

Using EHR Audit Log Data for Service Time Estimation

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This deck: https://go.umd.edu/ama_ruc_92525

Outline

What is EHR Audit Log Data?

What does the audit log capture that other data sources do not?

An Example

Potential Pilot Studies

Time standards & service time estimates

Discussion

What is EHR audit log data?

Key Features

- A record (“log”) of what a user did inside the EHR
- Track user activity while logged into the EHR
- Originally designed to track access to charts
 - **Auditing** if anyone improperly accessed
- Who accessed which patient record at what time & actions taken (e.g., view, modify, delete)
- Can measure EHR-based clinical activity at scale
 - Historically done w/ time & motion studies



ASTP

Assistant Secretary
for Technology Policy

§170.315(d)(10) Auditing actions on health information

Certification Companion Guide (CCG)

Conformance Method

Updated on 05-28-2024

Regulation Text

Regulation Text

§ 170.315 (d)(10) Auditing actions on health information—

- (i) By default, be set to record actions related to electronic health information in accordance with the standard specified in § 170.210(e)(1).
- (ii) If technology permits auditing to be disabled, the ability to do so must be restricted to a limited set of users.
- (iii) Actions recorded related to electronic health information must not be capable of being changed, overwritten, or deleted by the technology.
- (iv) Technology must be able to detect whether the audit log has been altered.

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Limitations

Not purpose-built for research or post-hoc analysis

Does not capture the universe of clinical activity

- Lots of clinical activity occurs outside the EHR

Not eye-tracking; don't know what exactly the user is looking at

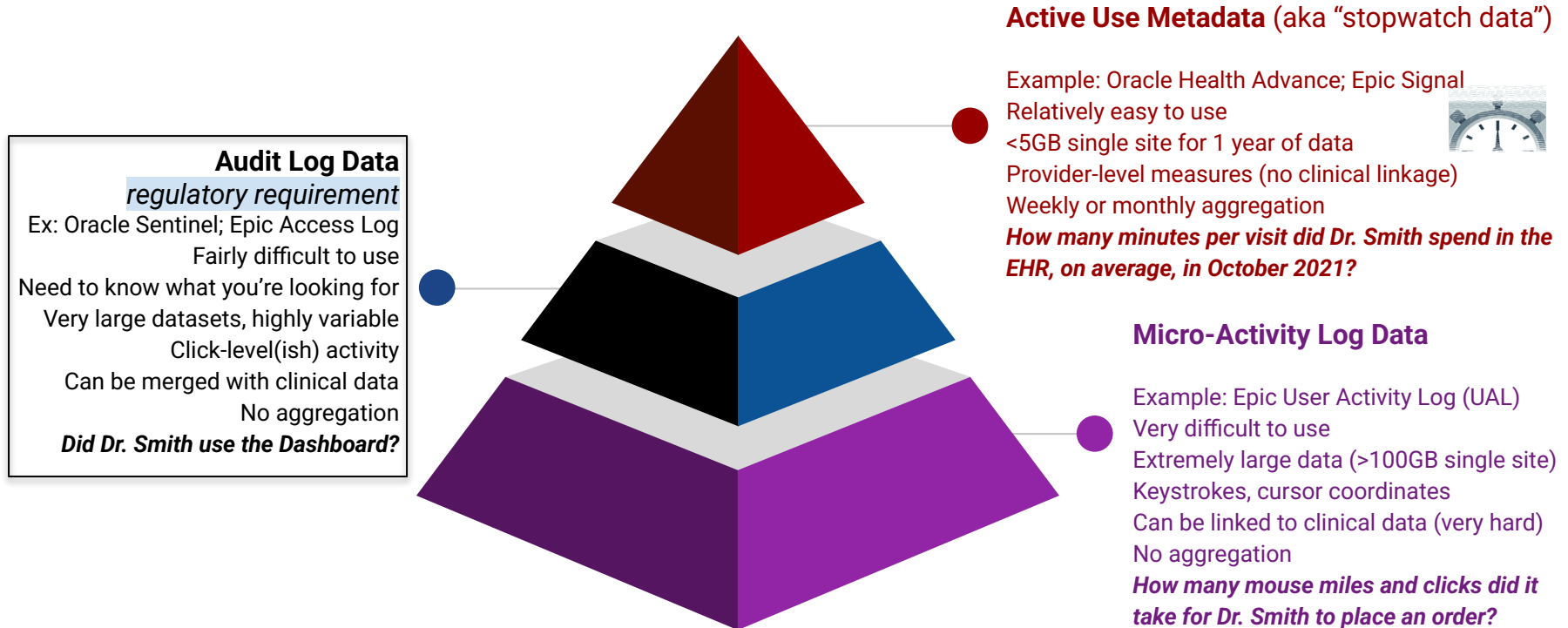
Limited in scope to the EHR system and anything integrated (e.g., bedside devices)

- Won't include information from other non-integrated technology used in care

Different **developers** capture different levels of detail in their audit logs (above the minimum requirements)

Different **organizations** configure more or less detailed auditing (above the minimum requirements)

Layers of log data you may be familiar with



Examples of studies using different layers of log data

National Comparison of Ambulatory Physician Electronic Health Record Use Across Specialties

A Jay Holmgren¹, Christine A Sinsky², Lisa Rotenstein³, Nate C Apathy⁴ 



JAMA Internal Medicine | [Original Investigation](#) | PHYSICIAN WORK ENVIRONMENT AND WELL-BEING

Physician EHR Time and Visit Volume Following Adoption of Team-Based Documentation Support



Nate C. Apathy, PhD; A. Jay Holmgren, PhD, MHI; Dori A. Cross, PhD

The Impact of Team-Based Ordering Workflows on Ambulatory Physician EHR Time, Order Volume, and Visit Volume

Nate C. Apathy^{1,2} | Alice S. Yan¹ | A. Jay Holmgren³



[Original Investigation](#) | Health Policy

Anesthesia Clinical Workload Estimated From Electronic Health Record Documentation vs Billed Relative Value Units

Sunny S. Lou, MD, PhD; Laura R. Baratta, BS; Daphne Lew, PhD, MPH; Derek Harford, BA; Michael S. Avidan, MBBCh; Thomas Kannampallil, PhD

What does the audit log actually look like?

id	visit_id	access_time	user_id	workstation_id	access_action	metric_id	metric_name	metric_desc	metric_group	event_action_type
105	103	3/15/2025 10:20:20	GgiTE2kR7vxlv	R24QF9ECHMG47	QUERY	20607	Storyboard viewed	AC_STORYLINE_VIEWED	EVENT AREA - PATIENT CLINICAL INFO	VIEW
106	103	3/15/2025 10:20:20	GgiTE2kR7vxlv	gYuaVsfxmenFVmē	QUERY	72026	Care Everywhere outside data auto-requested	CE_CHART_OVERVIEW_AUTO_RQST	EVENT AREA - PATIENT CLINICAL INFO	VIEW
107	103	3/15/2025 10:20:21	GgiTE2kR7vxlv	R24QF9ECHMG47	QUERY	20620	Visit Navigator template loaded	AC_VISIT_NAVIGATOR	EVENT AREA - PATIENT CLINICAL INFO	VIEW
108	103	3/15/2025 10:20:22	GgiTE2kR7vxlv	R24QF9ECHMG47	QUERY	20620	Visit Navigator template loaded	AC_VISIT_NAVIGATOR	EVENT AREA - PATIENT CLINICAL INFO	VIEW
109	103	3/15/2025 10:20:22	GgiTE2kR7vxlv	R24QF9ECHMG47	QUERY	17338	OurPractice Advisories displayed	MR_BPA_DISPLAYED	EVENT AREA - PATIENT CLINICAL INFO	VIEW
110	103	3/15/2025 10:20:22	GgiTE2kR7vxlv	R24QF9ECHMG47	QUERY	17126	Allergies activity accessed	MR_ALLERGIES	EVENT AREA - PROBLEMS	VIEW
111	103	3/15/2025 10:20:24	GgiTE2kR7vxlv	R24QF9ECHMG47	QUERY	17008	Report with patient data viewed	MR_REPORTS	EVENT AREA - PATIENT CLINICAL INFO	VIEW
112	103	3/15/2025 10:20:27	GgiTE2kR7vxlv	R24QF9ECHMG47	QUERY	20030	SmartLink used	AC_SMARTLINK_ACCESS	EVENT AREA - WORKFLOW	VIEW
113	103	3/15/2025 10:20:27	GgiTE2kR7vxlv	R24QF9ECHMG47	QUERY	20030	SmartLink used	AC_SMARTLINK_ACCESS	EVENT AREA - WORKFLOW	VIEW
114	103	3/15/2025 10:20:27	GgiTE2kR7vxlv	R24QF9ECHMG47	QUERY	20030	SmartLink used	AC_SMARTLINK_ACCESS	EVENT AREA - WORKFLOW	VIEW
115	103	3/15/2025 10:20:27	GgiTE2kR7vxlv	R24QF9ECHMG47	QUERY	20030	SmartLink used	AC_SMARTLINK_ACCESS	EVENT AREA - WORKFLOW	VIEW
116	103	3/15/2025 10:20:27	GgiTE2kR7vxlv	R24QF9ECHMG47	QUERY	20030	SmartLink used	AC_SMARTLINK_ACCESS	EVENT AREA - WORKFLOW	VIEW
117	103	3/15/2025 10:20:40	GgiTE2kR7vxlv	R24QF9ECHMG47	QUERY	17259	Patient SnapShot viewed	MR_SNAPSHOT_VIEWED	EVENT AREA - PATIENT CLINICAL INFO	VIEW
118	103	3/15/2025 10:21:22	GgiTE2kR7vxlv	R24QF9ECHMG47	QUERY	17158	Visit diagnoses viewed	VISIT_DIAGNOSES_VIEW	EVENT AREA - PROBLEMS	VIEW
119	103	3/15/2025 10:21:29	GgiTE2kR7vxlv	R24QF9ECHMG47	QUERY	60010	Pend clinical note	UCNNOTE_PEND	EVENT AREA - CLINICAL NOTES	MODIFY
120	103	3/15/2025 10:22:59	GgiTE2kR7vxlv	R24QF9ECHMG47	QUERY	60010	Pend clinical note	UCNNOTE_PEND	EVENT AREA - CLINICAL NOTES	MODIFY
121	103	3/15/2025 10:24:30	GgiTE2kR7vxlv	R24QF9ECHMG47	QUERY	17250	Problem List accessed	MR_PROBLEM_LIST_ACCESS	EVENT AREA - PROBLEMS	VIEW
122	103	3/15/2025 10:24:41	GgiTE2kR7vxlv	R24QF9ECHMG47	QUERY	49003	Visit diagnoses modified	VISIT_DIAGNOSES	EVENT AREA - PROBLEMS	MODIFY
123	103	3/15/2025 10:24:42	GgiTE2kR7vxlv	R24QF9ECHMG47	QUERY	17338	OurPractice Advisories displayed	MR_BPA_DISPLAYED	EVENT AREA - PATIENT CLINICAL INFO	VIEW
124	103	3/15/2025 10:26:45	GgiTE2kR7vxlv	R24QF9ECHMG47	QUERY	17008	Report with patient data viewed	MR_REPORTS	EVENT AREA - PATIENT CLINICAL INFO	VIEW
125	103	3/15/2025 10:26:59	GgiTE2kR7vxlv	R24QF9ECHMG47	QUERY	17008	Report with patient data viewed	MR_REPORTS	EVENT AREA - PATIENT CLINICAL INFO	VIEW
126	103	3/15/2025 10:27:14	GgiTE2kR7vxlv	R24QF9ECHMG47	QUERY	60010	Pend clinical note	UCNNOTE_PEND	EVENT AREA - CLINICAL NOTES	MODIFY
127	103	3/15/2025 10:27:15	GgiTE2kR7vxlv	R24QF9ECHMG47	QUERY	17108	Order list changed	MR_ENC_ORDERS	EVENT AREA - ORDERS	MODIFY
128	103	3/15/2025 10:27:16	GgiTE2kR7vxlv	R24QF9ECHMG47	QUERY	17008	Report with patient data viewed	MR_REPORTS	EVENT AREA - PATIENT CLINICAL INFO	VIEW
129	103	3/15/2025 10:32:57	LCRKrysbBBv' gYuaVsfxmenFVmē	QUERY	14200	Printing occurred	E_PRINT	EVENT AREA - WORKFLOW	EXPORT	
130	103	3/15/2025 11:14:42	LCRKrysbBBv' gYuaVsfxmenFVmē	QUERY	14200	Printing occurred	E_PRINT	EVENT AREA - WORKFLOW	EXPORT	
131	103	3/15/2025 11:20:41	LCRKrysbBBv' gYuaVsfxmenFVmē	QUERY	14200	Printing occurred	E_PRINT	EVENT AREA - WORKFLOW	EXPORT	
132	103	3/15/2025 11:32:57	LCRKrysbBBv' gYuaVsfxmenFVmē	QUERY	14200	Printing occurred	E_PRINT	EVENT AREA - WORKFLOW	EXPORT	

Credit: Penn Observer Repository (<https://observer.med.upenn.edu>), Epic ACCESS_LOG

What can we do with audit log data?

Rule A, Chiang MF, Hribar MR. Using electronic health record audit logs to study clinical activity: a systematic review of aims, measures, and methods. *JAMIA*. 2019.

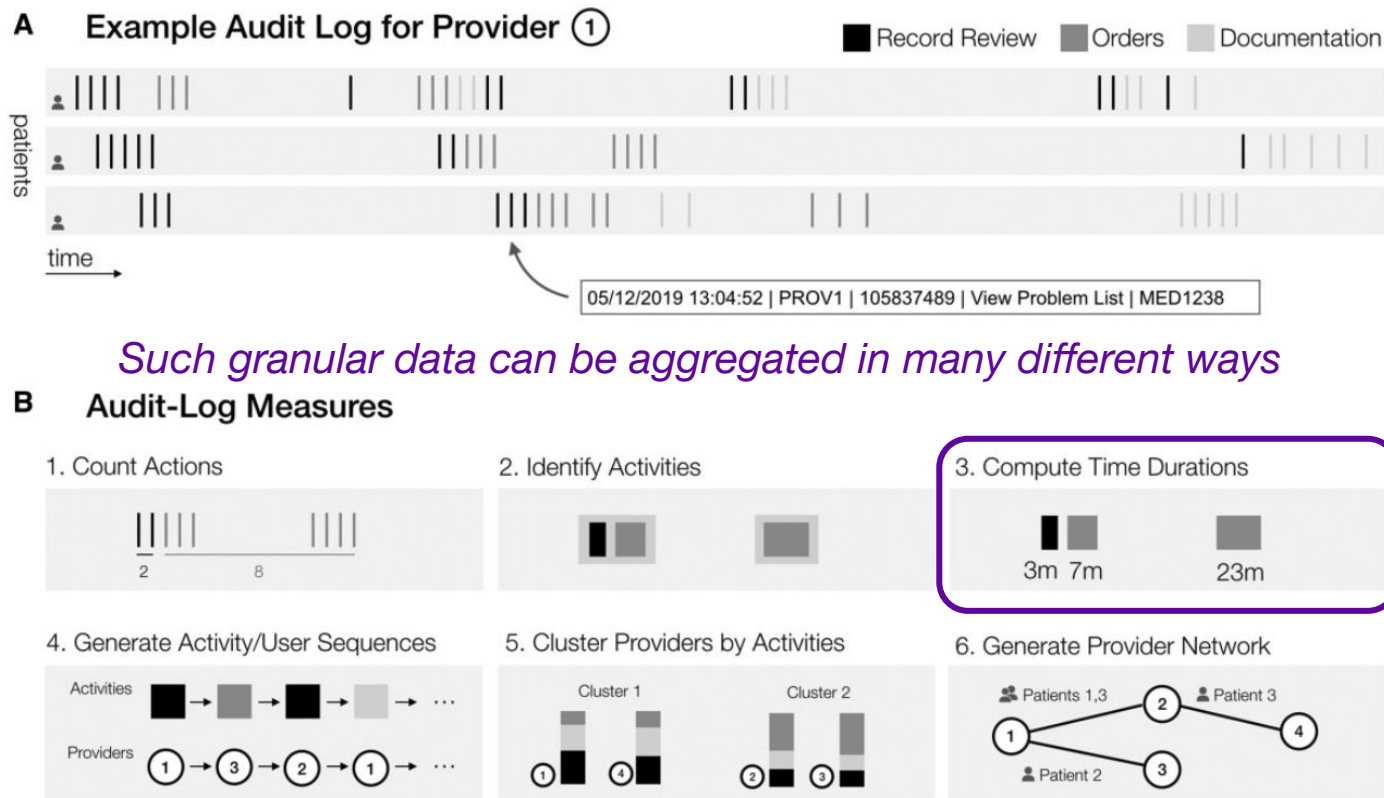


Figure 3. (A) Audit logs track actions EHR users perform in patient records. Here we show a simplified example of an audit log for 1 provider performing actions (eg, “View Problem List”) in 3 different patient records. We have already mapped these actions to 3 higher-level clinical activities (record review, orders, documentation). (B) Audit logs can be used to compute a variety of measures including simple measures such as (1) action counts, (2) higher-level activity counts, and (3) activity durations. These base measures may be used to create more complex models and measures such as (4) sequences of activities, (5) clusters of similar activity patterns, and (6) networks of providers based on their access of the same patient records.

What can this data source uniquely capture?

Major clinical “events” and their timestamps **do not require the audit log**

- Placing an order; completion of an imaging or lab test; completion of clinical documentation; completion of patient registration; etc.

The interstitial events that go into those major events **do require the audit log**

- Opening/closing a patient’s chart; incremental edits to documentation; initiating a registration workflow; the *sequencing* of a user’s workflow

For the AMA RUC use case, these interstitial events are more likely to be demarcations of pre/intra/post-service time, and they capture micro-activity across the entire clinical team relatively easily

Audit Log Actions for Example Patient Office Visit, March 15, 2025

Each point is one record in the audit log; color denotes different users

Example

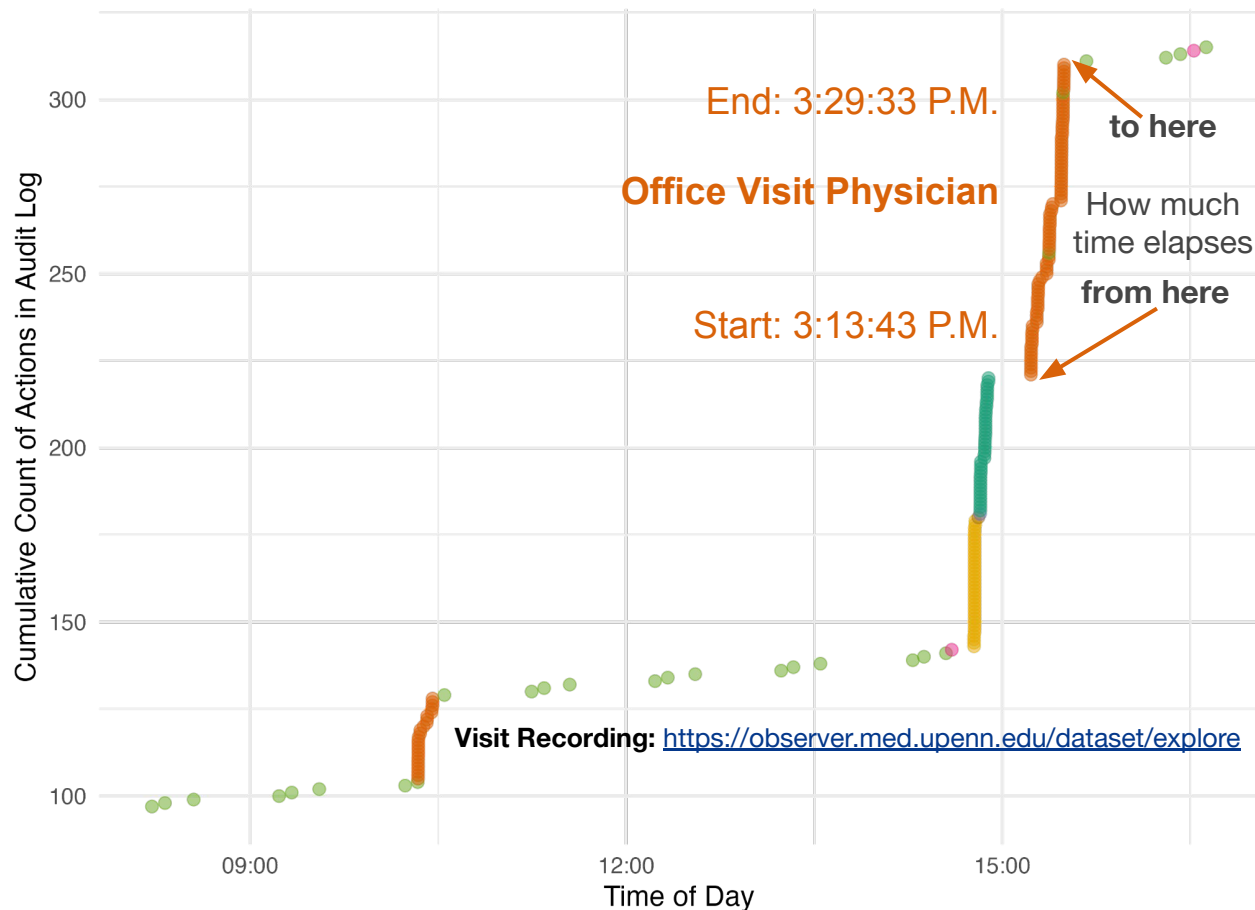
Face-to-face time
estimate from audit
log activity:

15min 50s

Face-to-face time
from visit recording:

17min 14s

84s or ~8.1% less time



Audit Log Actions for Example Patient Office Visit, March 15, 2025

Each point is one record in the audit log; color denotes different users

Example

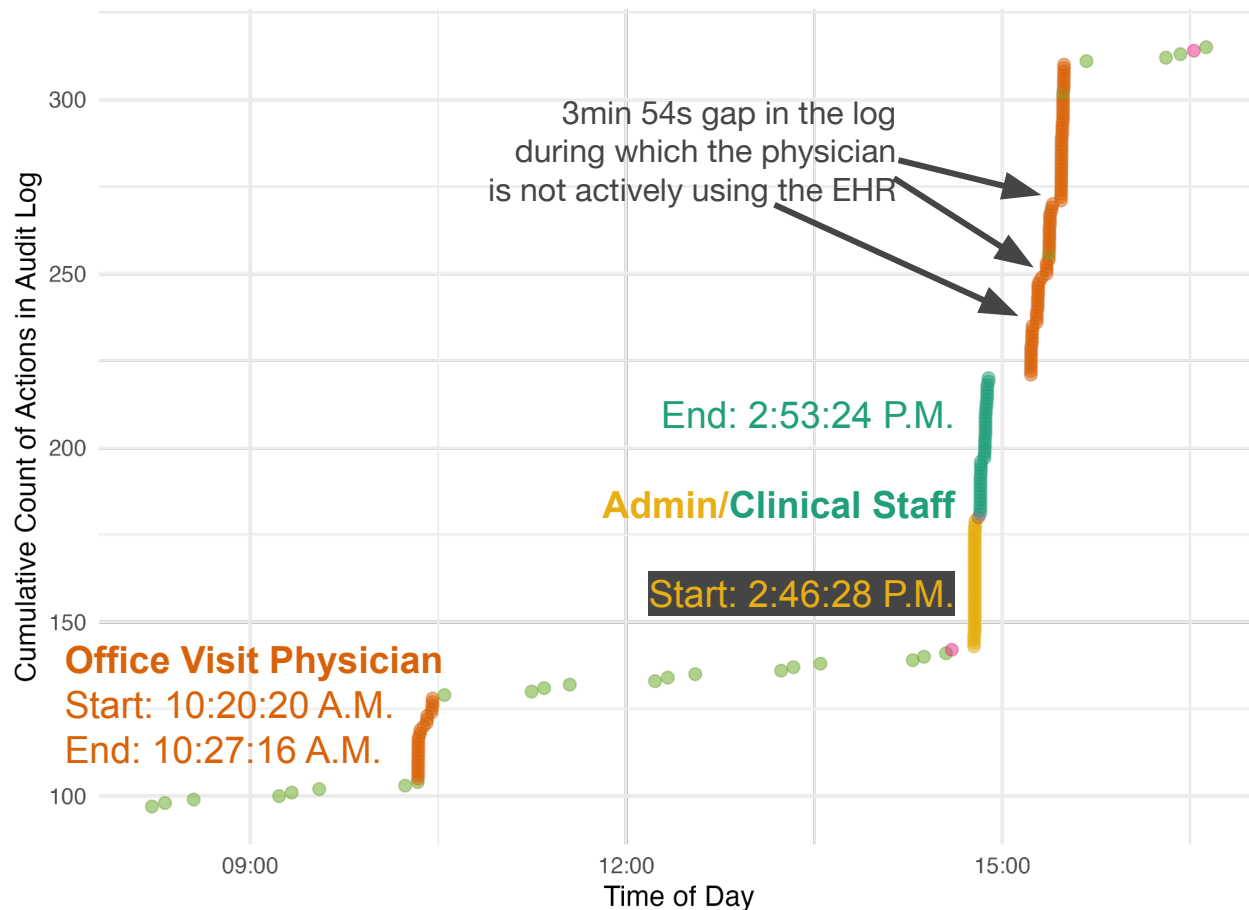
Staff time estimate
from audit log activity:

6min 56s

Time spent before
physician face-to-face
estimate from audit
log activity:

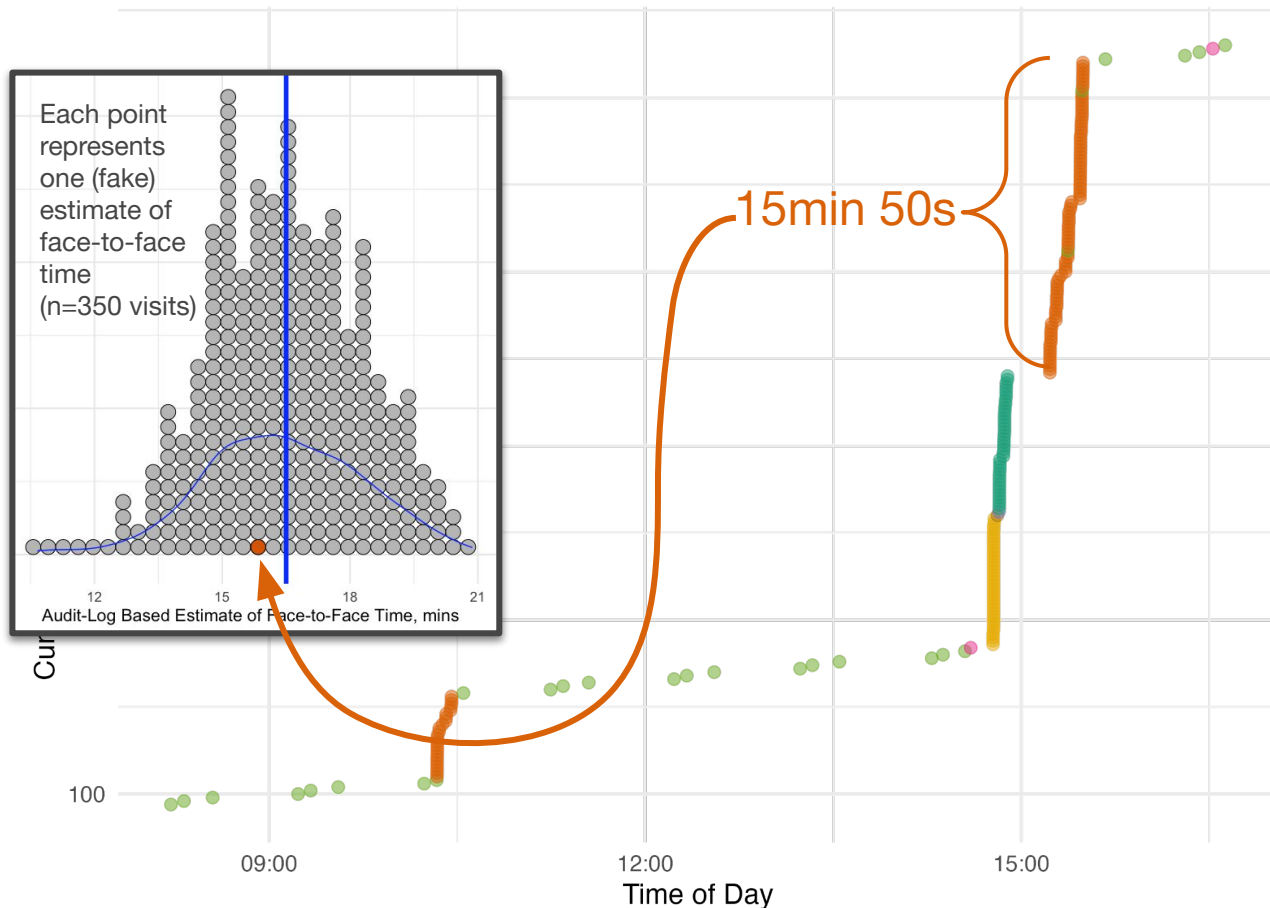
6min 56s

Total: 22min 46s



Example

Audit-log estimates of intraservice time can be analyzed collectively to get a sense of the overall average, variation, and reasonable bounds



Benefits of audit log-derived measures

Audit log data is systematically collected for all visits; can be organized by visit, patient, &/or user

Definitionally captures all activity in a given patient's chart (this is its core use case)

Can leverage start-points and end-points of “clusters” of activity to estimate time

- Can develop & apply rules for start/end points (e.g., specific action vs. any action)
- Can observe the *initiation* of specific workflows (e.g., registration)

Face-to-face time with the patient can be inferred and accounted for, as long as it is surrounded by some EHR use

Can combine context about the user, volume & nature of activity, and duration

Very easily de-identified while maintaining utility for measurement

Replicable across organizations (easier w/ same EHR vendor, but possible w/ different vendors)

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Drawbacks of audit log-derived measures

Hard to account for workflow, staffing, and teamwork differences across physicians and organizations (but we have the law of large numbers on our side)

Difficult (if not impossible) to capture *cognitive* intensity of work; this is a major potential issue for primary care specialties in particular

Can underestimate active time for activities that predominantly involve non-logged behavior (e.g., reading & writing notes)

Each CPT code will likely have slightly different ways to define start/stop times in the audit log (but we can observe these and design them in)

Potential pilot study of physician & staff time standards

1. Select sample of time standards (e.g., operative note, 5 mins)
2. Extract logs for sample of procedures (n=150) to which that standard applies
3. Identify the specific logged events that correspond to the activity
 - a. For example, all note-related events (see table, below)
4. Develop rules to determine start/end-points of specific activity in the log
5. Apply rules across procedure sample to estimate duration at scale
6. Construct distribution of activity durations to apply to CPT codes

visit_id	access_time	metric_id	metric_name	metric_desc
103	3/15/2025 10:21:29	60010	Pend clinical note	UCNNOTE_PEND
103	3/15/2025 10:22:59	60010	Pend clinical note	UCNNOTE_PEND
103	3/15/2025 10:27:14	60010	Pend clinical note	UCNNOTE_PEND
103	3/15/2025 15:23:30	60012	Clinical Note Signed	UCNNOTE_SIGN
103	3/15/2025 15:28:48	60012	Clinical Note Signed	UCNNOTE_SIGN
103	3/15/2025 15:29:27	60010	Pend clinical note	UCNNOTE_PEND
103	3/15/2025 15:29:28	34005	Notes viewed	VIEW_CLINICAL_NOTES
103	3/15/2025 15:29:33	60024	Clinical Note Signed as Visit Signed	UCNNOTE_SIGNATCE

Potential pilot study for audit-log service time estimates

1. Select a (small) sample of 5-10 CPT codes
 - a. Record contemporaneous EHR activity (who, what, & when) that proxies start-points and end-points of pre/intra/post-service time
2. Extract audit logs for observed procedures *and* larger (but not directly observed) sample of the same procedure (set some minimum n like 150)
3. Match observation data to audit logs for observed sample to construct rules for start/end-points
4. Apply those rules to unobserved sample to compute service time estimates at scale
5. Construct distribution (mean, median, IQR, etc.) of pre/intra/post-service time estimates for observed and unobserved samples
 - a. Compare to survey estimates

Thank you!

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More Information

Overview of Oracle Health (fmr. Cerner)
log data: bit.ly/nca_cernlogs

Recent studies of documentation
burden using log data: bit.ly/nca_doc

AMA-funded study of team-based
ordering using log data: bit.ly/tword_hsr