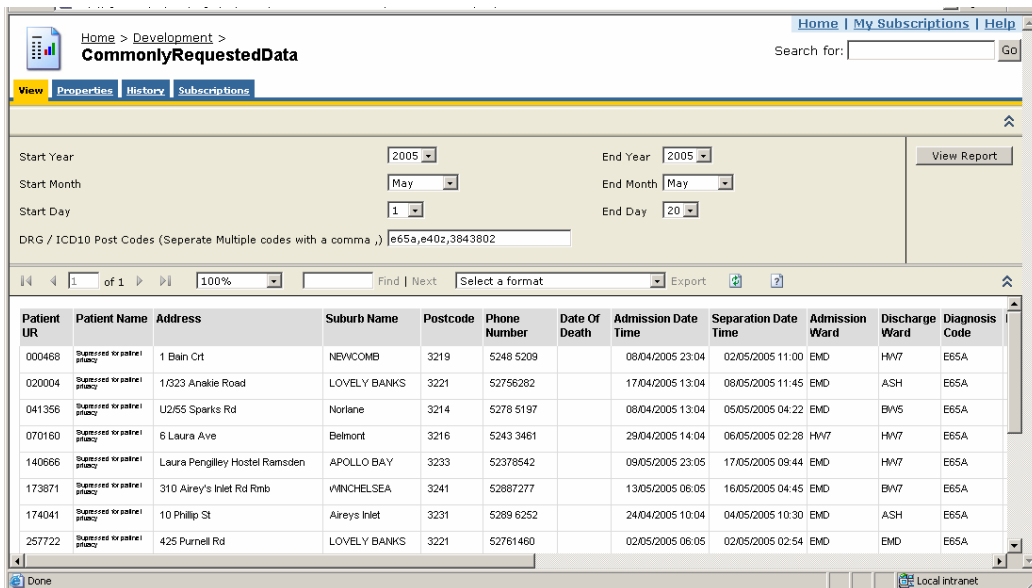
4.1 Access to Data in the Beta testing Data Warehouse

Access to data is currently limited to users who have been part of the project from the beginning as clinical sponsors of the DW and Information Systems professionals.

Beta Testing Access to data is from a familiar browser front end. The alternatives are to run a report with user defined parameters, receive the report with incremented parameters electronically, view a balanced scorecard of statistics relevant to each clinical unit or to design your own report using drag and drop software and being able to extract the data in the form of graphs or MS Excel. Significant benefits for the organisation includes faster access to data with server-scheduled reports that can be delivered by either push or pull methods. This provides clinicians with direct access to their own clinical data updated overnight, enhanced with the option to use a balanced scorecard. The warehouse enables the proactive use of data to evaluate and change clinical practice.



Report 1a: Reporting Services sample Reports



Report 1b: Reporting Services sample Parameters and Report

The pre-formatted quality checked reports provide access to data through familiar web base front end. The above example shows that users can select parameters from drop down menus or free text data entry fields. In this case start and end dates are available along with diagnosis and procedure codes. The data returned includes demographic data, length of stay, clinical consultant, clinical speciality and WEIS (Weighted Inlier Equivalent Separation). The amalgamation of this data in a user-friendly front end

facilitates the gathering of data for the numerous clinical trials and research papers. This particular report will facilitate faster collation of the data because no programming is required and with the use of Excel data that is not required can be removed. Formatting of these reports is decided by the users after seeing the data, adding the flexibility of software tools like MS Excel to further analyse and format the data, or the security to prevent data change provided by Adobe Acrobat. Further enhancing the process will be that scheduling of reports can be triggered for email delivery with for instance change of date at the end of the month or change of clinical condition such as Category 1 Surgical Waiting List patients on the list for surgery approaching thirty days without a theatre date per DHS benchmarking.

Measures>		Episodes		
Separation Specialty> Acute (ACUTE)		Stroke - SDP (SDP)		
Separation Date> 2005		Jan	Feb	Mar
Separation Day of Week				
All Days				
1 - Sun		1	1	1
2 - Mon		2		3
3 - Tue		2	2	5
4 - Wed		1	1	2
5 - Thu		2	1	2
6 - Fri		2	4	
7 - Sat		2	1	3
All Days*		12	10	16

Download CSV Save Report Title:

Table 1: Separations by Month by Day of Week for SDP patients: Jan Feb Mar

Drag and drop software allows users to create their own reports and charts. They can be saved in “My Reports” and run on an as needs basis in the same way that other system reports can be run.

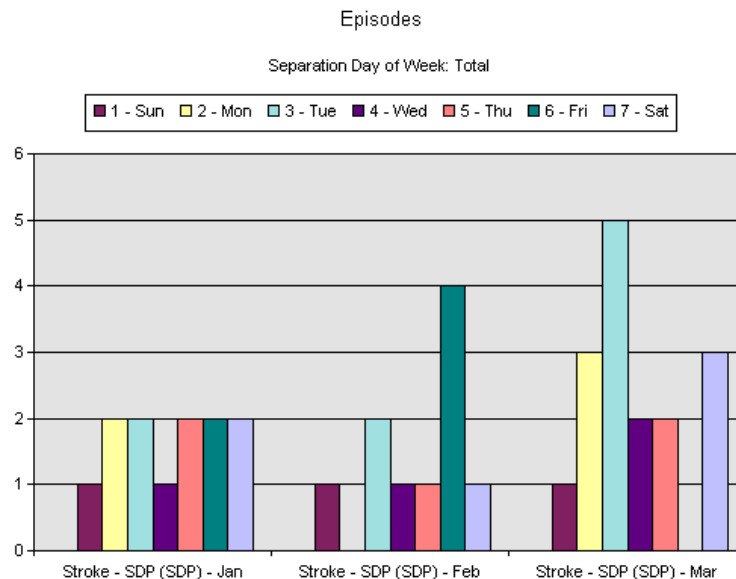
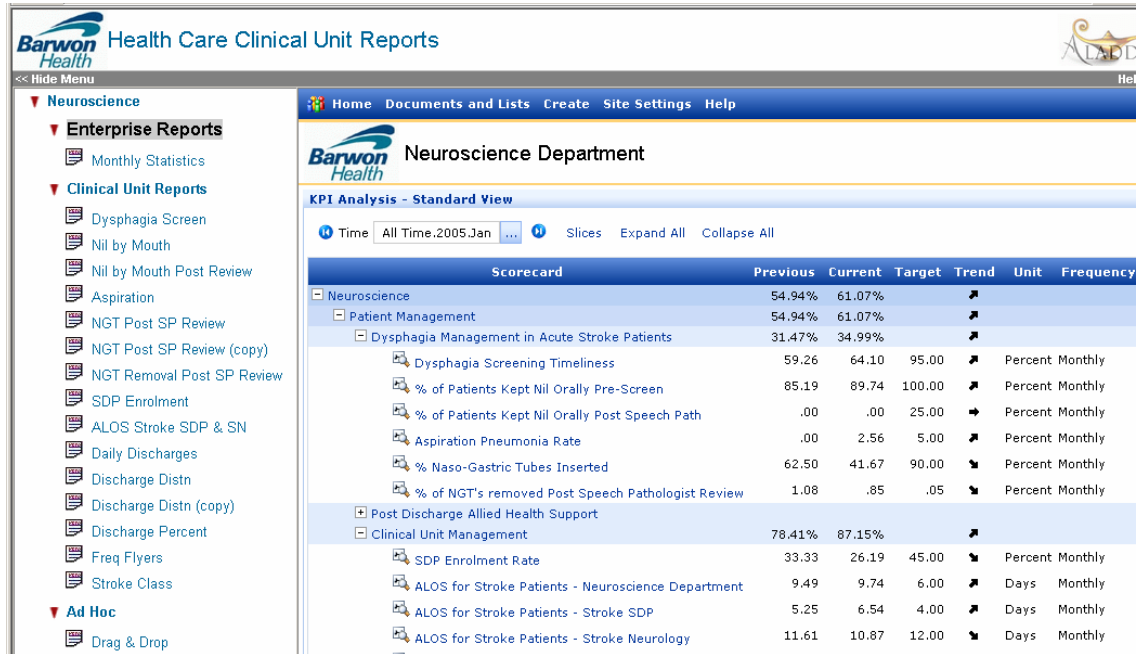


Chart 1: Separations by Month by Day of Week for SDP patients: Jan Feb Mar

The above sample is from the DW clinical sponsor the Neuroscience department. The aim of the department is to standardise the day of the week of discharge according to the clinical requirements of the patient. With the access to data as above, clinicians will be able to compare the date of discharge with the date of admission for patients on the Supported Discharge Program.

Chart presentation of data facilitates data delivery to staff requiring visual or instant interpretation of data.



Report 2: Neuroscience KPI Analysis

The intention for the Business Score Card Accelerator is that it is to be used as a facilitator of the Clinical decision making process. The clinical buy in of the Neuroscience Department at BH with the development of the DW has provided the management support to bridge the gap between technology and the clinician. While Key Performance Indicators are common in the realm of Business, to clinicians they could be confronting without strong leadership. The Medical Services Division, Neuroscience Department of BH is the primary clinical sponsor and business driver for the improvement of clinical practice based on clinical data. Keeping potential stroke patients nil orally till they have had a dysphagia screen is important for patient outcomes. The Neuroscience department intend to use the KPI to educate the Accident and Emergency Department staff, providing them with data feedback on their change process achievements. At this time the limitations are data only recorded since November 2004 and the pending configuration of a production server.

5. Conclusion

The dynamic requirements of Clinical Decision making and Management Reports has had a significant impact over the years on the workload of the Health Information Services Department, in particular the Clinical and Business Analysts. The data warehouse in its early phase of development is already improving access to our data. As more Clinical Systems become part of the Data Warehouse it is hoped and

anticipated that the focus of the workload will change from basic requests of patient numbers and diagnosis to a focus on clinical outcomes making the DW a part of the clinical decision making process

7. References

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