

VIDS

Vital Information Decision Support

Proposal

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Background

Family of ICU patients frequently face the harrowing and tortuous decision of whether to extend hope and continue life support or let a loved one pass peacefully. Typically, if a patient is making progress towards recovery, the decision makers will continue treatment, if there is no evidence of progress the decision makers may choose to let their loved ones go. Unfortunately, determining progress under the dread circumstances of the ICU is difficult. Emotions and bias are piqued and often enflamed by the absence of hard data. The elusiveness of Doctors and clinicians to help make predictions about a patient's recovery only isolates decision makers. Thankfully Clergy and counsellors are available to help, but not based on data.

Any visitor to the ICU knows with every beep and rattle of a respirator that data is being generated, but few know that it is not being stored. Vital data in the ICU is generally used for alarms. If a vital sign crosses a threshold, nurses and doctors are summoned to administer treatment. This transient data is not collected and analyzed over time, and not used to formulate a picture of a patient's recovery, or absence of recovery. Why?

The VIDS system collects a patient's 8 vital measurements during their stay in the ICU. This data is rolled up into a daily report that a family member can be guided through to assist their decision. Before VIDS, family members would have to make guesses. What was his blood pressure 2 days ago? What was her heart rate? Are they getting better? With the introduction of VIDS, that data is recorded and subjected to an exploratory data analysis. Decision makers will have be able to see whether vital signs are approaching normal or not, and have solid, data based information upon which to make a decision.

The 8 vital signs:

Vital Sign	Notes
Temperature	Indicative of age, infection, medications, location of measurement
Pulse	Pulse and EKG pattern indicate heart function
Blood Pressure	Indicative of age, infection, medications, location of measurement
Respiratory Rate	Indicative of age, infection, medications, location of measurement
SpO2	Indicative of age, infection, medications, location of measurement
Pain	Measured by Patient's or clinician's perception
Level of Consciousness	Measured by Patient's or clinician's perception
Urine Output	Renal function, cardiac output

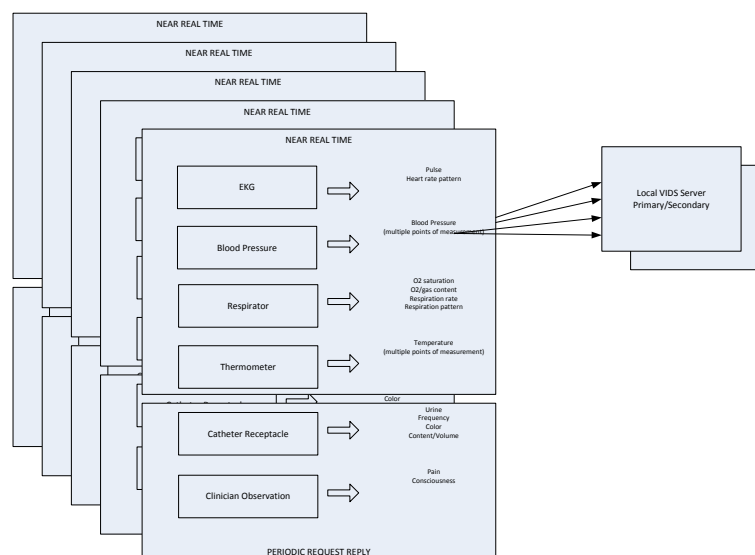
Problem

A trove of data is generated every minute and is used for alarming only, not for diagnostic or palliative care. By storing and analyzing the data decision makers can have a valuable decision support tool.

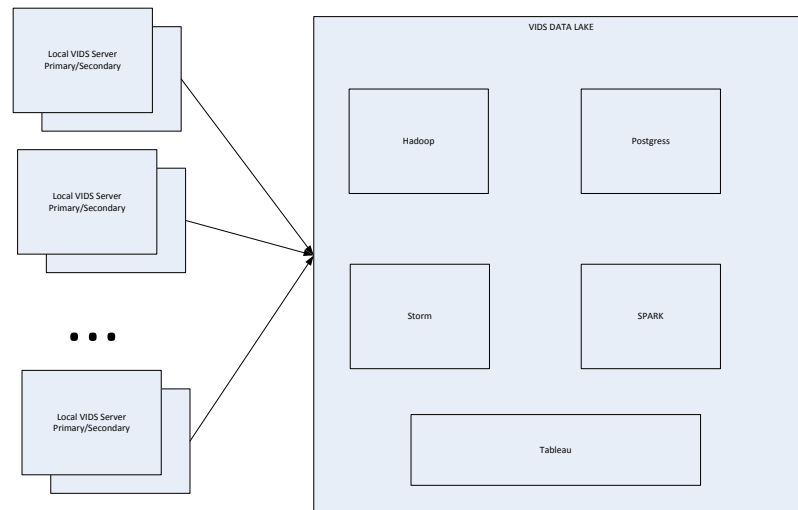
Solution

Each ICU chamber will be instrumented with software to forward existing alarm information to a local VIDS server in near real time. In many cases, EKG and respiratory assistance equipment publish SNMP traps to an existing monitoring platform. The VIDS server will be configured to listen for those traps and clean and store the information. Additionally, some information such as consciousness and urine analysis will periodically be queried from existing patient reporting systems.

ICU CHAMBERS



Individual VIDS servers will report to the cloud based VIDS Data Lake. The lake will authenticate servers and provide storage and analysis for individual patients, and aggregate information on all patients. The lake is built on a Hadoop distributed file system to promote extensibility. Apache Storm will be used to receive data between individual VIDS servers and the lake. Postgress databases will be used with PySpark programs to store, administer and analyze data, and prepare it for visualization by Tableau.



Reporting and Visualization

Users will have access to a Tableau front end to provide an exploratory data analysis of the vital information. Including:

- Histograms of O2 saturation and utilization
- Charts of blood pressure, heart rates, and respiration rates
- Trending information.

Scale for Proof of concept

The Proof of concept will model one local VIDS server, serving one (or maybe two) ICU Chambers for all 8 data points. The data lake will be created, and Tableau visualization will be provided. Data from the VIDS server will be centered around the University of Queensland vital data dataset. It will be supplemented with home-made vital data simulators.

Deliverables

1. Data Lake
2. VIDS server simulator using Queensland data set and simulated data
3. Tableau visualizations
4. Runbook
5. Presentation