

A Dashboard System Development Life Cycle Using the Waterfall Method

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Preventative care is widely understood to be of monumental importance in the effort to ensure public health. Unfortunately, gaps in screening or diagnostic follow up jeopardizes the health of ambulatory patients across the country (Selby, 2018). At Providence many of these gaps, especially colorectal cancer gaps, are missed by providers, and patients with positive fecal occult blood tests must be identified through reports. Nurse outreach end users receiving these reports must go through busy Tableau-generated spreadsheets manually, then access Epic and look up each patient in the EHR. They must then scour the medical record for evidence of diagnostics or the lack thereof, and if missing, contact each provider with a patient on the list. If a provider is not listed or is unresponsive after outreach, the outreach nurses must contact the patients directly. The next step in their workflow is to go back to the spreadsheet and document any patient outreach or provider communication.

The creation of a dashboard inside Epic which can interface with the patient record will facilitate a better workflow, remove the need for a Tableau report, remove the need for a separate patient working list spreadsheet, guide patient outreach prioritization, highlight pain points and other opportunities for workflow improvement, and track key performance indicators (KPI's). This dashboard will be utilized by end user outreach team nurses to easily identify patients in need of diagnostic follow up, efficiently document follow up once completed, and clearly see which patients no longer need outreach. Having a transparent, user-friendly interface will increase user satisfaction, process efficiency, and eliminate the need for workarounds. This paper will explore the software development life cycle (SDLC) deliverables of a transparent dashboard for the colorectal cancer care gap and will explain

the necessary activities while moving through feasibility, analysis, design, implementation, testing, and maintenance.

Feasibility

Using the TELOS strategy as explained by McGonigle and Mastrian (2021), feasibility will be determined by looking at technological and systems feasibility, as well as economic, legal, operational and schedule feasibility. It is through this exploration that a project plan and approximate budget can be created (McGonigle & Mastrian, 2021).

Technological and Systems

The first SDLC goal will be to secure Epic growth and expansion approval. The second goal will be to ascertain if there is someone within the organization that could develop the dashboard. If not, the informaticist conducting the feasibility study will need to procure the services of an Epic builder. It will be imperative that the informaticist keeps an excellent record of the project details, as dashboard extension into other care gaps should be expected once the colorectal cancer visualization proves successful.

Economic

The cost of dashboard development will vary depending on how much data will be flowing into it. The volume of patients is different for each region of the country, and therefore each instance, of Epic. This dashboard will capture patients in California and Oregon and will be built in the ORCA instance of Epic. The manual nature of the current colorectal gap workflow makes it easy to miss patients or lose track of them for extended periods of time, which increases the chances of patients developing colorectal cancer. A cost-benefit analysis will be important and will need to involve the organization's legal team, as

the cost of missed colorectal cancers must to be considered. This should include medical intervention costs as well as any financial losses related to litigation.

If an outside Epic builder is needed to create the dashboard, salary considerations will have to factor into economic feasibility. If an existing Providence professional can develop the software, an increase in their base-salary may similarly need to be budgeted. The source of financial resources will need to be explored as, though the dashboard will be utilized by ambulatory care nurses and ambulatory nurse leaders, the cost-savings and preservation of patient health and wellness from preventing colorectal cancers will be felt by the entire organization. The ambulatory arm of Providence should be ready to discuss a cost recovery strategy with the organization's chief executive.

Liabilities that could affect the project could include a higher number of defendants should a malpractice claim be initiated (Paterick et al., 2018). Having a team that is responsible for identifying patients that have failed to follow up regarding positive fecal occult blood tests could create liability for the organization, as optics on the outreach team's failure to follow up will be highlighted by the dashboard. This concern will need to be addressed in the design phase of the SDLC to assure that having the ability to visualize non-responsive patients translates into action.

Operational

To meet the needs of the organization and ensure the success of this project, the informaticist will serve as the project manager for the dashboard system. This will allow the informaticist to provide valuable analysis input and will maximize project consistency. Having governance over both the dashboard SDLC and the outreach team of end users, the informaticist will guide the project in mission and scope with replete vision.

The business problem associated with orphaned diagnostic tasks is the risk of disease development in the patient, and legal vulnerability for the primary care provider and the organization. One of the more impactful benefits of a care gap dashboard will be the ability to understand the time it takes an end user to get through an entire patient, from chart review to outreach. Having the information in a more organized visualization will make the outreach process faster.

The dashboard will increase efficiency and allow the informaticist the ability to monitor team progress, look for pain points, and determine nursing resource allocations. The dashboard will also be able to track outreach success and illness prevention, which will assist with cost recovery strategic planning. Economic considerations aside, there will be negligible impacts on outside stakeholders as the creation of this dashboard will only help the current team do what they are already doing, but in a more efficient, reliable manner.

Schedule Feasibility

The feasibility schedule will need to factor in the time it would take to achieve Epic growth and expansion permission, and to secure an Epic builder. Consideration will have to be given for how long it will take the design team to analyze the project, and to perform high and low-level design functions. Additionally, it will mean looking at the time it will take to train nurses to use the dashboard. This education will facilitate a return-on-investment in as early as one week, as the team's current workflow will be significantly reduced.

Schedule feasibility will have to include projections on implementation, testing, and maintenance, as future adjustments to the dashboard will be necessary. Prospective adjustments to the system must be anticipated, as HEDIS regulations could be revised to

reflect new evidence-based practice, just as they were for colorectal cancer screening ages in 2022 (National Committee for Quality Assurance, n.d.).

Analysis

The analysis phase of the waterfall model of SDDL should delve into functional requirements such as the goal and scope of the software, and non-functional system requirements such as pain points and impediments (Aroral, 2021). The system requirements, which are to allow the dashboard to serve both as a prioritization guide, working list, and productivity visualization, will necessitate partnership with Epic builders to construct a system that allows users to drill into the patient record.

The business needs of the organization include the need to monitor outreach team productivity, to understand how many full-time employees are necessary to manage the list of patients, and to create a workflow that maximizes user efficiency and reduces patient outreach delay. The configuration of the dashboard will need to be explored so that an accurate detail of the structure can be created (McGonigle & Mastrian, 2021). This exploration will need to result in a definitive configuration plan during the design phase.

Because the current working patient list is a spreadsheet and is not tied to the EHR, patient comments must be manually entered onto the spreadsheet to track ongoing outreach-team communication. By using the dashboard as the patient list, the patient name being represented by a summative number, the status of patient outreach could be identified by the nurse. Numbers in active sections of the dashboards will allow the user to modify patient placement on the tracker.

Using a hopscotch design, the workflow will cease to be the electronic equivalent of a piece of paper with various colors of ink, which is all that it is now. The dashboard will be a

usable visualization of where patients are in the spectrum of diagnostic follow up, and will serve as an intuitive interface for nursing documentation. This workflow will allow the user to be vastly more efficient and organized, reducing the risk of erroneous contact delays or inadvertent working list deletions.

There will be two major limitations to the dashboard. First, it will not be available on mobile devices as such portability is not warranted. Second, the dashboard will not function as a list of names. If a patient calls an outreach team member in response to a call they received, the nurse will not be able to go through the dashboard to find the patient. They will have to access Epic and type in the patient's medical record number, after which they can look up any activities done through the dashboard.

Though the care venue will be in an office setting and not open to patients or visitors, the visualization will not include patient names, as HIPPA concerns necessitate privacy protections. Outreach team nurses will be housed in cubicles within administrative ambulatory spaces. Because their work is repetitive in nature, frequent breaks will be expected, and alternative, non-repetitive duties will be built into their daily scheduled.

Design

During the high-level phase of design, development programs will need to be identified (McGonigle & Mastrian, 2021). The plan for system architecture will also be developed during this time. The design team will work together closely to assure that all stakeholders understand the information and functionality needed from dashboard (Shergil, 2022). Specifications will be detailed in this phase and will be transformed into a comprehensive document that will guide the developer's actions once the high-level phase is complete (Halwai, 2021). This document will provide a clean, non-redundant picture of the

project, including its goal, timelines, priorities, and expected milestones (Department of Information Technology, n.d.-a).

During the low-level phase of design, the design team will get into the specifics of program function (McGonigle & Mastrian, 2021). The team will use the comprehensive design document to create an interface design. This will map out how the dashboard will interface with the patient record and will identify the area of the EHR that will allow the user to signal that the gap has been satisfied. Once care gap satisfaction has been entered into the EHR by documenting and thereby modifying the health maintenance schedule, diagnostic disposition will be captured. Capturing the disposition will remove the patient from the active portion of the dashboard. This interface design will paint a picture of the dashboard's appearance and user experience. Much of the time spent in low-level design will be aimed at strategically teasing out the most important elements of data capture (Shergil, 2022).

Design documents will need to be catalogued and an archival system created so that stakeholders can access project information efficiently (Department of Information Technology, n.d.-a). Similarly, the availability of a well-organized document repository will allow the design team to keep track of lessons learned as well as successful processes that could be revisited (Halwai, 2021). An implementation plan will need to be created by the informaticist and the developer. The implementation plan will outline the various codes which will be utilized to create the dashboard. Epic is made up of several different types of code (Epic, 2020). As such, all programming languages utilized, Java, C+, etc. will be included in the plan.

Two dashboard vulnerabilities will be discussed: one being security and the other, legal. If this dashboard was created outside the EHR, additional security considerations

would have to be outlined and developed. Because the dashboard is within Epic, no new security measures need to be taken. In terms of legal vulnerabilities, the dashboard highlights when patient intervention through outreach is needed. The informaticist will develop educational materials which will include the importance of addressing non-compliant patients in a timely manner. A process for notification through certified letter will be developed and shared with users, their competence assured and documented post training.

Design tools or products will need to be explored, discussed, and agreed upon. While the design tool could be anything from a data model to a network diagram, (Department of Information Technology, n.d.-a), in the opinion of this writer, a prototype would be the ideal design product for the Epic dashboard project. Such a product would allow for dashboard function to be evaluated by end users, which would allow the informaticist to elicit feedback critical for assuring a coherent human-technology interface. The user experience is cardinal to the success of the dashboard, the goal being the creation of navigation system that is exceedingly transparent. Having a prototype will allow for the performance of a field study utilizing end users (McGonigle & Mastrian, 2021).

Once the prototype is built the field study will commence. The informaticist will partner with the developer and allow users to explore the dashboard. The design team will note any difficulties or areas of confusion and will assess how easy the dashboard is for the users to learn. Any adjustments to the design plan will be made based on feedback from the field study.

Implement

As explained by Kramer (2018), during this phase “Thorough and detailed documentation and mapping are necessary for the developers to implement the design and

develop the application” (p. 81). In the implementation phase, the informaticist will guide the process away from design and into production (Aroral, 2021). The deliverable of this phase should be a complete system, as well as supportive documents that will allow future dashboards for new care gaps to be created (Department of Information Technology (n.d.-b).

The developer will take the design and implementation plans and create the dashboard. The informaticist will compile related documents into the project repository and will monitor development progress and performance. Should problems arise, the informaticist must address and document them. Upon completion of the dashboard, the informaticist will create a post-implementation review report. This report will detail the efforts and activities completed during the implantation efforts and will assess how successfully and completely objective were met (Westland, 2018).

Testing

The five testing phases of the SDLC waterfall model will be used to evaluate the dashboard. The process will be initiated by examining the performance of individual modules of the program. The developer will inspect and challenge isolated pieces of code and assure the pieces are functioning properly (Ataman, 2023). Once individual modules of the program have been tested, integration testing will begin. The testing team will explore any integration issues, assuring that the dashboard is responding correctly to documented changes in patient status, and that once the gap is closed, the system automatically moves the patient into the inactive area of the dashboard.

Volume testing will be performed to confirm that the integrated EHR data has maintained its integrity. The testing team will monitor for data losses, will evaluate system speed and response time, and will look for any system failures or crashes (Rana, 2023). To

ensure that the dashboard is functioning correctly, the testing team will proceed to a system-wide test (McGonigle & Mastrian, 2021). Finally, beta-testing will be conducted. End users will be asked to click various tiles within the visualization to demonstrate their ability to drill into a report or data set. They will be asked to explore each tile systematically.

The users will be asked to examine their spreadsheet from the legacy working list and compare it to the information within the data sets. This will instill trust that the dashboard is an accurate representation of the information on the colorectal surveillance patients. To promote user acceptance of the interface, the outreach team will be directed to the “Success” tiles. Because the dashboard interface will contain all the patients that have received diagnostic intervention based on user outreach, it will allow the team’s productivity to be visualized. The informaticist will show users how to click on the Success tiles, demonstrating how easy it is to see team driven KPI’s.

Maintain

Dashboard maintenance will be performed by the developer, though maintenance efforts will be routinely evaluated by the informaticist. Any needed changes to the system will be performed and documented in the project repository for future insights. The informaticist will ensure quality management by eliciting regular feedback from end users, and by evaluating the effectiveness of the visualization’s ability to accurately reflect outreach team productivity. The informaticist will utilize performance reports to monitor KPI’s and track system performance. Program trouble reports will also be utilized to record system incidences, interruptions, or reductions in quality (Department of Information Technology, n.d.-c).

Regulatory requirements for care gap screening are likely to change based on evidence-based research. Therefore, the informaticist will need to monitor for such changes and assure that any new parameters are addressed by modifying dashboard reporting. Routine EHR and basic operating software maintenance and performance will continue to be provided by Providence information technology teams.

User satisfaction reviews will be disseminated to end users and collected by the informaticist to ensure that any practice changes or needs for replacement are identified. This will aid in relevance monitoring, will herald signs of obsolescence, and will help the informaticist to appreciate when it may be time to contemplate dashboard system retirement. Because the waterfall method is limited by its systematic, inflexible nature, the informaticist must be diligent in capturing and recording any modifications to the dashboard that would improve its performance for future iterations.

Conclusion

Using the waterfall method, this paper has explored the software development life cycle deliverables of dashboard implementation for the colorectal cancer care gap, including feasibility, analysis, design, implementation, testing, and maintenance. It has established the need for a vigorous information repository, as well as a multitude of tools needed for project monitoring and continued evaluation. Using an SDLC is crucial to the software development process. Though the waterfall method poses some limitations, it is an excellent tool for systematically working through the six phases of system development and aids the software development team in attaining the highest level of project control.

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