Published in final edited form as:

Eval Health Prof. 2017 September ; 40(3): 372–379. doi:10.1177/0163278716669793.

Improving initiation and tracking of research projects at an academic health center: A Case Study

Susanne Schmidt, PhD^{1,*}, Martin Goros, MS^{1,*}, Helen M Parsons, PhD, MPH¹, Can Saygin, PhD², Hung-da Wan, PhD², Paula K. Shireman, MD^{1,3}, and Jonathan A. L. Gelfond, MD, PhD¹

¹University of Texas Health Science Center at San Antonio

²University of Texas at San Antonio

³South Texas Veterans Health Care System, San Antonio, TX

Abstract

Research service cores at academic health centers are important in driving translational advancements. Specifically, biostatistics and research design units provide services and training in data analytics, biostatistics, and study design. However, the increasing demand and complexity of assigning appropriate personnel to time-sensitive projects strains existing resources, potentially decreasing productivity and increasing costs. Improving processes for project initiation, assigning appropriate personnel, and tracking time-sensitive projects can eliminate bottlenecks and utilize resources more efficiently. In this case study, we describe our application of lean six sigma principles to our biostatistics unit to establish a systematic continual process improvement cycle for intake, allocation and tracking of research design and data analysis projects. The Define, Measure, Analyze, Improve, and Control (DMAIC) methodology was used to guide the process improvement. Our goal was to assess and improve the efficiency and effectiveness of operations by objectively measuring outcomes, automating processes, and reducing bottlenecks. As a result, we developed a web-based dashboard application to capture, track, categorize, streamline and automate project flow. Our workflow system resulted in improved transparency, efficiency and workload allocation. Using the dashboard application, we reduced the average study intake time from 18 to 6 days, a 66.7% reduction over 12 months (January–December 2015).

Keywords

Lean Six Sigma; Project Tracking; Academic Biostatistics Units; Web-based dashboard; R shiny

Corresponding Author: Susanne Schmidt, PhD, Department of Epidemiology & Biostatistics, The University of Texas Health Science Center San Antonio, 7703 Floyd Curl Drive, Mail Code 7933, San Antonio, Texas 78229, Phone: (210) 567 0905, Fax: (210) 567 0921, Schmidts4@uthscsa.edu.

*Joint first authors

Conflict of Interest: The authors declare that there is no conflict of interest.

Introduction

Biostatistics and research design units at academic health centers (AHC) are central components of scientific advancements; driving translational research and developing new methodologies for studying the growing body of data collected through patient care and research. These units provide statistical expertise, study support, and research training for the AHC as a whole and play an important role as cores for center and program project grants. However, there is ever increasing demand and complex need for both data analytic expertise and teaching in a climate of declining resources (Enders & Conroy, 2014). The ability to objectively assess productivity and efficiency has become more important for justifying resource allocations in these units (Rubio et al., 2011; Welty et al., 2013). Actively tracking projects promotes operational awareness for identifying bottlenecks and efficiently directing resources. Previous work has suggested a number of metrics to evaluate productivity and collaboration of biostatistics units, including consultations, collaborations, education/training, mentoring, investigator satisfaction, grants, publications and other research outputs (Rubio et al., 2011). However, these metrics do not capture critical process flow metrics that can provide important insights into delays and inefficiencies in the pipeline for driving clinical and translational research.

The stakeholders in biostatistics cores include 1) investigators who use core services, 2) biostatistics faculty/staff, and 3) principle investigators of core support grants. We surveyed investigators who used our core to determine customer satisfaction needs. Transparency in resource allocation and project process flow with timely turnaround of deliverables were identified as priorities. Commercial project tracking products have limited customizability to collect operational metrics and assign projects. Our approach was guided by the lean six sigma framework, two integrated schools of thought for implementing process improvement. While “lean” focuses on streamlining processes to reduce waste and eliminate non-value added steps, “six sigma” seeks to make processes more uniform and precise. The integration of lean and six sigma builds upon the strengths of each tool and addresses the shortcomings of each (Schweikhart & Dembe, 2009). While these methodologies were first introduced in manufacturing environments to streamline and improve processes, lean six sigma has been successfully applied in a variety of settings, including healthcare systems (Ahmed, Manaf, & Islam, 2013; de Koning, Verver, van den Heuvel, Bisgaard, & Does, 2006; DelliFraine, Langabeer, & Nembhard, 2010). Previous applications in healthcare have targeted patient care processes, such as improving time to diagnosis by removing wasteful and non-value added activities from their processes (Martens et al., 2014). Other applications have improved clinical research practices by standardizing case report forms and implementing dashboards for monitoring key performance indicators (Glasgow, Scott-Caziewell, & Kaboli, 2010; Marti, 2005). For this descriptive case study (Yin, 2003), we developed a flexible, customizable project tracking tool which includes a web-based dashboard to capture, track, evaluate, and automate processes to identify bottlenecks, improve efficiencies, and reduce waste in our processes leading to more

Methods

For the scope of this case study, the biostatistics and research design unit of our AHC began collaborating with the Evaluation and Implementation Team (EIT) from our Clinical Translational Science Award (CTSA) to examine project flow of research design and data analysis projects in September 2014. For our study, we used the Define, Measure, Analyze, Improve, and Control (DMAIC) methodology of the lean six sigma framework to guide our examination. This five-step methodology combines project planning (Define), problem solving (Measure, Analyze, Improve), and sustained improvement (Control) into one improvement cycle. Based on lean and six sigma principles, the main objective of this case study was to enhance operational efficiency and effectiveness by identifying and removing bottlenecks from process flows.

Following the lean six sigma methodology, our examination took place in multiple phases. During the define phase, we examined both project intake procedures and process flows. Our previous process lacked uniform request intake procedures as well as formal project tracking, resulting in unfulfilled requests due to lack of follow-up. Hence, there was a need for an efficient system for tracking project requests and a means of determining demand for biostatistical and research design services. Further, minimal data was available to determine staff workload, availability, and efficiency. Given these deficiencies, we developed a system to actively track projects at all stages, identify and reduce bottlenecks in the process flow and allow for more efficient use of resources and allocation of staff efforts. First, we developed a web-based Study Intake form in REDCap (Harris et al., 2009), an online data capture tool, to streamline project intake by collecting general information from the investigators with information automatically saved in a REDCap database. Second, we defined data analytic project phases to describe the process flow of biostatistics and study design projects beginning with “Intake” (period from request to meeting with the collaborator), “Data Validation” (evaluation and cleaning of data), “Analysis”, “Results” (preparing tables and figures for publications), and “Completed” in addition to “Waiting on Investigators”, “Hold” (faculty/staff unavailability and/or project overload), “Manuscript Writing” and “Grant Writing”. These phases do not have to follow in a strictly ordered manner. A separate project “ticket” database was created to track projects, allowing faculty and staff to update project phases and input comments using “tickets” for each project. This database automatically migrated data from REDCap only requiring entry of updates for tracking process flow. To integrate the new Study Intake form database and the project ticket database, we developed a web-based tool called Department of Epidemiology and Biostatistics Interactive (DEBi) to combine these two key databases and develop an interactive dashboard to track project progress and operational metrics. We used the packages “shiny” (Chang, Cheng, Allaire, Xie, & McPherson, 2015) and “shinydashboard” (Chang, 2015) in R, a free and open-source platform for statistical computing and programming, to build the web application. “Shiny” allows for building customized, flexible, and interactive web applications in R, while “shinydashboard” extends these capabilities to create easy to use web-based dashboards. Over the course of the process improvement project, the programming behind the DEBi tool was refined based on biostatistics faculty and staff feedback.

Results

Our resulting process flow is detailed in Figure 1. Investigators interested in collaborating with our group complete the study intake form which automatically creates a new entry in the project database. “DEBi” automatically checks the REDCap database for new projects and sends automatic email notifications of new projects to all faculty/staff. Biostatistics faculty/staff update the status for ongoing projects using the department’s MyTime application, a departmental project entry tool used to track effort. DEBi pulls the status updates from MyTime to avoid the need for duplicate entries. Using the information stored in the project database, the DEBi dashboard provides descriptive statistics regarding the number of projects in each phase, lead times and provides an overview of workflow, project load and allocation using interactive graphics. The dashboard contains critical information for a number of operational metrics providing the foundation for weekly faculty/staff meetings to discuss project progress, identify potential bottlenecks and evaluate project allocation. These weekly meetings are also essential for identifying ways to further improve the tracking process and discuss future capabilities of the DEBi tool. Lastly, we have incorporated a feedback loop to gain insights into the investigators’ experience with our processes to identify and better address their needs.

Over 12 months we continuously measured and analyzed our operational metrics, including but not limited to study intake numbers and times, work load allocation and project completion. Within the first month of the process, we determined that scheduling initial appointments presented a bottleneck. The process was modified so that requests were redirected to an administrative assistant to schedule the initial meeting. Through the use of the DEBi dashboard, in conjunction with weekly project meetings, we reduced the average study intake time from 18 days (n=5) in January to 6 days (n=11) in December 2015; a 66.7% reduction over a 12 month period. In addition to streamlining the study intake process, we have a better understanding of the workflow of projects. Specifically, we are able to identify delayed projects and the causes. One major step in reducing project delays was to track how many active and inactive projects each staff member has at any given moment, providing critical information to allocate time to new projects. The systematic collection of requests revealed a difference between the investigator’s estimated workload compared to the actual workload. In fact, the median number of actual work hours was almost double the estimated number of work hours. The system also allows the estimation of institutional needs for services and the biostatistics unit’s capacity. On average 11.83 new studies were initiated per month (range=5–19; standard deviation=3.97) from January through December 2015. During this same period, the biostatistics unit completed 64 projects.

Conclusion and Next Steps

This case study highlighted bottlenecks in our processes by objectively tracking the phases of collaborative projects. We better balanced workloads among staff, avoiding stress and delays. Next, we will examine ways to prioritize projects and formally estimate capacity. In addition, operational metrics will be added to the project tracking dashboard to measure the numbers of projects completed within the deadlines provided by investigators at study

intake. This will provide a direct measure of efficiency and allow us to set benchmarks for further improvements. Furthermore, we have recently incorporated a project outcomes database to track publications, abstracts, and presentations and will soon include submitted and funded grant proposals that are linked to each project. This linkage will provide valuable information to improve the overall efficiency of conducting and disseminating translational research at our institution, and these metrics are highly relevant to statistics cores within center or program project grants. Automating the tracking of the numbers of collaborators, publications and grant applications facilitates the evaluation of and progress reports for these cores. The inclusion of these metrics provide objective measures demonstrating the biostatistics unit's contribution to the biomedical research enterprise and our dedication to continual process improvement.

Acknowledgments

Funding/Support: The project was supported by the National Center for Advancing Translational Sciences, National Institutes of Health, through Grant UL1 TR001120. The content is solely the responsibility of the authors and does not necessarily represent the official views of the NIH.

References

- Ahmed S, Manaf NH, Islam R. Effects of Lean Six Sigma application in healthcare services: a literature review. *Rev Environ Health*. 2013; 28(4):189–194. DOI: 10.1515/reveh-2013-0015 [PubMed: 24413212]
- Chang, W. shinydashboard: Create Dashboards with “Shiny”. R package version 0.5.1. 2015. <https://cran.r-project.org/web/packages/shinydashboard/index.html>
- Chang, W., Cheng, J., Allaire, J., Xie, Y., McPherson, J. shiny: Web Application Framework for R. R package version 0.12.2. 2015. <http://CRAN.R-project.org/package=shiny>
- de Koning H, Verver JPS, van den Heuvel J, Bisgaard S, Does RJMM. Lean Six Sigma in Healthcare. *Journal for Healthcare Quality*. 2006; 28(2):4–11. DOI: 10.1111/j.1945-1474.2006.tb00596.x
- DelliFraine JL, Langabeer JR 2nd, Nembhard IM. Assessing the evidence of Six Sigma and Lean in the health care industry. *Qual Manag Health Care*. 2010; 19(3):211–225. DOI: 10.1097/QMH.0b013e3181eb140e [PubMed: 20588140]
- Enders T, Conroy J. Advancing the Academic Health System for the Future - A Report from the AAMC Advisory Panel on Health Care: Association of American Medical Colleges. 2014
- Glasgow JM, Scott-Caziewell JR, Kaboli PJ. Guiding inpatient quality improvement: a systematic review of Lean and Six Sigma. *Jt Comm J Qual Patient Saf*. 2010; 36(12):533–540. [PubMed: 21222355]
- Harris PA, Taylor R, Thielke R, Payne J, Gonzalez N, Conde JG. Research electronic data capture (REDCap)--a metadata-driven methodology and workflow process for providing translational research informatics support. *J Biomed Inform*. 2009; 42(2):377–381. DOI: 10.1016/j.jbi.2008.08.010 [PubMed: 18929686]
- Martens L, Goode G, Wold JFH, Beck L, Martin G, Perings C, ... Baggerman L. Structured Syncope Care Pathways Based on Lean Six Sigma Methodology Optimises Resource Use with Shorter Time to Diagnosis and Increased Diagnostic Yield. *PLoS ONE*. 2014; 9(6):e100208.doi: 10.1371/journal.pone.0100208 [PubMed: 24927475]
- Marti F. Lean Six Sigma method in Phase 1 clinical trials: a practical example. *The Quality Assurance Journal*. 2005; 9(1):35–39. DOI: 10.1002/qaj.315
- Rubio DM, Del Junco DJ, Bhore R, Lindsell CJ, Oster RA, Wittkowski KM, ... Demets D. Evaluation metrics for biostatistical and epidemiological collaborations. *Stat Med*. 2011; 30(23):2767–2777. DOI: 10.1002/sim.4184 [PubMed: 21284015]
- Schweikhart SA, Dembe AE. The Applicability of Lean and Six Sigma Techniques to Clinical and Translational Research. *Journal of investigative medicine: the official publication of the American*

Federation for Clinical Research. 2009; 57(7):748–755. DOI: 10.231/JIM.0b013e3181b91b3a [PubMed: 19730130]

Welty LJ, Carter RE, Finkelstein DM, Harrell FE Jr, Lindsell CJ, Macaluso M, ... Ware JH. Strategies for developing biostatistics resources in an academic health center. Acad Med. 2013; 88(4):454–460. DOI: 10.1097/ACM.0b013e31828578ed [PubMed: 23425984]

Yin, RK. Case Study Research: Design and Methods. London: Sage Publications; 2003.

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

Figure 1. Project intake and tracking after the Lean Six Sigma process improvement project was implemented