

# Valuing variance: the importance of variance analysis in clinical pathways utilisation

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## Abstract

Variations from the anticipated course of events in clinical pathways provide valuable information that could be used to improve clinical practice and health service planning. Surprisingly, variance data are rarely collected in health care organisations using clinical pathways. This paper describes a project which aimed to improve reporting and analysis of variance data in a large regional and a smaller rural hospital using clinical pathways for a number of surgical, medical and obstetric procedures. The project used change management techniques and a variance analysis software program to inform clinical practice change.

**Aust Health Rev 2007; 31(4): 565–570**

IN A HIGH-RISK industry such as health care, we are constantly striving to improve our practice to improve patient outcomes. Important information for these improvements is the understanding of the variance between what is anticipated to happen during a patient's course of hospitalisation and what actually occurs. Over the past decade the health care sector has introduced

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## What is known about the topic?

There has been limited focus on collecting, analysing and using information on variances from clinical pathways in managing health services.

## What does this paper add?

This paper provides a case study of a project that implemented clinical pathway variance analysis in two hospitals.

## What are the implications for practitioners?

This case study suggests that managers and clinicians should pay more attention to clinical pathway variance analysis, as the variance data can be used to improve the pathways and enhance patient care processes.

clinical pathways to standardise care and improve the quality of care by shifting the focus from task orientation to patient outcomes.<sup>1</sup> The ultimate purpose of clinical pathways is to improve patient outcomes, but insufficient account is given to the fact that things don't always go to plan. Everyone knows that deviations arise, but little analysis is completed of the deviations.

Evidence-based clinical pathways enable clinicians to identify unexpected events (ie, variances) that can be positive or negative for patient outcomes; positive variances include early discharge, while negative variance may consist of unplanned return for surgery. Variance data can be used to build a body of evidence to help improve systems and clinical practice, and assist in planning health service delivery. Use of variance data to examine cohorts of patients who experienced similar variances from a specific clinical pathway can enable identification of factors that contribute to the variance, resulting in interventions that address negative variances.<sup>2</sup> The process of examining variances is referred to as variance analysis and forms a critical part of the quality improvement cycle for clinical pathways.<sup>3</sup>

## I Clinical pathways from which data were collected

Participating unit	Clinical pathways nominated for collection of variance data	
Regional hospital		
Surgical	Transurethral resection of the prostate	Laparoscopic cholecystectomy
	Hernia repair (inguinal and abdominal)	Breast surgery
Maternity	Caesarean section	Laparoscopic-assisted vaginal hysterectomy
	Vaginal birth	Total abdominal hysterectomy
Rehabilitation	Fractured neck of femur	Neurological/stroke
	Generic	Amputee
Rural hospital		
Acute	Intraocular lens implant	Septoplasty and turbinectomy
	Hysterectomy	Hernia repairs
	Day surgery	Normal vaginal delivery
	Caesarean section	Tonsils and adenoids
High Dependency	Chest pain/angina	Acute myocardial infarction

Development and implementation of clinical guidelines is widespread across acute health providers, but identifying, collecting and analysing variances from clinical pathways has not been widely achieved.<sup>4</sup> Only 4% of the health care agencies that have implemented clinical pathways also have a process for analysing variances.<sup>5</sup> The barriers to variance analysis include: difficulty in determining what constitutes a variance; difficulty in identifying a clinician responsible for collecting and analysing variances; difficulty in reporting the variance data; and lack of technological support to assist with the management of variance data.<sup>6,7</sup> The aim of this project was to implement an effective variance analysis process at a large regional and a small rural health service using a change management framework.

## Methods

Two sites were selected to participate in the study. The first was a large regional hospital that provided acute, community, rehabilitation and psychiatric health services. The other site was a smaller rural hospital that provided acute health services. Both sites had established clinical path-

way programs. The Surgical Unit, Maternity Unit and Rehabilitation Unit from the large regional hospital participated. The smaller rural hospital consisted of two units, a High Dependency Unit and an Acute Unit, and both participated in the study.

A project team was convened to identify variances to be reported. The clinicians on the team were recruited from all the units involved in the study and included a surgical nurse, a surgeon, a midwife, an obstetrician, a rehabilitation nurse, a physician and two rural nurses who were qualified in emergency nursing and midwifery. Two researchers and an applications development manager were also part of the project team.

We used principles of change management, such as involving all layers of staff, providing education and using clinician champions to implement the variance analysis process. This meant engaging clinicians and managers to develop a process for collecting variances, to educate other clinicians and to implement the variance analysis process. We also convened a reference group of health care professionals, managers, researchers and a consumer to provide advice and guidance to the study.

## 2 Clinical variance management and analysis (CVMA) application entry window

The screenshot displays the 'VA Patient Record REHAB' application window. It features a menu bar (File, Data Extracts, Profiling, Find Options, System) and a toolbar (Save, Find, Clear, Delete, Exit). The main interface is divided into several sections:

- Patient Information:** Includes fields for Unit (REHAB), Pathway (Amputee), URI No (123456), Pathway Version No (3), Last Name (SMITH), Given Names (John William), DOB (01-08-1948), Pcode (3550), Gender (Male/Female), Dx (Ca), Dr@Admission (Black.J), Surgeon (Euwe.E), Admission Date (01/08/2005), Age@Adm (57), Discharge Date (26/08/2005), LOS (25), CRAFT, DHS ALOS, Dr@Discharge (Black.J), Discharge Destination (Home), Discharged to care of (Family), and Fund (TAC).
- Non-Influencing Existing Conditions:** A list of conditions including AF, AMI, Anaemia, Angina, ARF, Asthma, CCF, and Chest Infection.
- Non-Influencing New Conditions:** A similar list of conditions.
- Audits:** A table for recording audit data.
- Pt Variance Record:** A section for entering variance data, including Path Day (1), Var.Cat (Patient), Var.Type (Gastrointestinal), Variance (DIARRHOEA), Occurrence (1st Occurrence), Cause (Undiagnosed existing condition), and Act/Outcome (03-08-2005 Medication : 03-08-2005 Pathway resumed).
- Principal Cause of Variance:** A section for entering the principal cause of variance, including Date, Action, and Outcome.
- Buttons:** Save, Clear, and Delete buttons are located at the bottom right.

The specific clinical pathways from which we collected data are shown in Box 1.

A comprehensive list of variances was developed by the project team for each of the diagnostic groups and this list provided clinicians working on the units with a guide to the variances that needed to be recorded. The list formed the foundation for the variance analysis computer application known as "clinical variance management and analysis" (CVMA).

### Clinical variance management and analysis (CVMA) application

The variance analysis computer application was designed to collect variance data in a structured and consistent manner for accurate reporting and analysis. The application was developed in Visual Basic 6 (Microsoft Corporation, Redmond, Wash, USA). The minimum system requirement to run the application is Pentium 2, Windows 95

onwards, 250 MB RAM, with no special database licensing required.

The application is list driven, thus, by adjusting the lists it can be adapted to any clinical setting. Once data are entered, the application provides a single electronic record of variances for a patient admission. Within any patient variance record the user can call up comparative data for all other patients on that pathway and analyse similarities among patients on the pathway. Variance data can be extracted from the CVMA system and used for analysis in an appropriate tool, such as the Statistical Package for Social Sciences (SPSS Inc, Chicago, Ill, USA).

Education on variance analysis was provided to three groups. First, some members of the project team attended a 3-day education program on collecting and analysing variances. Second, education was provided by the project team clinicians to clinicians in each of the units involved in the study. The purpose of the initial education ses-

### 3 Clinical pathways that were changed as a result of the study

Clinical pathway	Changes
Hernia	Reviewed; reportable parameters included
Laparoscopic cholecystectomy	Reviewed; reportable parameters included
Breast surgery	Reviewed; integrated with Breast Cancer Nurse
Transurethral resection of the prostate	Reviewed; time to remove indwelling catheter and admission and discharge processes included
Vaginal birth	Developed, implemented and reviewed to include improved linkages with community services
Caesarean section	Format changes; reviewed to include improved linkages with community services
Total abdominal hysterectomy	Format changes; reviewed to include improved linkages with community services
Laparoscopic assisted vaginal hysterectomy	Format changes; reviewed to include improved linkages with community services
Fractured neck of femur	Format changes; reviewed
Generic	Format changes; reviewed
Neurological/stroke	Format changes; reviewed
Amputee	Format changes; reviewed
Intra ocular lens implant	Format changes; reviewed to include information for patients and carers
Septoplasty and turbinectomy	Format changes; reviewed to include introduction of new nasal packs
Hysterectomy	Format changes; reviewed to include introduction of prophylactic antibiotics
Hernia repair	Format changes; reviewed
Day surgery	Format changes; reviewed
Normal vaginal delivery	Format changes; reviewed
Caesarean section	Format changes; reviewed to include introduction of prophylactic antibiotics
Tonsils and adenoids	Format changes; reviewed
Chest pain/angina	Format changes; reviewed
Acute myocardial infarction	Format changes; reviewed

sions was to provide information about identifying and recording variances from clinical pathways. Education sessions were also conducted after variance data had been collected and analysed as a way to provide feedback to the clinicians who documented the variances and to show how variance analysis could improve clinical practice. Third, a one-day workshop was conducted to provide education about the benefits of clinical pathways and variance analysis. All clinical units from the regional hospital, including those not participating in the project, were represented at the workshop. Staff from the rural hospital participating in the project were also in attendance. A total of 58 clinicians and clinical unit managers attended.

Variance data were collected retrospectively by the project team clinicians, with variances recorded on a variance sheet that formed part of the clinical pathway and then entered into the CVMA application. Once other clinicians started to use the application, a number of shortcomings became apparent, requiring an iterative process of refinement over 4 months. The variance analysis application enabled collection of variance data from clinical pathways and is readily changed to accommodate new clinical pathways or additional variances. The variance analysis application is capable of containing all variances for a patient admission and relates to the patient details by unit record number and admission date. Box 2 shows the CVMA application entry window.

## Results

Cases on clinical pathways were audited and variance data collected from the regional hospital (500 cases) and the rural hospital (227 cases). Reports were generated on the variances and these reports were then used to analyse and improve existing care processes, as described below.

### **Improved use of clinical pathways**

Although both hospitals had established clinical pathway programs before the study, the audit found that the use of clinical pathways in some of the participating units was not reliable. During the study period patients who were admitted were placed on the appropriate clinical pathway, and overall pathway usage increased.

Previously, the project variances were rarely documented. Comparison of the variances recorded in patient histories to the outcomes of the variance application found that the recording of variances increased by between 70% and 100% per clinical pathway. The increase in variance recording occurred after the introduction of two strategies that aimed to highlight how clinicians could identify and document variances. The first strategy introduced clinicians to what constituted a variance, and clinicians on the project team developed posters and guidelines for recording variances, which were displayed in participating units. The second strategy aimed to support clinicians who worked in the participating units with informal education on variance identification and documentation provided by the project team clinicians who worked in the units.

### **Review of clinical pathways**

As a direct result of this project, and the resulting insights provided by closer scrutiny of variances, the clinical pathways that were selected for the study were reviewed and improved. For example, the clinical pathway for transurethral resection of the prostate was redesigned to include a patient pathway, as it was clear that greater patient education was required. In addition, analysis of variances from this clinical pathway enabled identification of a delay to postoperative removal

of the urethral catheter that contributed to an increased length of stay for patients. As a result, recommendations for changes in practice and protocols were made to clinicians, such as the removal of urethral catheters at midnight instead of 06:00 the following morning.

The list of clinical pathways that were modified as a result of the study are included in Box 3.

Two years after completion of the variance analysis project, use of the CVMA application has been sustained in two of the five participating units. The CVMA application continues to evolve and Version 7 of the application is currently under development. One unit did not continue with variance analysis because of lack of management support. The other two units in the rural health service did not continue with variance analysis because their computer infrastructure required upgrading to continue to support the application and funding was not available to achieve the upgrade.

## Discussion

This study suggests that the collection and analysis of variance data can be a powerful tool to assist health service planning. Analysis of variance data can assist in evaluating and revising clinical pathways and reducing variances. A precursor to anticipating deviations from standardised care is collection of variances that build a picture of what actually occurs to patients during a hospital admission. Variance data can be used to make improvements to health care, contributing to the body of evidence that informs and guides clinical practice.<sup>8</sup>

We believe that the factors that led to the success of our variance collection and analysis systems in the small rural and larger regional hospitals were based on change management principles. Clinicians adopted a leadership role and championed the process on the participating units. Support was provided to clinicians and managers at the unit level and on an individual basis through an extensive education program.

Comprehensive lists of variances and actions taken by clinicians in response to the identified

variance were developed, which aided the implementation process. There were no guidelines that enabled clinicians to clearly identify a variance, and clear identification of what constituted a variance was critical to successful implementation of the process.<sup>9</sup> Development of an electronic variance analysis database, which relied on lists, simplified and standardised the system for collection and analysis of variances. Furthermore, the development of this database overcame a major barrier to the collection and analysis of variances.<sup>10</sup> In health care the professional autonomy of clinicians creates a barrier to the implementation of standardised clinical pathways.<sup>11</sup> We believe that variance analysis can assist in addressing the difficulties experienced in introducing standardised care by enabling clinicians to implement an objective measure to review practice. Additionally, with the ageing population in Australia, patients tend to present with more comorbidities<sup>12</sup> and treatment plans need to be flexible enough to accommodate specific patient needs. Variance analysis can assist in ensuring this flexibility within standardised clinical pathways.

The variance analysis application was designed to manage variance data and not general data associated with each patient's hospital admission, but it could be used as a foundation for an electronic medical record. In addition, we believe this application can be used to assist with costing clinical episodes by attaching prices to each stage and to variances from any given clinical pathway.

## Conclusion

During the course of this project it became apparent that analysis of variance data is a useful tool to improve clinical practice, identify trends among cohorts of patients and to assist the evaluation process for clinical practice. Analysis of standardised data collected from patients receiving clinical care can provide useful information for quality management, risk management and health service planning by providing a clearer picture of what occurs during the acute phase of hospital management.

Development of a system to collect and analyse variances will increase the health care industry's

ability to monitor and improve performance. Collection and analysis of variance data is possible and has enormous potential in the health service arena.

## Competing interests

The authors declare that they have no competing interests.

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(Received 2/03/06, revised 22/11/06, accepted 1/04/07)

