The Trainee Digital Growth Chart:

Turning the Audit Logs of the Electronic Health Record into a Scalable, Automated Clinical Teaching and Assessment Tool

Names of individuals being nominated:

University of California Berkeley
School of Public Health
- Aaron Tierney, PhD Candidate

UCSF
Office of Graduate medical Education
- Suria Sadat (Education Technology Manager)
- Amy Day Rossa, EdD, MBA (Director of Graduate Medical Education)

Center for Clinical Informatics and Improvement Research
- Robert Thombley (Lead Data Architect)
- Benjamin Rosner, MD, PhD (Associate Professor, Project Lead)

School of Medicine Technology Office (SOMTech)
- Jonathan Prugh (Designer)

Office of Technology Enhanced Education, School of Medicine
- Sascha Cohen (Director, Technology Strategy & Development)

Pediatrics
- Glenn Rosenbluth, MD (Pediatrics, and Director, Quality and Safety Programs, Graduate Medical Education)
- Michelle Long, MD (Attending Physician)
- Karen Sun, MD (Attending Physician)
- Suni Kaiser, MD (Attending Physician)
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- Fatima Barragan, MD (Resident Physician)
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- Sarah Apgar, MD (Attending Physician)
- Cindy Fenton, MD (Attending Physician)
- Andy Lai, MD (Attending Physician)
- Tim Dyster, MD (Resident Physician)
- Justin Bullock, MD (Resident Physician)
- Erica Evans, MD (Resident Physician)

PROJECT NARRATIVE

Inspiration

The mission of the UCSF School of Medicine is to "Educate learners who will improve the health of our communities…[and to teach] graduates to excel in the competencies needed by 21st century physicians." In pursuit of that mission, the UCSF Center for Faculty Educators put out an Innovation Funds for Education grant opportunity to develop "New tools or strategies for assessing competency-based learning, including reporting performance [of resident physicians] in clerkships, and novel approaches to faculty training for common challenges such as learner assessment."

The following is a narrative of a truly outstanding 2-year collaboration across UCSF Health of over 25 individuals, and 7 departments, to develop a technology enhanced solution in service of the UCSF School of Medicine, in order to solve a decades long problem of how to bring objective data to bear in the education and assessment of trainees during the clinical phase of their training.

Background

Assessment of trainees (medical students and resident physicians) during their clinical clerkship years has long been a challenge. Unlike assessment in the didactic stages of training, assessment during clinical care relies on an engaged clinician educator to observe the many facets of the trainee's performance while also providing direct patient care and concurrently fostering a supportive and safe learning environment. These many tasks, carried out by the clinician educator in busy clinical settings, are in part, why clinical evaluations to be submitted by clinician educators often suffer from delay. Furthermore, in one study, over 50% of hospital attending physicians felt that they lacked sufficient information by the end of a trainee's block to supply an "adequate" evaluation. (1) Other challenges with the current modalities of clinical assessment, even those using standardized evaluation forms, include poor intra- and inter-rater reliability, as well as inference, recall, and implicit gender bias. (2-6)

In response to these challenges, there have been calls for novel assessment approaches that are automated, low burden, objective, realistic, and more reflective of skills required in 21st century medicine. (7-11) A thought piece on this topic noted that "Big data holds great promise to inform performance…[but] little effort has been directed toward exploiting big data to improve…education. Because our current system relies on faculty observations of competence, is it not unreasonable to ask whether big data in the form of clinical EMRs…can answer questions of importance?" (12)

Leveraging the audit logs of the electronic health record (EHR) - timestamped records of all activities carried out by a user during routine care - is a novel means of studying and assessing how trainees are providing care for their patients. Aggregating a trainee's audit log data into a usable performance dashboard could automate a process unobtrusively in the background as trainees carry out their routine care, and could provide learners and clinical teaching faculty alike objective performance data reflective of actual information gathering clinical skills, considered to be the foundation of clinical reasoning.

At the University of California San Francisco, funded by the Innovation Fund for Education and the Haile T. Debas Academy of Medical Educators, a large group of collaborators came together

to develop the first tool to our knowledge that automates the collection of audit-log based information gathering performance metrics of trainees over the course of their training in adult hospital medicine and pediatric hospital medicine.

Over the 2-year project period from April, 2020 to now, a broad array of collaborators came together in concert to yield the final product; the Trainee Digital Growth Chart (Figure 1). This project, with an initial cohort of 188 residents in Internal Medicine and 84 residents in Pediatrics, offers the promise of high scalability that offers the potential to be implemented across the over 2,000 medical trainees in all specialties at UCSF, as well as in any allied health field whose trainees use the electronic health record (e.g. Nursing, Physical/Occupational Therapy, Pharmacy). This approach can then become a model for other academic medical centers around the country.

Ideation, Buy in, and Funding

To be responsive to the funding opportunity, Dr. Rosner first began with stakeholder discussions from each of two residency programs (Pediatrics and Internal Medicine), as well as with leadership in the Graduate Medical Education (GME) Office, the Office of Technology Enabled Education (TEE), and the School of Medicine Technology (SOMTech) Office. Based on enthusiasm for the concept, letters of support that were provided, and personnel that were offered to the project, Dr. Rosner wrote a study proposal to the Innovation funding for Education grant and was fortunate to be selected as a fund recipient to carry out this novel project.

Off to the Races

At the project start, several lines of discovery and development began in parallel. First, because no benchmarks have ever existed describing the types of information gathering trainees should be responsible for as they mature through their training, Dr. Rosner, and Aaron Tierney, a PhD candidate, brought together 10 clinical teaching faculty from pediatrics and internal medicine, with whom, over the course of 6 months, they conducted a series of panels using a modified Delphi process to iterate to consensus on what types of information residents should be responsible for gathering at different stages of their training. This also involved REDCap surveys to faculty between each of the four sessions. Dr. Rosner and Mr. Tierney aggregated these consensus results into tabular format for handoff to the Lead Data Architect, Robert Thombley.

In parallel to this, Jonathan Prugh, a designer from SOMTech solicited participation from faculty as well as 6 residents from across both residencies to engage in user-centered design interviews. These interviews sought to identify the ways in which potential end users prefer to consume data and information, so that future dashboards could be designed with their preferences in mind. Over the course of 9 months, Jonathan iteratively developed design mockups that would, in their final state, be handed off to Mr. Cohen of the Technology Enhanced Education office for building.

Also in parallel, Suria Sadat and Amy Day Rossa of the Graduate Medical Education office helped identify the cohort of trainees from both residencies who were on inpatient Wards blocks over the prior three academic years so that audit log queries for these individuals could be written against the EHR Clarity database. In addition, Ms. Sadat began reviewing the literature for assessment tools that could be sent to users post-launch to help inform the team

about the adoption and usability of the tool, eventually landing on the System Usability Scale which she coded into REDCap.
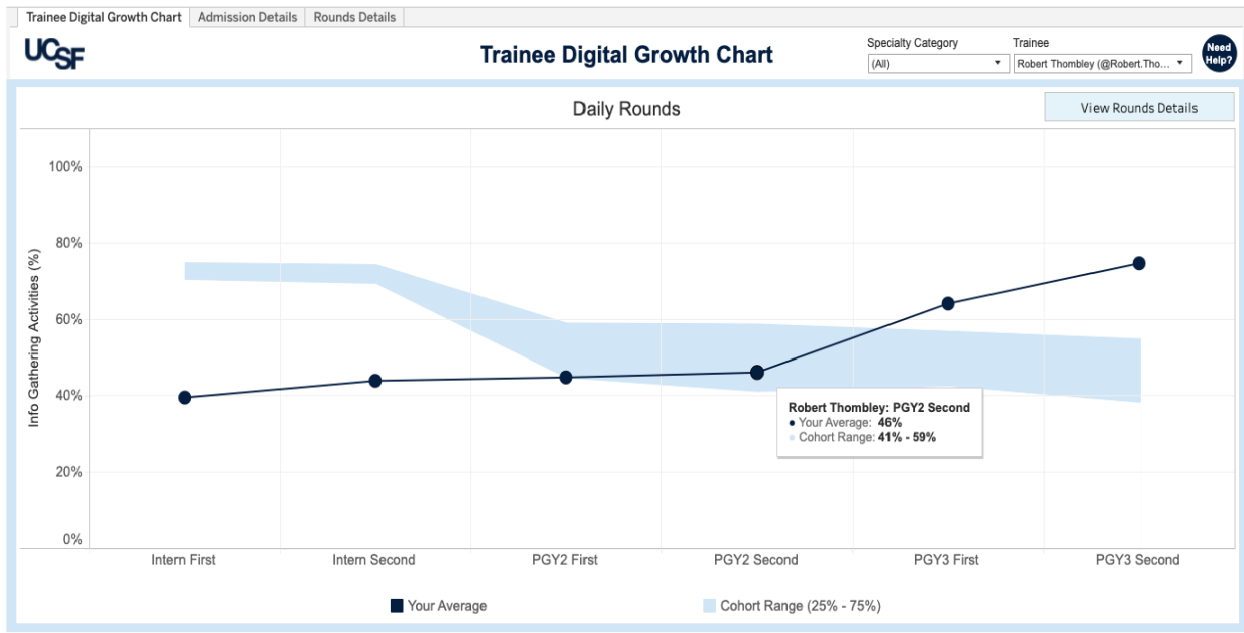
Procuring the Performance Data

Upon receipt of the tabular results from the faculty panels, Mr. Thombley and Dr. Rosner went through a series of iterations to identify all EHR activities that were unambiguously identifiable in the EHR audit logs. Once finalized, Mr. Thombley, an expert in the audit logs, wrote the queries, the aggregation rules, and the cohorting rules to report the numerator and denominator of performance for each trainee at each semester throughout training. He also broke these down by information type (e.g. vital sign review, Xray views, consultant notes viewer, etc.), and passed these data as well as trainee information to Mr. Cohen for the dashboard build and data population.

Building the Dashboards and Pushing them to Production

Mr. Cohen started with a landscape analysis to determine which data platform would serve end users with the greatest functionality and convenience. After determining that Tableau would serve this function best, He used the wireframe mockups supplied by Mr. Prugh and the data supplied by Mr. Thombley to build the interfaces consisting of desktop and mobile friendly graphical dashboards, each with tabular drill downs, and created both a test environment which was tested by Dr. Rosner and Mr. Thombley, as well as a Production environment. Dr. Rosner concurrently created a wiki, URL shorteners, and QR codes for the convenience of end users.

At the time of this writing, new users, both trainees and clinical teaching faculty are anticipated to go live with the tool before the end of the current academic year, and their feedback using the System Usability Scale will be solicited. The future of trainee clinical assessment, we believe, will increasingly rely on objective, automated, and low burden tools such as these, that will increasingly leverage clinically important and meaningful data from the EHR to guide trainees and support clinician-educators.

This first step along that journey represents a truly unique and tremendous collaboration of diverse stakeholders across the health system. Collaborations of teams like this represent the best of what the University of California has to offer; a shared belief in and collective enthusiasm about an end goal that unites a diversity of stakeholders and that will scale to ultimately improve the education of future generations of healthcare providers.

Trainee Digital Growth Chart

Specialty Category: (All)
Trainee: Robert Thombley (@Robert.Tho...)

Daily Rounds

View Rounds Details

Info Gathering Activities (%): 100%, 80%, 60%, 40%, 20%, 0%

Intern First | Intern Second | PGY2 First | PGY2 Second | PGY3 First | PGY3 Second

Robert Thombley: PGY2 Second
- Your Average: **46%**
- Cohort Range: **41% - 59%**

■ Your Average   ■ Cohort Range (25% - 75%)

Rounds Details

Specialty Category: (All)
Trainee: Robert Thombley (@Robert.Tho...)

Your % (Hover or Tap for Cohort 25% and Gold Standard %)

Back to Chart

EHR Activity	Intern First	Intern Second	PGY2 First	PGY2 Second	PGY3 First	PGY3 Second
Checked Lab Results	34%	43%	64%	65%	72%	75%
Viewed Consult Notes	21%	51%	53%	44%	80%	98%
Reviewed Orders from Others	75%	62%	47%	54%	69%	80%
Reviewed Home Meds during Encounter	65%	61%	46%	47%	-	-
Completed Home Med Rec	2%	2%	-	-	-	-
Viewed Case Manager Notes	-	-	37%	58%	58%	67%
Viewed PACS Images	-	-	29%	30%	43%	87%
Viewed Social Worker Notes	-	-	38%	25%	75%	73%

Robert Thombley: Reviewed Orders from Others - PGY2 Second
- Gold Standard: **100%**
- Your Average: **54%**
- Cohort 25%: **53%**
- Patient Days: **78**

Figure 1. Trainee Digital Growth Chart showing information gathering activities and growth over time, as derived from the EHR audit logs.

Citations

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