VLAD CM
Clinical Monitoring System

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IN PARTNERSHIP WITH

Queensland Government

FACILITATED & SUPPORTED BY

Australian Institute for Commercialisation

tomorrow’s technology for today’s health
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2. OUT OF NECESSITY COMES INNOVATION – THE BUNDABERG SCANDAL

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The technology revolution heralds the arrival of ever-increasing volumes of data; data which must be assimilated, verified and analysed if it is to be of value, and if it is to be relied upon to guide actions and decisions. This decision-support is critical in the healthcare industry, in which missed “signals” in data can lead to poor, sometimes fatal, outcomes; outcomes that could have been avoided had the signals been identified and acted on.

For healthcare organisations to keep pace and to extract the most value out of the information hidden within this data, they need to turn to the very technologies that gave rise to this data in the first instance.

Out of necessity comes innovation – The Bundaberg Scandal

In 2005, a scandal surfaced concerning a surgeon employed in a Queensland public hospital. Investigations, set up to find out what exactly happened and how, arrived at compelling conclusions of systemic maladministration and suboptimal governance and reporting frameworks, sending shockwaves through both the medical and political arenas.

The Bundaberg tragedy came on the heels of events elsewhere in Australia that seriously jeopardised patient care in Western Australia, the Australian Capital Territory and New South Wales. An editorial reflecting on these events noted:

‘Not surprisingly, all these incidents had common characteristics: Compromised patient safety not detected by sentinel event reporting; suboptimal clinical governance; health care professionals, who, frustrated by inaction after internal reporting of adverse events, brought the matter to the attention of politicians; and finally, all incidents provoked one or more independent enquiries’


The Bundaberg hospital tragedy became a rallying call to hospitals and health departments everywhere. For Queensland, home to the most recent events, hard questions had to be asked. What was it about reporting and monitoring at the time that so dramatically failed? How could such an event be avoided in the future?

Out of necessity comes innovation; Variable Life Adjusted Display (vLAD) was introduced by Queensland Health as a means of monitoring clinical outcomes.
VLADs

A VLAD (Variable Life Adjusted Display) is a type of statistical control chart or graph that is used for exposing trends and identifying breaches of defined control limits.

The VLAD records patient outcomes in a precise way that allows for unexpected trends to be seen. In addition, the outcomes for a clinical indicator in a particular hospital or facility can be plotted against the averages of the health jurisdiction as a whole, and the points at which one hospital’s or facility’s outcomes go significantly above or below the jurisdiction average are automatically marked as needing review and explanation. The VLAD also helps focus attention on those areas that most likely hold the explanations for unexpected deviations in outcomes.

Outcomes from a procedure, such as hip replacement, do vary from hospital to hospital, and even from period to period within the same hospital. Variations may be coincidental, but sometimes they may be the result of a real shift in practice or treatment quality. The VLAD is the starting point of a process that looks for patterns that might indicate either a problem or an inspired practice change that has actually improved outcomes.

The complete VLAD methodology is available in the Queensland Health publication of ‘VLADs for Dummies’.

Within Queensland Health, VLADs are sponsored at the highest levels and supported by the Departments’ dedicated Clinical Practice Improvement Centre which was formed in 2005 to improve patient outcomes in high-impact areas through supporting and working closely with clinicians and health service managers.

“The VLAD also helps focus attention on those areas that most likely hold the explanations for unexpected deviations in outcomes...”
The results of introducing vLADs into Queensland Health were immediate and compelling and gave rise to the recognition of the potential for the associated methodologies and frameworks to be adopted in other health organisations.

This recognition led to a partnership with Opus 5K, facilitated by the Australian Institute for Commercialisation, for the development of the VLAD Clinical Monitoring (VLAD CM) solution, being the culmination of several years of intensive research and consultation carried out by Queensland Health. Through the mechanisms of a worldwide, exclusive commercialisation agreement, Opus 5K is now able to make this intellectual property available to the market at large, for use by healthcare organisations around the globe.

The immediate benefit in adopting VLAD CM is that the system neatly packages up all the proven processes, policies and frameworks that have made the vLADs such a success within Queensland Health; in effect, it will short-circuit many of the learning curves, setbacks, costs and frustrations that would otherwise be encountered when embarking upon the introduction of a clinical monitoring framework as advanced as that supported by VLAD CM.

Taking advantage of the value propositions available through VLAD CM does not in any way, shape or form mean that the indicators, policies or processes of Queensland Health come as part of the package. One of the most significant components of the system is its configuration module; in effect, the system provides the foundations of vLADs, being the core engines for calculations, charting, workflow and reporting, on which each health jurisdiction may then define its indicators, policies and processes.

VLAD CM is more than just a system; it is the single platform from which the VLAD methodology may be promoted and deployed and the associated governance frameworks and policies may be enforced whilst at all times maintaining complete probity or process.

“...The immediate benefit in adopting VLAD CM is that the system neatly packages up all the proven processes, policies and frameworks that have made the vLADs such a success within Queensland Health...”

VLAD CM

Built to the design patterns proven within Queensland Health, VLAD CM has been introduced to simplify and make more efficient the monitoring of quality of services provided. It provides an easily understood graphical overview of clinical outcomes over a course of selected time and plots the cumulative difference between expected and actual outcomes.

VLAD CM also provides a flagging mechanism for when further investigation of performance is warranted, with a full workflow and escalation module to ensure that flags are followed up in a timely manner. VLAD CM allows timely detection of both potential problems and improved performance and is easily understood by clinicians and hospital managers. A configurable Pyramid of Investigation is used to assist in the identification of causes where variations in outcomes are significant.
At the most basic level, health organisations will use VLAD CM to:

+ Define the clinical indicators that are to be monitored;
+ Import and analyse data from their core databases, to arrive at acceptable control limits;
+ Identify those areas where control limits have been crossed and commence an investigation-based workflow to identify contributing factors;
+ Provide those responsible for the investigation with a framework and easy to use charting and drill-down tools to assist in identifying contributing factors;
+ Automatically follow up on investigations, and escalate where necessary, to ensure that all workflow processes are brought to a satisfactory conclusion;
+ Gain a high level insight into the contributing factors of control limit breaches, and move towards practices and policies that alleviate the factors of adverse outcomes and that promote the factors of positive outcomes.
Implementation

Having worked side by side with Queensland Health in the implementation of vLAD CM, Opus 5K is well positioned to take forward this knowledge and experience to ensure that other health organisations are able to take full advantage of the potential of the system.

A typical implementation will commence with the analysis of existing clinical data, the formulation of clinical indicator definitions and a complete stakeholder analysis, including in particular consultations with clinicians, data analysts, statisticians and management. In addition, consideration is given to the interactions that may be required with existing monitoring frameworks.

It is important that the supporting environment is carefully evolved in response to the new concepts, processes and methodologies that will be introduced with VLAD CM; in anticipation of this change, there will be consideration of the governance frameworks and feedback loops, strategies for training and change management and securing of overall sponsorship of the project.

Through its previous and current assignments, Opus 5K has built up a reputable network of support staff from all disciplines; all experts in their selected fields.

Opus 5K has the people, the implementation blueprints, the experience and the track record to ensure that the introduction of VLAD CM provides health organisations with results that are immediate and compelling; results that can form the basis for future programs of continual improvement in clinical outcomes.

“provides health organisations with results that are immediate and compelling; results that can form the basis for future programs of continual improvement in clinical outcomes”
The clinical monitoring system for the future?

VLAD CM is ambitious and forward-looking in its potential to support the sharing of clinical data across health jurisdictions. The opportunity exists to leverage the power of combined data sets, collected across jurisdictions, for the purposes of benchmarking and reporting and of enhancing the calculations of predicted outcomes. It may at first appear that the solution is years ahead of its time in this regard, however ongoing discussions with different health jurisdictions have already led to significant progress being made in this regard. This opportunity may appeal in particular to the smaller health jurisdictions who may partner with those of a more significant size to take advantage of the more sophisticated modelling of predicted outcomes that come with higher volumes of data.

The assurance provided here is that VLAD CM is ready to support the business models of the future, whether they are defined on a local, national or global level.
KEY FEATURES

Some of the key features of VLAD CM include:

Configuration

VLAD CM has been built with the widest user base in mind. For this reason, the system is highly configurable on an ongoing basis by each organisation using just a web browser.

+ It all starts with the indicators and their associated outcomes. These indicators are the signals that are monitored constantly by the system. These components are configurable by end users, meaning as new indicators are identified, they may be added to the suite managed through VLAD CM. Indicators may be configured in terms of their definitions, selection criteria, co-morbidities, data dictionaries and control limits. The number of indicators that may be monitored in the system is unlimited.

+ The Pyramid of Investigation provides a framework through which control limit breaches may be investigated. The pyramid may differ from one health organisation to another. Configure the pyramid as required, setting both the descriptions and typical investigation questions for each level of the pyramid. Further, the pyramid may be fine-tuned to be applicable to the type of flag being investigated, and by the type of organisation carrying out the investigation.

+ One of the key value propositions of the system is the ability to configure its workflow; that is, when a control limit breach has been identified, who needs to do what? And when? What questions should they be asked? What happens if they do not complete their task in time? Can extensions be requested? The workflow configuration module allows each organisation to embed their specific business rules into the system and have the system enforce and manage them. This configuration is at the breach level and facility type, meaning you can have one workflow defined for a lower level 1 breach, one for a lower level 2 breach, and so on, with each breach type having a variation of workflow based on whether the healthcare facility is public or private.

+ VLAD CM uses emails to prompt, remind and escalate. Configure the content, timing and recipient roles of these emails easily and quickly; again, this configuration can be sensitive to the breach type and level and the type of facility conducting the investigation.

“The workflow configuration module allows each organisation to embed their specific business rules into the system and have the system enforce and manage them.”
Data Import

Once the system has been configured to support your indicators, policies and business processes, it is then ready to start accepting data from the clinical databases.

Integrity and completeness of data is a key requirement of any system, in particular for a system that is to act as a trigger for investigation-based workflow processes; for this reason, VLAD CM has the following features to maintain the highest quality data:

+ High level overview to provide a one-page summary of the import status of each indicator.

+ Import audit. Log tables are maintained for all aspects of the system, including keeping track of all import jobs run. This means that you will always know the latest status of the data in the system, including who imported it, who validated it, and when.

+ Manual validation of data. Once the data has been imported, it is held in a suspended state until it has been cleared by an authorised user. Whilst the new data is in that suspended state, end users maintain access to the existing data in the system, meaning that data can be imported and validated without affecting existing users.

+ To assist in validating the data, parallel charts are made available. This allows the user to plot the newly imported data against the existing data to look for any obvious errors. Only once the data has been confirmed as valid is it then made available to the end users. At that point, the old data is moved to an archive where authorised users may continue to access it as required.

+ Once data is imported and validated, VLAD CM automatically calculates all control limits and potential control limit breaches in accordance with the rules established against each of the indicators. These breaches then become flags that go into a suspended state until manually cleared by an authorised user. To assist in their validation, when viewing a particular flag, VLAD CM will show side by side any existing flags against that facility for that given indicator. This reduces the chances of duplicate flagging.
Workflow

Where breaches have been identified, VLAD CM comes alive with a wave of workflow activity. The workflow module features the following capabilities:

+ Task routing and task escalation in accordance with the rules configured in the system.

+ A graphical flag overview providing a snapshot of the status of all flags held in the system. Colour coding is used to easily differentiate between positive and negative outcomes.

+ A “My Tasks” style inbox, showing all flags requiring action by the user logged in to the system.

+ Online form completion, allowing real-time validation of form content prior to submission, with the ability to save a work-in-progress until submission of the response is authorised.

+ Structured investigation feedback against the configured Pyramid of Investigation, with the ability to flag contributing factors and to have these factors feed into subsequent reporting.

+ The ability to record specific cases investigated.

+ The ability to provide notes against individual forms.

+ The ability to request revisions to forms, extensions to due dates or further investigation to be carried out, triggering a revised workflow in accordance with the configured business rules in the system.

+ Role-based access, meaning only those users with the required security clearance may complete their respective forms.

+ An easily traversable list of all documents that relate to a particular flag, allowing you to see the complete history of forms, revised forms, extension requests and emails that are associated with a particular flag.

+ All forms carry with them their own audit tables, so that for every form you will know who created, revised and submitted them, along with all respective dates.

All in all, the workflow module, as supported by the system configuration, ensures that very specific tasks are “pushed” out to those users responsible for their completion, and that these tasks are followed up and escalated to ensure that all requests for investigation of a control limit breach are brought to a swift, satisfactory conclusion.
**Reporting**

Graphical models are used heavily in VLAD CM as a way of providing snapshots into vast volumes of data.

+ The charting feature is one of the key features of VLAD CM. Generate charts by facility and indicator to monitor performance over a period of time. To maximise the usefulness of these charts in the investigation process, they support the following features:
  - Chart zooming. Zoom in on particular areas of a chart to focus on control limit breaches and the lead up to these breaches.
  - Tooltips. Hover over any point on the chart to see the underlying case number and separation date.
  - Cases tab. Expose a wealth of information, including details of all co-morbidities, on the particular cases that make up the data set for the chart.

+ Contributing Factors Summary. This overview serves as the ideal starting point for contributing factors analysis, as it comprises of the configured Pyramid of Investigation with colour-coded bars both to the left and right of each level of the pyramid denoting the number of times each level was cited as a contributing factor of the breach. Users may then drill-down into each level of the pyramid to expose the underlying indicators and their respective counts. From that level, users may then ultimately gain access to the individual flag details, including all investigation data associated with each flag.

+ Report Distribution. VLAD CM has its own reporting distribution module which allows users to subscribe to reports. Once subscribed, these users will receive their reports directly into their inbox, specifically tailored to their respective areas of responsibility.

+ Deidentification of Data. VLAD CM supports the deidentification of investigation data (the removal of any specific names of doctors, hospitals etc) for inclusion in public-facing reports.

+ Indicator Groups. VLAD CM supports an unlimited number of groupings that may be set up for indicators. In that reports are driven by these indicator groups, this effectively provides an unlimited scope for the segregated reporting of clinical indicators.

“The workflow module ensures that very specific tasks are “pushed” out to those users responsible for their completion...”
**Technology**

+ The system is developed using Microsoft technologies (ASP .NET, SQL Server) capable of supporting full, enterprise-scale deployments.

+ An online system means no local software installations are necessary. All that is required to access the system is a computer with internet access (allows for easy off-site access).

+ A central database means that data is entered once and immediately available to all authorised users of the system, no matter where they are located.

+ Work is currently in progress to make modules of the system accessible by smart phones, needing only an internet connection.

**User Management**

VLAD CM is designed with three-tier access protocols for users;

+ Role-based access. The roles the user has been assigned with will determine the functionality the user may have access to in the system.

+ Indicator-based access. This access tier restricts the user to only access data for nominated indicators.

+ Facility-based access. This access tier restricts the user to only access data for nominated facilities.

With this level of security, organisations will maintain complete control over who can access which records in the system, and what they can actually do in those accessible records. It is this detailed level of profiling users that allows the system to carry out its workflow functions in the most targeted manner.
A LOOK AT VLAD CM

Flag overview

The flag overview provides an easy to read summary of the status of all flags against either a particular facility or against all facilities available to the user.

The length of the bars provides an insight into the number of flags at each level.

The position of each bar along the X-axis reveals the progress the flags have made along the workflow processes defined in the system.

The overview supports drill-down features to reveal a detailed list of the underlying flags.

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<tr>
<td>Public Reviewers</td>
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<td>LOWER 3</td>
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<tr>
<td>Total Flags</td>
</tr>
</tbody>
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“A nerve centre for quality management”
### Contributing Factors Summary

The contributing factors summary provides a snapshot of the levels of the pyramid identified as possible contributing factors of a control limit breach.

To the left of the pyramid are the lower breach counts, whilst to the right are the upper breach counts.

The summary supports drill-down features to expose counts per indicator against each level of the pyramid. These counts support further drill-down to ultimately expose the investigation data itself.

![Contributing Factors in the Pyramid of Investigation](image-url)
Charting

Charts show the VLAD line with both upper and lower control limits for the selected facility and indicator.

Charting supports the zoom feature, allowing users to focus on control limit breaches to facilitate investigation of cases leading up to the breach.

Tooltips provide further information for each point in the series.
Investigation Feedback

Web-based forms provide real-time validations and structured data.

Expose the complete history of the investigations against a particular flag, including all forms, revisions to forms, extension requests and even emails.

Investigation results are recorded against the pre-defined Pyramid of Investigation.

Complete probity of process is assured at every step of the workflow, with user names and timestamps being captured each time a form is created, changed and submitted.
Workflow Configuration

Systems should be driven by business rules and policies, not the other way around. VLAD CM allows users to configure the workflow component of the system and finely tune it on an ongoing basis to closely support and enforce existing policies and processes. This makes for a highly responsive system.

This configuration can be carried out for every combination of flag type and flag level, potentially meaning that the workflow followed for one type of flag could be completely different to that followed for another type of flag. Further, for each flag type, variations may be configured dependant on whether the facility conducting the investigation is a public or private facility.

This configuration also extends to the content and timing of emails.
Opus 5K, incorporated in 2007, is Australia’s newest entrant to the health informatics industry. Relationships forged early on with both Queensland Health and the Australian Institute for Commercialisation has propelled Opus 5K into a position of strength, in which it is now pursuing an aggressive strategy of building its portfolio of solutions.

The commercialisation agreements in place with Queensland Health provide Opus 5K with a competitive edge; in particular:

- The ability to tap into intellectual property within Queensland Health that has been built up over several years by experts in their fields;
- Access to continual improvement opportunities, leveraging both ongoing analysis and research conducted by Queensland Health and feedback from the large number of existing users;
- Access to test, refine and stabilise its solutions in large-scale production environments;
- Access to the networks established by Queensland Health in relation to its ongoing projects.

To see the complete range of solutions offered, please visit our website at www.opus5k.com.au
contact

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