NIH Grant: Phase 1 Case Study from Hospital

Diversion Detection and Reporting Solution for Healthcare

National Institutes of Health

In May of 2017, Invistics won a 30-month grant from the National Institutes of Health to conduct a research project in partnership with seven hospitals around the nation to adapt Flowlytics®, our existing supply chain analytics software, to healthcare. The project's goal is to utilize advanced technology to detect with greater efficiency and effectiveness when Health Care Workers (HCWs) in hospitals steal or "divert" drugs using three methods:

1.) Real-time drug inventory dashboard for visibility with critical alert capability.
2.) Historical reporting that consolidates data from five healthcare IT systems to provide a baseline of data to facilitate collaboration across departments.
3.) Utilizes Machine Learning and Advanced Analytics to detect non-compliant & suspicious behavior.

To date, Invistics has engaged with enough hospitals to facilitate the grants minimum requirements of seven sites and is considering adding additional facilities to augment the machine learning intelligence. The initial facility was specifically selected because of having a comprehensive program where testing could be done comparing existing methods to advanced technology. Each facility is being implemented chronologically to optimize their unique systems and workflows. This paper outlines the case study for the first facility.

"What was most impressive is the solution not only detected known diversion cases faster than current methods, it also highlighted recent cases under investigation. The solution also provided a historical baseline view that has allowed us to clean up practice by partnering with all departments involved." - Diversion Investigator

NIH Grant Phase 1 Project Summary

During the six-month Phase 1 study, Invistics partnered with one large, Georgia-based hospital to test improved diversion detection methods, focusing on algorithms that would detect known, historical diversion cases across their entire medication supply chain. Our Phase I hypothesis was if we create and tested machine learning and other advanced algorithms on blinded data from five hospital computer systems at a single hospital, then we could detect known diversion cases that current methods do not detect, and detect them earlier.

To test this hypothesis and reach the milestones shown below, Invistics extracted data from five computer systems at this hospital: Automated Dispensing Machines (ADM), Electronic Medical Records (EMR), Wholesaler Purchasing Systems, Internal Inventory System(s), and Employee Time Clocks. The team then consolidated the disparate data into a single database, and programmed a variety of computer algorithms to classify non-compliant transactions, e.g., a nurse who dispensed 10 ml of narcotics, administered 2 ml to the patient, and reported waste of only 5 ml, causing suspicion that the remaining 3 ml might have been potentially diverted. Machine Learning technology was used to test and optimize weighted factors used to differentiate what might be sloppy practice from a potential diversion. This is an important part of the study as the increasing data gained from additional facilities will add to the system's ability to detect unknown suspected diversion.

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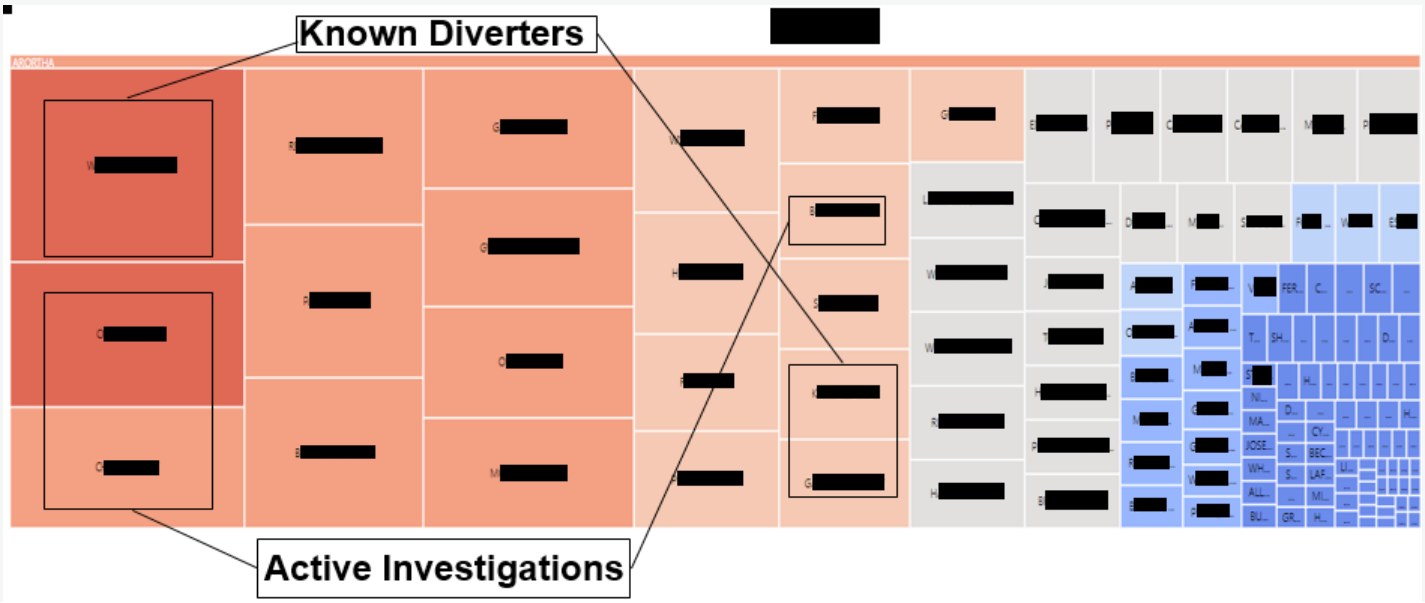
The partner hospital provided detailed case files providing Invistics with documented proof of diversion in a variety of circumstances, with detailed notes such as when the diversion was first investigated. The first project milestone 1a was achieved in mid-October 2017 by selecting three known diversion cases/nurses and confirming the algorithms classified all three of these unblinded cases/nurses with suspicious transactions. Invistics then expanded the analysis to all areas of the supply chain including 1850 Heath Care Workers in the hospital across 33 months of history, including over 4.6 million individual ADC dispenses. This data included 9 nurses who were known to have committed diversion at profiled ADCs. These 9 known diversion cases were blinded, i.e., not revealed to the algorithm. The algorithm classified every ADC dispensing transaction as either suspicious or not suspicious. The team then summarized these results into a list of nurses with suspicious ADC transactions, showing the earliest suspicious transaction for each nurse.

NIH Grant Phase 1 Project Results

The project milestone 1b was achieved in mid-November, when the solution confirmed that 100% (9 of 9) of the nurses had transactions that were classified as confirmed diversion. In all 9 cases, the algorithms classified suspicious transactions well BEFORE the date of the diversion investigations had begun for these nurses, i.e., before existing detection methods at the hospital had detected the diversion.

Milestone	Progress Achieved
1a) Detecting known diversion cases in unblinded, historical data.	• Worked with one hospital to compile a list of 15 diversion investigation cases • Extracted & consolidated historical data from five health IT systems at the hospital • Built advanced algorithms to detect suspicious dispensing transactions in the data • Applied these advanced algorithms to classify or "flag" suspicious transactions • Milestone 1a focused on three unblinded diversion cases, as an initial test • Confirmed our algorithms detected 100% (3 of 3) of the known diversion cases
1b) Detecting known diversion cases in blinded, historical data.	• Expanded analysis to 1850 nurses, including 9 known, "blinded" diversion cases • Applied algorithms to "flag" suspicious transactions across all 1850 nurses • Confirmed our algorithms detected 100% (9 of 9) of the blinded diversion cases. • Confirmed our algorithms detected 100% (9 of 9) of these diversion cases before the hospital first detected the diversion using existing methods.

What was even more promising from the initial Phase 1 Results was that the system correctly identified additional Health Care Workers that were currently undergoing active investigations, completely unknown to Invistics. In addition, using the historical data, Invistics used advanced reporting and heat maps to create views of data across clinical areas that has proved to be valuable for the organization in working collaboratively to address issues of sloppy practice versus potential diversion.



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Conclusions and What's Next?

Users of the technology saw value in more effectively detecting potential diversion while more efficiently being able to investigate diversion cases and work with hospital departments to collaboratively change practice patterns. Advanced dashboards and alerting take the solution towards real-time detection. Invistics is continuing with Phase II of the NIH Project and will expand current research to include 6 more hospitals, and test our hypothesis that the solution can detect previously undetected diversion with increasingly greater efficiency and effectiveness. To accomplish Phase II, Invistics will continue to refine our algorithms and machine learning to assign "Risk Scores" to transactions that can highlight non-compliant or suspicious transactions. All facilities participating will be asked to investigate known diversion and report confirmed diversion to Invistics.

To learn more about our Hospital Drug Diversion & Reporting solution, call Invistics at 1-800-601-3456 or visit us online:

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