

Seeing CLIR-ly: Policy-relevant Insights from UCSF's Center for Clinical Informatics and Improvement Research

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UCSF

Osher Mini Med School

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CENTER FOR CLINICAL INFORMATICS AND IMPROVEMENT RESEARCH

VALUES

We are a collaborative research center that believes in the importance of maximizing the impact of digital health on health system performance.

MISSION

CLIR uses innovative approaches to advance discovery of how to improve the use and impact of digital health on health outcomes.

VISION

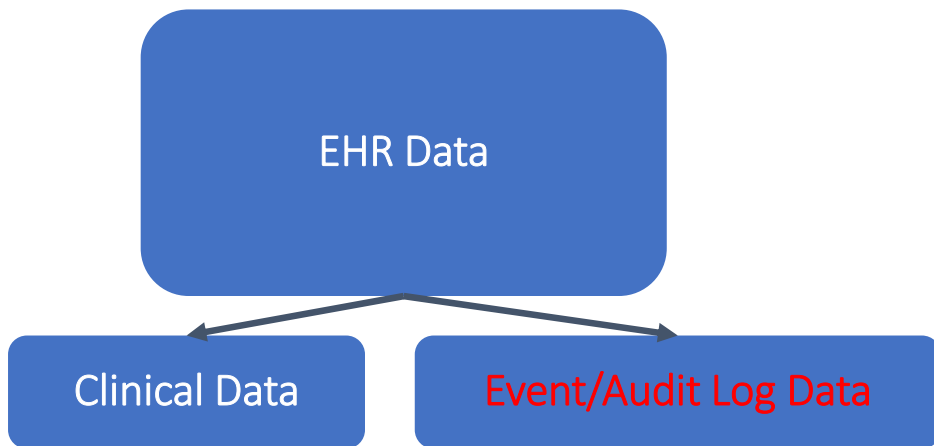
CLIR leverages data from UCSF and UC Health to serve as a learning lab and leading academic research and policy hub in digital health.

MOTIVATION

While EHRs have been widely implemented, we do not yet understand how to use them and other sources of digital data to *improve the clinical decisions* that drive the quality and cost of care.

Opportunity to Derive New Insights from Enterprise EHR Data – Beyond Clinical Data

ENTERPRISE DATA SOURCES



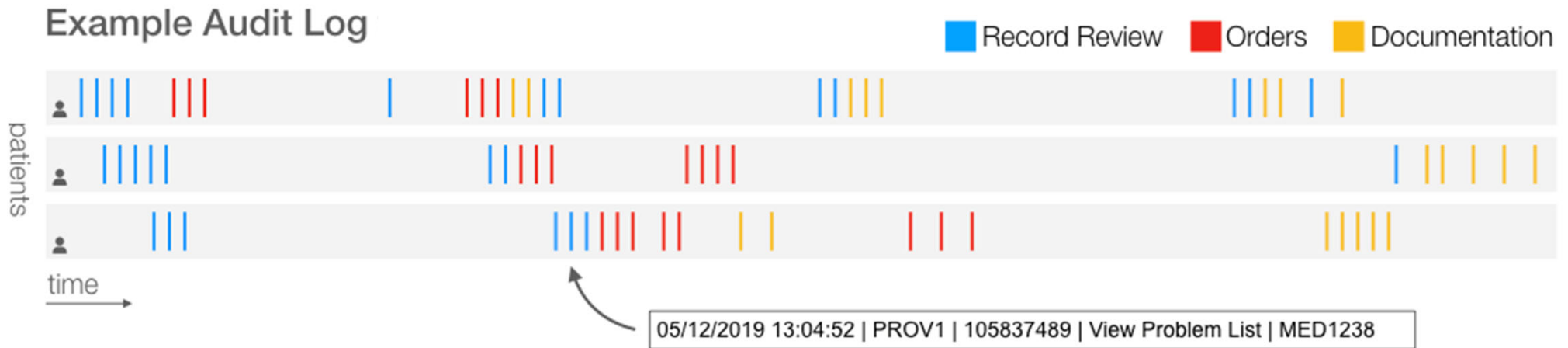
AUDIT LOG DATA:

Captures *who* is doing *what* and *when* – to measure e.g.,

- What information is viewed before making a decision or before an adverse event
- Communication patterns with patients or other providers

Offers a novel window into clinical decision making and healthcare delivery processes to better understand what predicts good/bad outcomes

Audit Logs

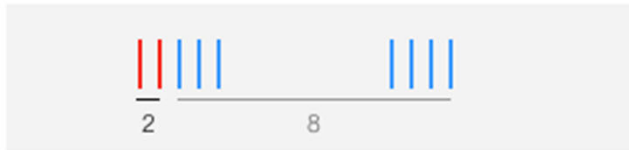


Log entries contain:

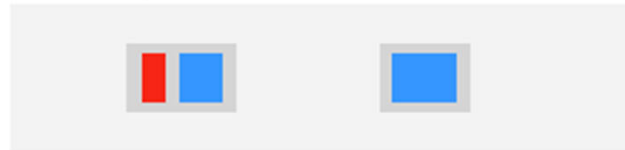
- Who accessed
- What patient
- When
- What action

Audit Log Measures

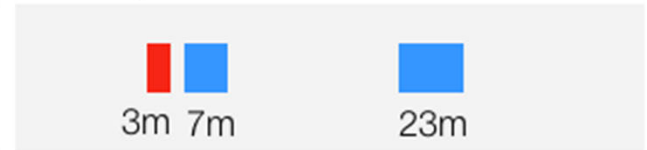
1. Count Actions



2. Identify Activities



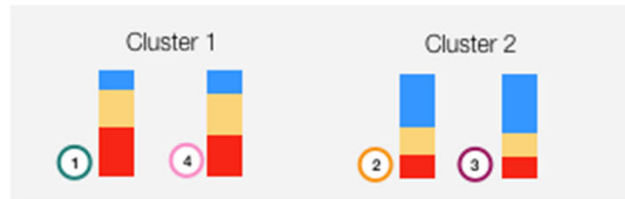
3. Compute Time Durations



4. Generate Activity/User Sequences



5. Cluster Providers by Activities



6. Generate Provider Network



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. To appear.

CLIIR Research “Pillars”

Interoperability: Adoption, Use, & Impact

Clinician and Care Team Work & Well-being

Digitally-enabled Patient Engagement

Event/Audit Log Data

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Project 1: Policy Context

Interoperability of health data is a major policy priority

>80% of US hospitals exchanging data electronically

But, 34% of those hospitals report rarely or never using outside data available electronically.

When asked why, they said:

Table 2: Reasons for rarely or never using patient health information received electronically from providers or sources outside their health system when treating patients, 2017.

Reason	2017
Difficult to integrate information in EHR	55%
Information not always available when needed (e.g. timely)	47%
Information not presented in a useful format	31%
Information that is specific and relevant is hard to find	20%
Information available and integrated into EHR but not part of clinicians' workflow	16%
Do not trust accuracy of information	10%
Vocabulary and/or semantic representation differences limit use	7%

Source: 2017 AHA Annual Survey Information Technology Supplement.

Notes: *Significantly different from previous year ($p < 0.05$).

Project 1: Impact of Changing User Interface Design on Viewing of Outside Records

The screenshot displays the Epic EMR interface for patient Kelly Galvan. The top navigation bar includes 'Epic', 'ED Manager', 'ED Track Board', 'ED Map', 'In Basket', and 'ED Chart'. The patient's name 'Galvan, Kelly' is shown in the top left, along with a search bar for 'JESSIE TRAUMEL'.

The patient's demographic and clinical information is displayed in a header section:

- Galvan, Kelly**, Male, 55 y.o., 08/04/1964
- TT: 00:33, Rm: CC 02, Code: Not on file
- Att: EDDISON, C, RN: None, Acuity: 4
- T: 36.8 °C, HR: 68, BP: 110/72, W: 79.5 kg
- Allergies/Reactions: Penicillins, Sulfa Drugs
- Ins: Epic Ins, MRN: 35791, MyChart: Active, PCP: Marty Seeger

The main area is titled 'Chart Review' and features a navigation menu with options like 'Encounters', 'ED Visits', 'Labs', 'Imaging', 'Procedures', 'ECG', 'Other Orders', 'Medications', 'Episodes', 'Letters', 'Notes', 'Misc Reports', and 'Media'. Below this menu are various filters and tools, including 'Preview', 'Refresh (9:43 AM)', 'Select All', 'Deselect All', 'Review Selected', 'Side-by-Side', 'Synopsis', 'Lifetime', 'Flowsheet', 'Route', 'Load Remaining', 'Encounter', and 'Add to Bookmarks'.

The 'Encounters' table is the central focus, showing a list of patient visits:

When	Type	With	Description
Today	ED	EM - Eddison, C	
6 Months Ago			
03/20/2019	Office Visit	Family Medicine - Benn...	Urinary tract infection, site not sp...
1 Year Ago			
09/01/2018	Office Visit	Family Medicine - Benn...	UTI (urinary tract infection) (Prim...
08/24/2018	Office Visit	Family Medicine - Seeg...	Diabetes mellitus, type 2 (Primary...
08/24/2018	Brief Office visit	Family Medicine - Seeg...	
3 Years Ago			
01/23/2016	Office Visit	Family Medicine - Walke...	Diabetes mellitus type II (Primary...
11/09/2015	Colonoscopy	GI - Davis, P	
02/22/2015	Office Visit	Ophthalmolog - Kadil, T	Screening for eye condition (Prim...
01/02/2015	Office Visit	Ophthalmolog - Kadil, T	Screening for eye condition (Prim...
12/29/2014	Office Visit	Fam Med - Walker, D	Type II or unspecified type diabet...
5 Years Ago			
06/01/2014	Office Visit	Fam Med - Walker, D	Diabetes mellitus (Primary Dx); H...
05/30/2014	Brief Office visit	Family Medicine - Gardn...	Essential Hypertension (Primary...
05/21/2014	PCP/Clinic Change		
05/20/2014	Office Visit	Fam Med - Stadler, J	Pure hypercholesterolemia; Esse...
01/04/2014	Office Visit	Family Medicine - Gardn...	Osteoarthritis of knee (Primary D...

The right-hand pane provides a detailed view of the 'Office Visit' on 3/20/2019 at the Verona Medicine Clinic. It includes:

- Office Visit** (3/20/2019, Verona Medicine Clinic)
- Location: River Hills Health System
- Encounter Summary: Mr. Kelly Galvan - 54 y.o. Male; born Aug. 04, 1964
- Reason for Visit:** Genito-urinary Problem
- Encounter Details:**

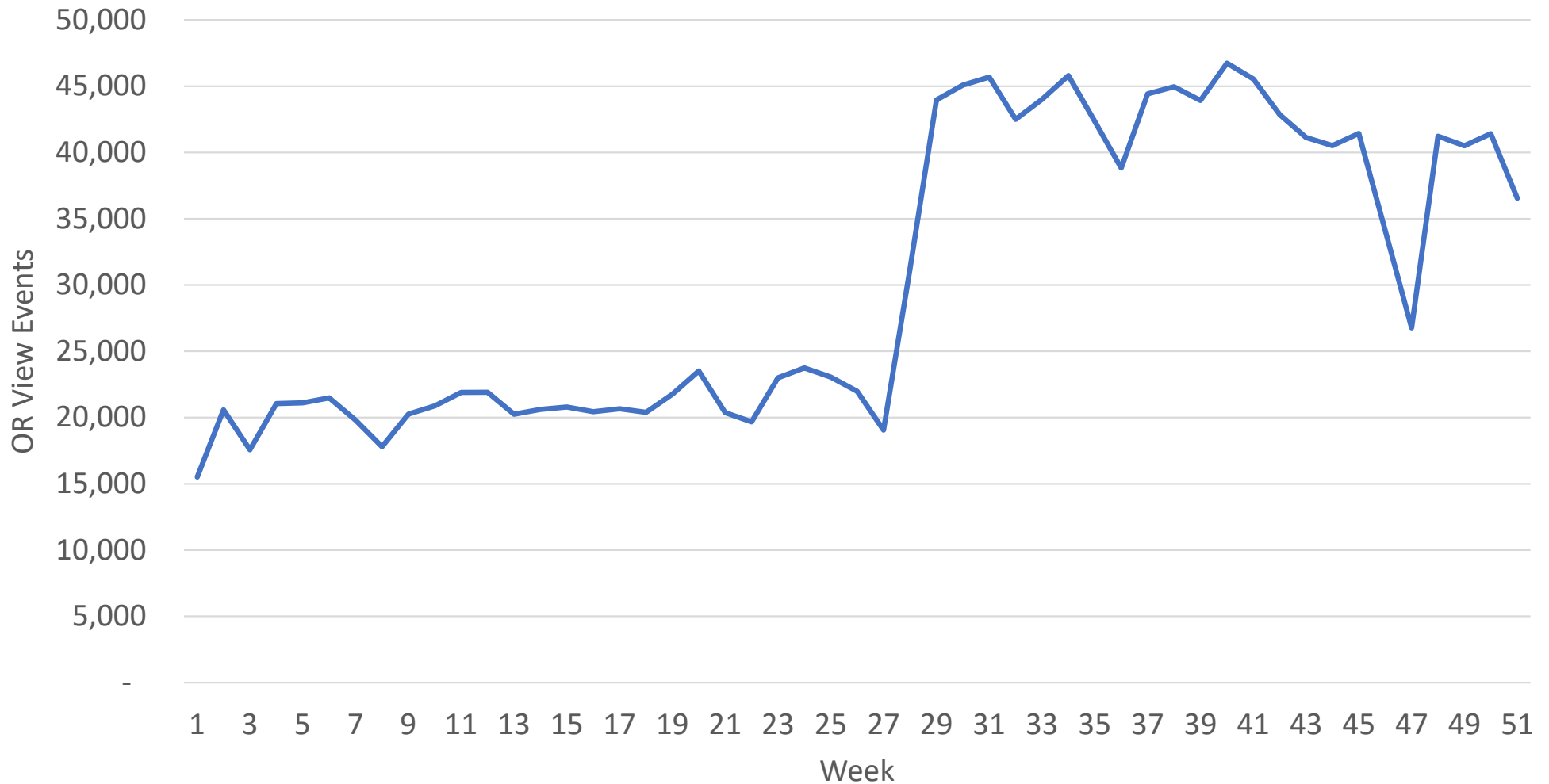
Date	Type	Department	Care Team	Description
03/20/2019	Office Visit	Verona Medicine Clinic 25 Northern Lights Ln VERONA, WI 53593 608-303-2340	Bennett, Dana, M.D. 1979 Milky Way VERONA, WI 53593 608-271-9000 608-255-6192 (Fax)	Urinary tract infection, site not specified (Primary Dx)
- Social History:** documented as of this encounter

Tobacco Use	Types	Packs/Day	Years Used	Date
Former Smoker	Cigarettes	1	20	Quit: 05/14/3466

Comments: Quit smoking following episode of hemoptysis, negative bronchoscopy
- Alcohol Use:**

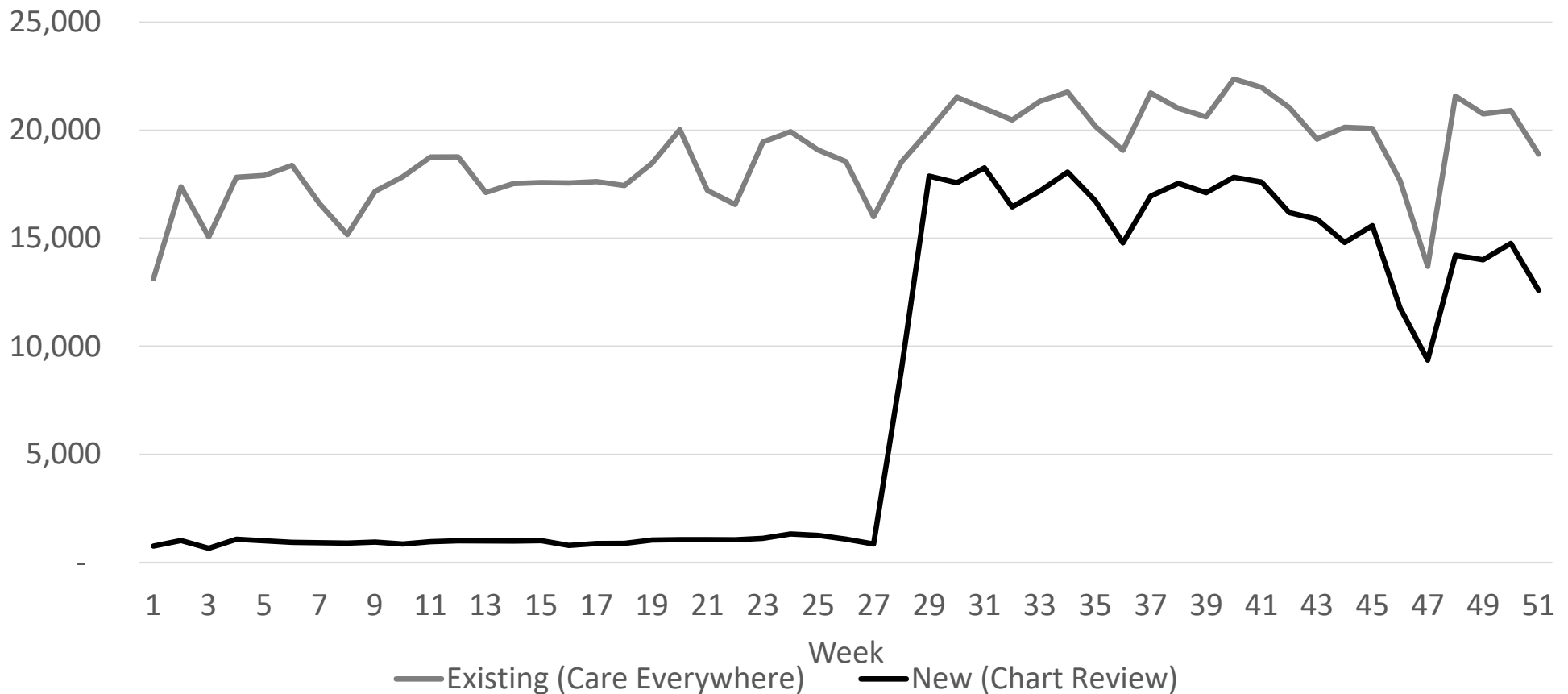
Alcohol Use	Drinks/Week	oz/Week	Comments
Yes		1.0	Beer or wine on weekend
- Sex Assigned at Birth: [Blank], Date Recorded: [Blank]

Impact of Integrated Encounters on Viewing of Outside Records



Significant increase in level: 29,921 outside record views per week ($p < 0.001$)

Impact of Integrated Encounters on Viewing of Outside Records: via Chart Review versus Care Everywhere



Almost all of which came via the “new” channel (16,600 per week; $p < 0.001$)

No substitution of CR pathway for CE pathway; net gain

And now on to studying lab result integration...

Went live 10/2019

The screenshot shows a 'Chart Review' window with a navigation bar at the top containing 'Snapshot', 'Chart Review', and 'Problem List'. Below the navigation bar are tabs for 'Encounters', 'Notes', 'Labs', 'Micro', 'Pathology', 'Imaging', 'Cardiology', 'Procedures', 'Scan Clin', 'AD/POLST/Legal', 'Scan Admin', 'Letters', 'Referrals', and 'Anesthesia'. A toolbar includes options like 'Preview', 'Refresh (12:44 PM)', 'Select All', 'Deselect All', 'Review Selected', 'Lab Flowsheet', 'Route', and 'Add to Bookmarks'. A filter section contains checkboxes for 'Hide Canceled', 'John Muir Results', 'Marin Results', 'Exclude POCT', 'BCHO Results', 'UCSF Results', 'Kaiser Results', 'In process', 'Ordered / Future', 'Blood Bank', and 'Care Everywhere Resu...'. A yellow warning banner states: 'To save time not all records have been loaded and sorted. Load All Records Now Hide'. Below this is a table with columns: CE, Ordered, Result Date, Collect Date/Time, Test, Specimen, Status, Result, and Ordering Provider. The table is divided into 'Recent' and '1 Year Ago' sections. The first row in the 'Recent' section is highlighted in blue and has a red box around its 'CE' column. The 'Kaiser Results' checkbox in the filter section also has a red box around it.

CE	Ordered	Result Date	Collect Date/Time	Test	Specimen	Status	Result	Ordering Provider
	03/23/2020	03/24/2020	03/23/2020 15:55	COVID-19, PCR (EXTERNAL RESULT)		Final result		Provider, Generic Extern
	11/19/2019	11/25/2019	11/19/2019 17:00	FUNGAL CULTURE		Final result	Abnormal	Provider, Generic Extern
	01/30/2019	01/31/2019	01/30/2019 19:05	CHLAMYDIA + GC, SWAB, AMPLIFIED PROBE		Final result		Provider, Generic Extern
	10/08/2018	10/11/2018	10/08/2018 13:00	FUNGAL CULTURE		Final result		Provider, Generic Extern
	10/08/2018	10/09/2018	10/08/2018 13:00	CHLAMYDIA + GC, SWAB, AMPLIFIED PROBE		Final result		Provider, Generic Extern

CLIIR Research “Pillars”

Interoperability: Adoption, Use, & Impact

Clinician and Care Team Work & Well-being

Digitally-enabled Patient Engagement

Event/Audit Log Data

Clinician EHR Use During COVID-19

Evidence from National EHR Metadata

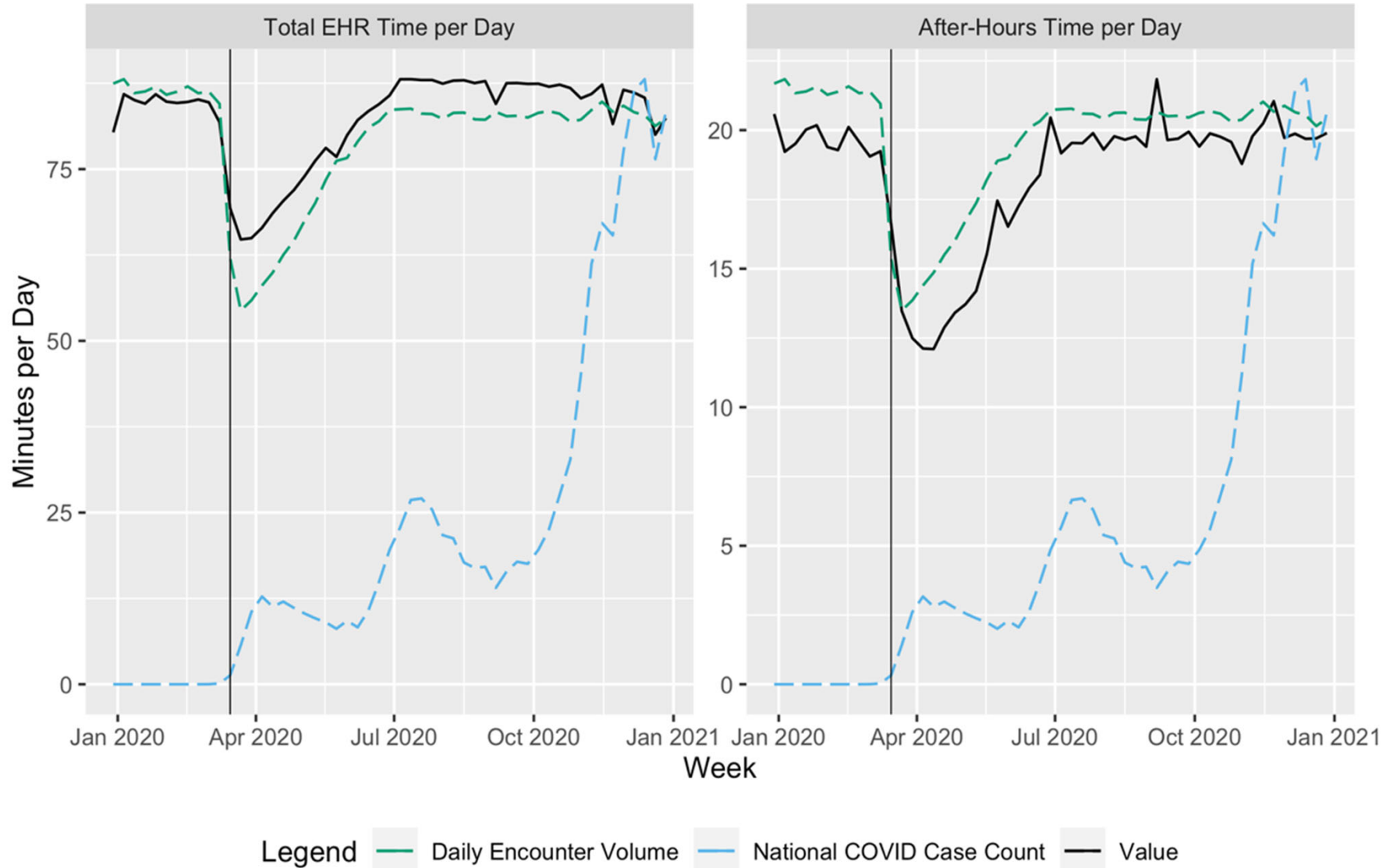
- The COVID-19 pandemic caused a sudden and dramatic shift in care delivery
- This includes clinician work and interactions with technology
 - Telemedicine
 - Volume
- How did EHR use change during the pandemic?

Clinician EHR Use During COVID-19

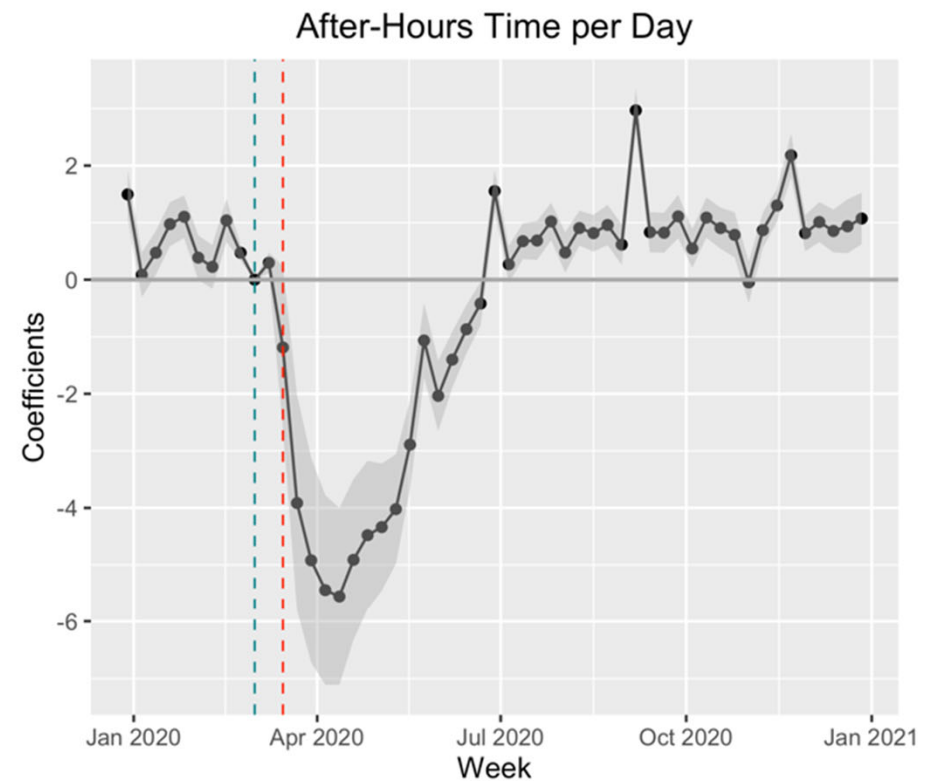
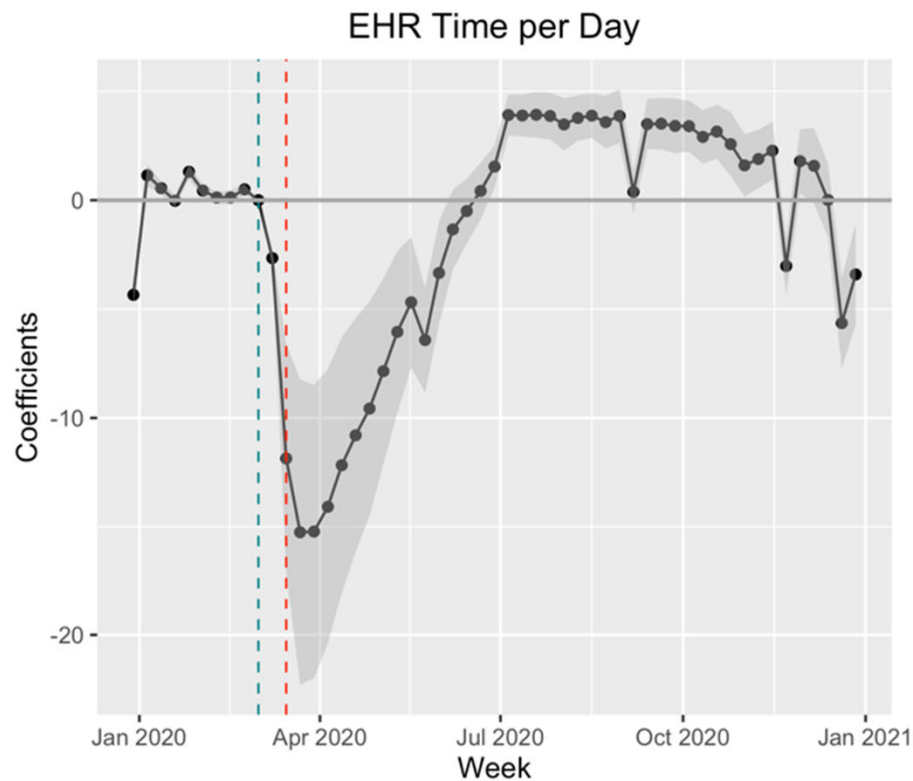
Evidence from National EHR Metadata

- National data from Epic Systems ambulatory care EHR
- 366 health systems from December 2019 – January 2021
- Physicians and APPs, aggregated to the health system level

Clinician EHR Use During COVID-19

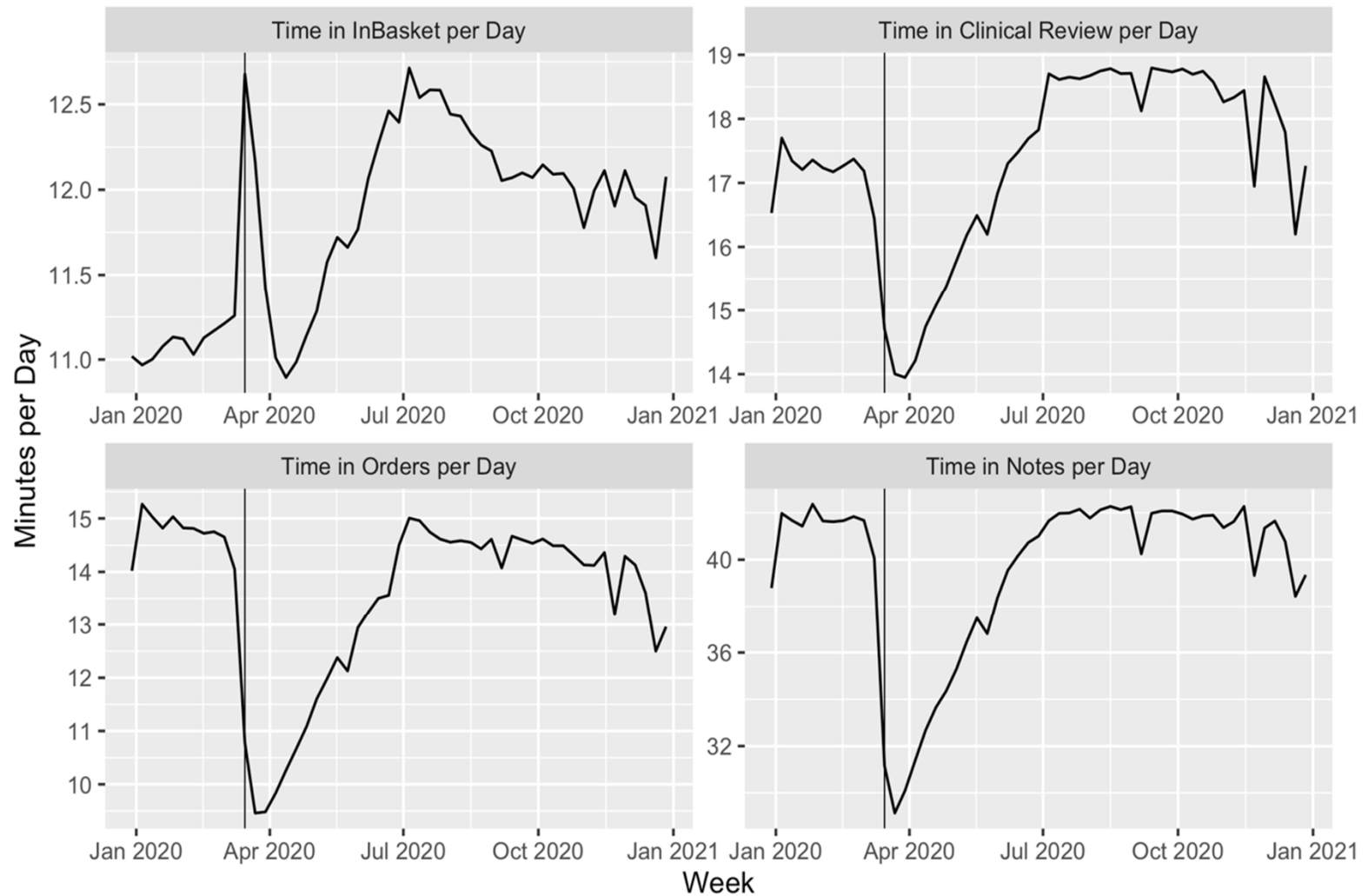


Clinician EHR Use During COVID-19

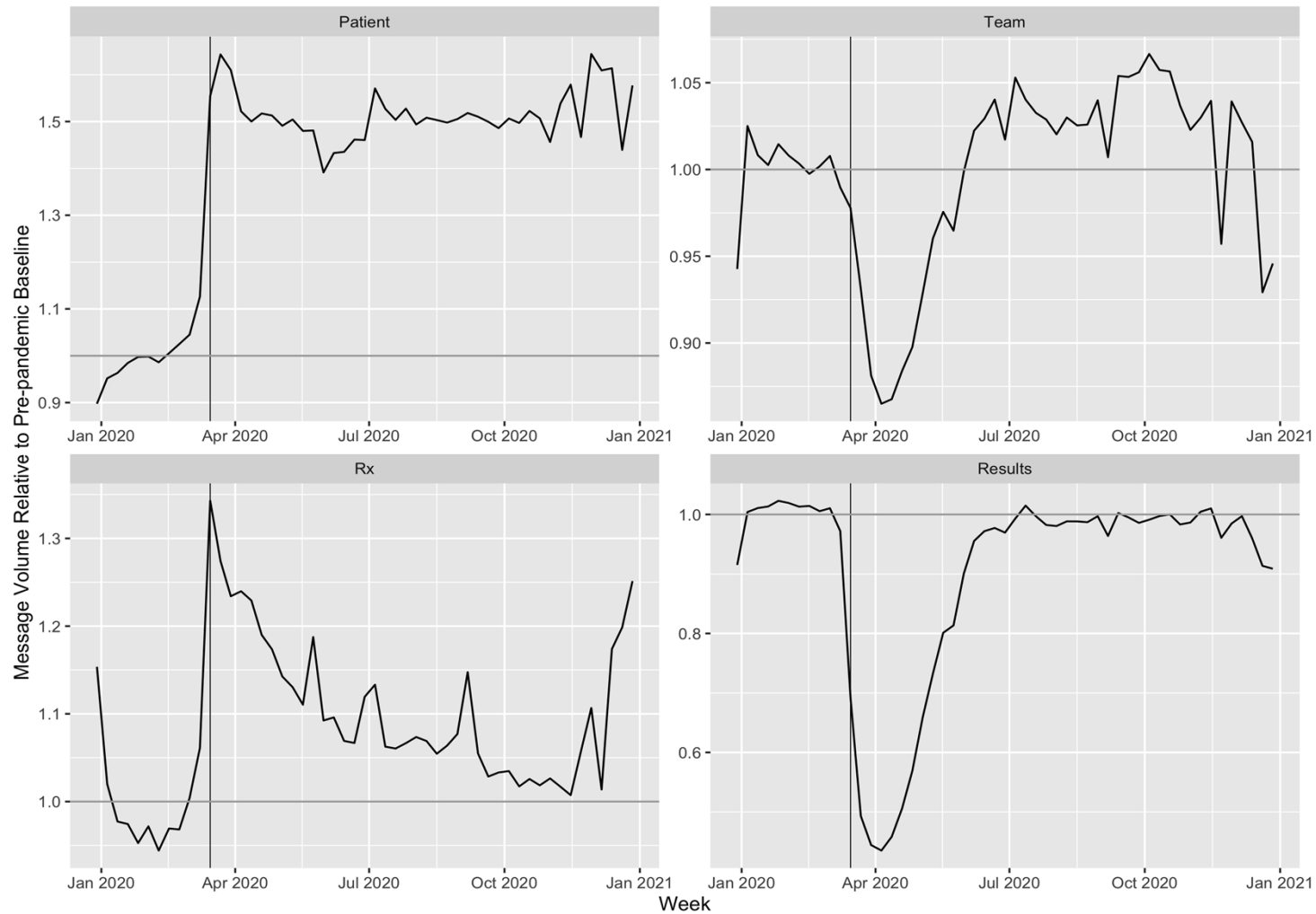


Notes: graphs are event study plots controlling for organization fixed effects and daily volume. All point estimates are relative to the week, 2-weeks prior to the first state-wide shelter in place (SIP) order in California, our proxy for the onset of the pandemic. Gray regions represents 95% confidence intervals with standard errors clustered at the organization level

Clinician EHR Use During COVID-19



Clinician EHR Use During COVID-19



Clinician EHR Use During COVID-19

<i>Dependent variable:</i>			
‘Time in In Basket per Day‘			
	(1)	(2)	(3)
MessageSystem	-0.040 (0.032)	-0.001 (0.002)	-0.001 (0.002)
MessageTeam	0.401*** (0.073)	0.178* (0.095)	0.182** (0.089)
MessageResults	0.081 (0.088)	0.238*** (0.040)	0.121* (0.065)
MessageRx	0.651*** (0.135)	-0.010 (0.123)	0.036 (0.105)
MessagePatient	2.111*** (0.173)	2.321*** (0.159)	1.915*** (0.301)
MessageCustom	2.683 (2.299)	0.071 (0.074)	0.073 (0.063)
MessageOther	0.261 (0.186)	0.200* (0.118)	0.245* (0.137)
Constant	5.239*** (0.432)		
OrgID fixed effects	No	Yes	Yes
Week fixed effects	No	No	Yes
Observations	18,347	18,347	18,347
R ²	0.667	0.970	0.974
Adjusted R ²	0.667	0.969	0.974
Residual Std. Error	2.424 (df = 18339)	0.737 (df = 17976)	0.682 (df = 17924)

Note:

*p<0.1; **p<0.05; ***p<0.01

Clinician EHR Use During COVID-19

- Big disruptions in EHR work at the onset of the pandemic
- Slight increase in EHR time per day and after-hours time through the end of 2020, driven by InBasket and Clinical Review
- BIG increase in patient messages – which also demand the most clinician time

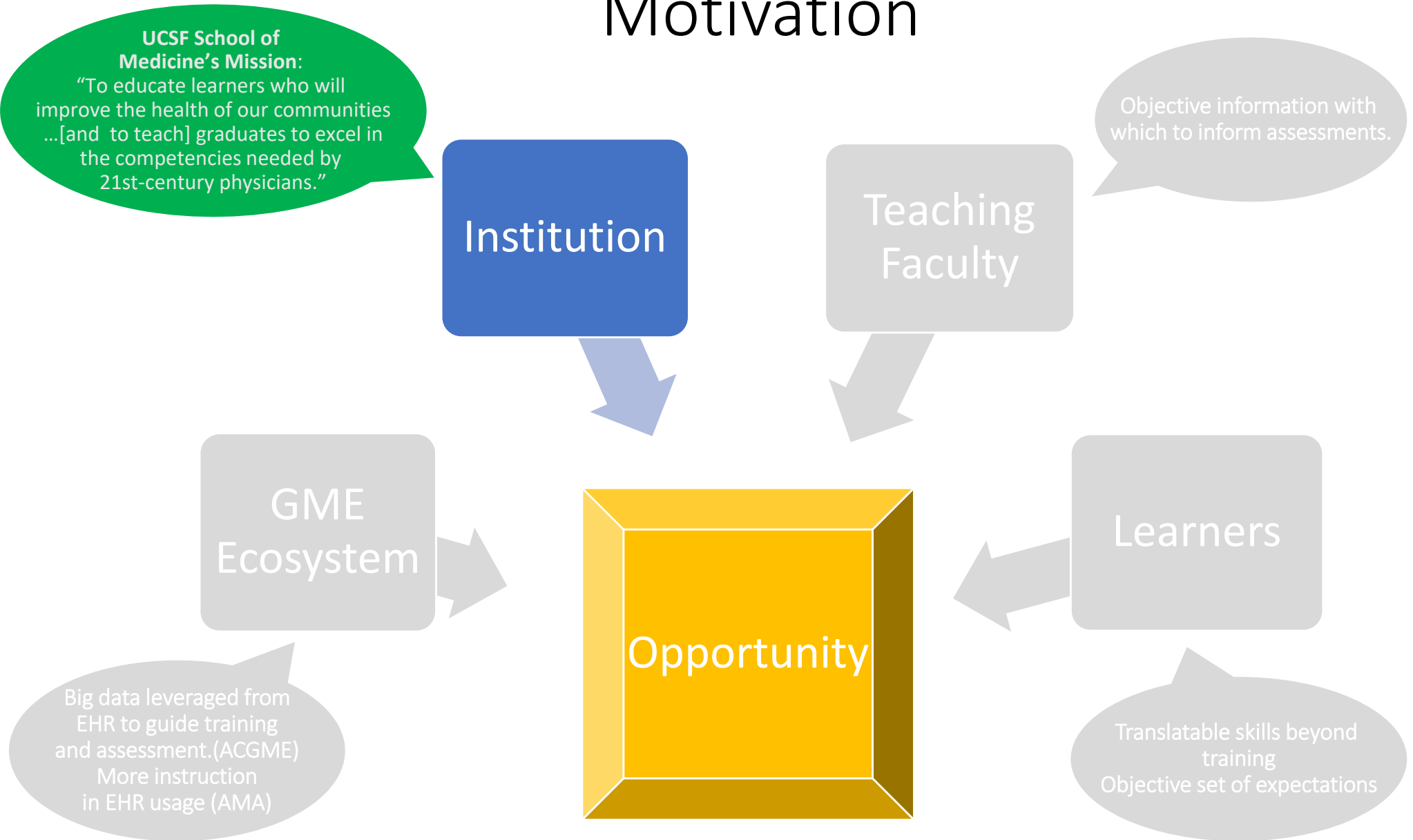
Ongoing Policy Evaluations with EHR Audit Log Data

- Evaluation of 2021 E/M coding changes on physician work
- Impact of patient access to clinical notes on documentation patterns
- Telehealth and demands on physician time, decision-making
- Finding effective strategies to reduce documentation burden:
 - Identifying optimal use of EHR tools
 - Evaluating the use of documentation support staff to increase health system capacity

The use of EHR Activity Logs for Assessing
Trainee Growth and Maturation

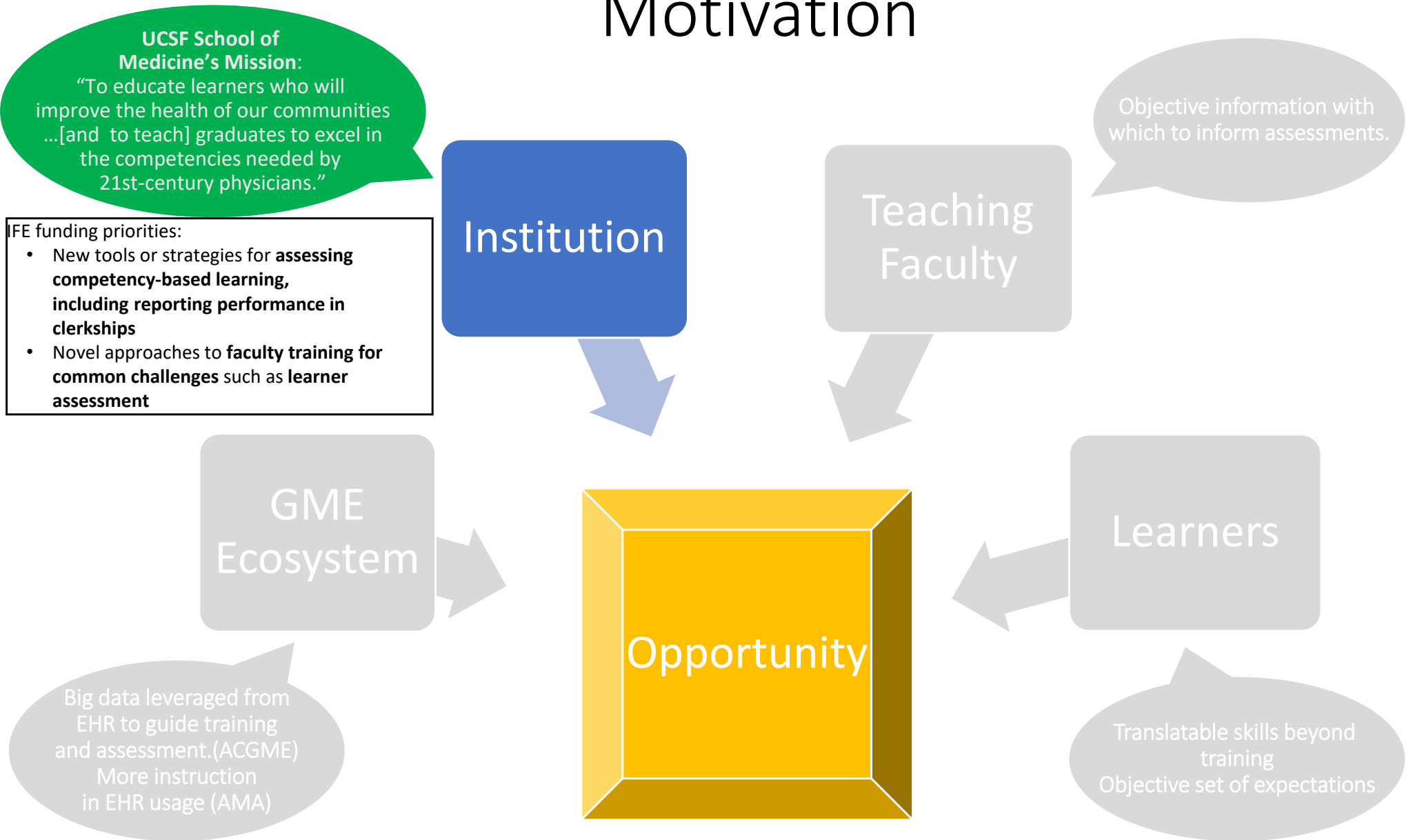
The Trainee Digital Growth Chart

Motivation



1. Arora VM. Harnessing the Power of Big Data to Improve Graduate Medical Education: Big Idea or Bust? *Acad Med J Assoc Am Med Coll.* 2018;93(6):833-834.
2. Graduate Medical Education Outcomes and Metrics - Workshop : Health and Medicine Division. <http://nationalacademies.org/hmd/Activities/Workforce/GMEoutcomesandmetrics/2017-OCT-10.aspx>.
3. Chi J, Bentley J, Kugler J, Chen JH. How are medical students using the Electronic Health Record (EHR)?: An analysis of EHR use on an inpatient medicine rotation. Lindeman B, ed. *PLOS ONE.* 2019;14(8):e0221300
4. <https://www.ama-assn.org/sites/ama-assn.org/files/corp/media-browser/public/about-ama/councils/Council%20Reports/council-on-medical-education/a18-cme-4.pdf>

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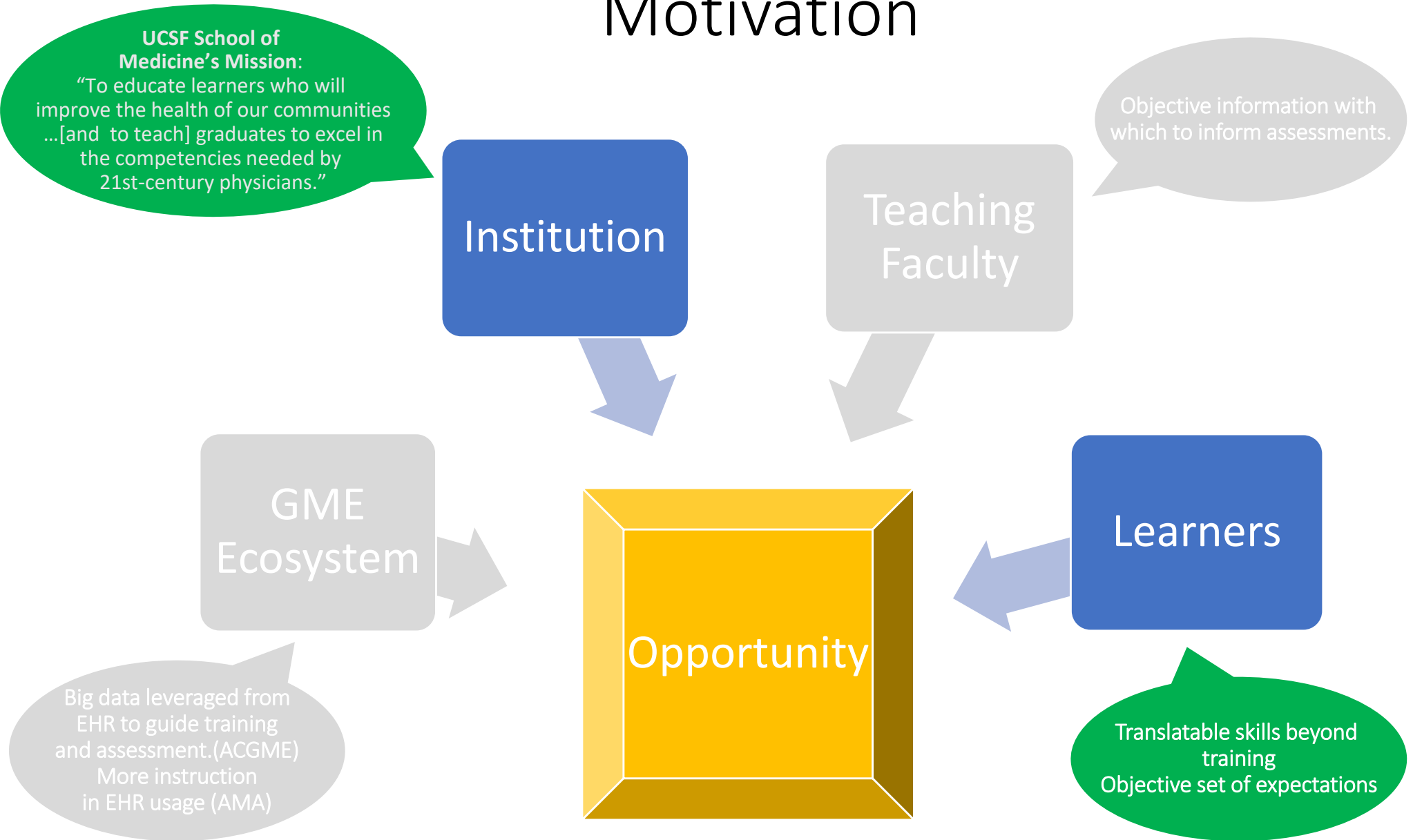
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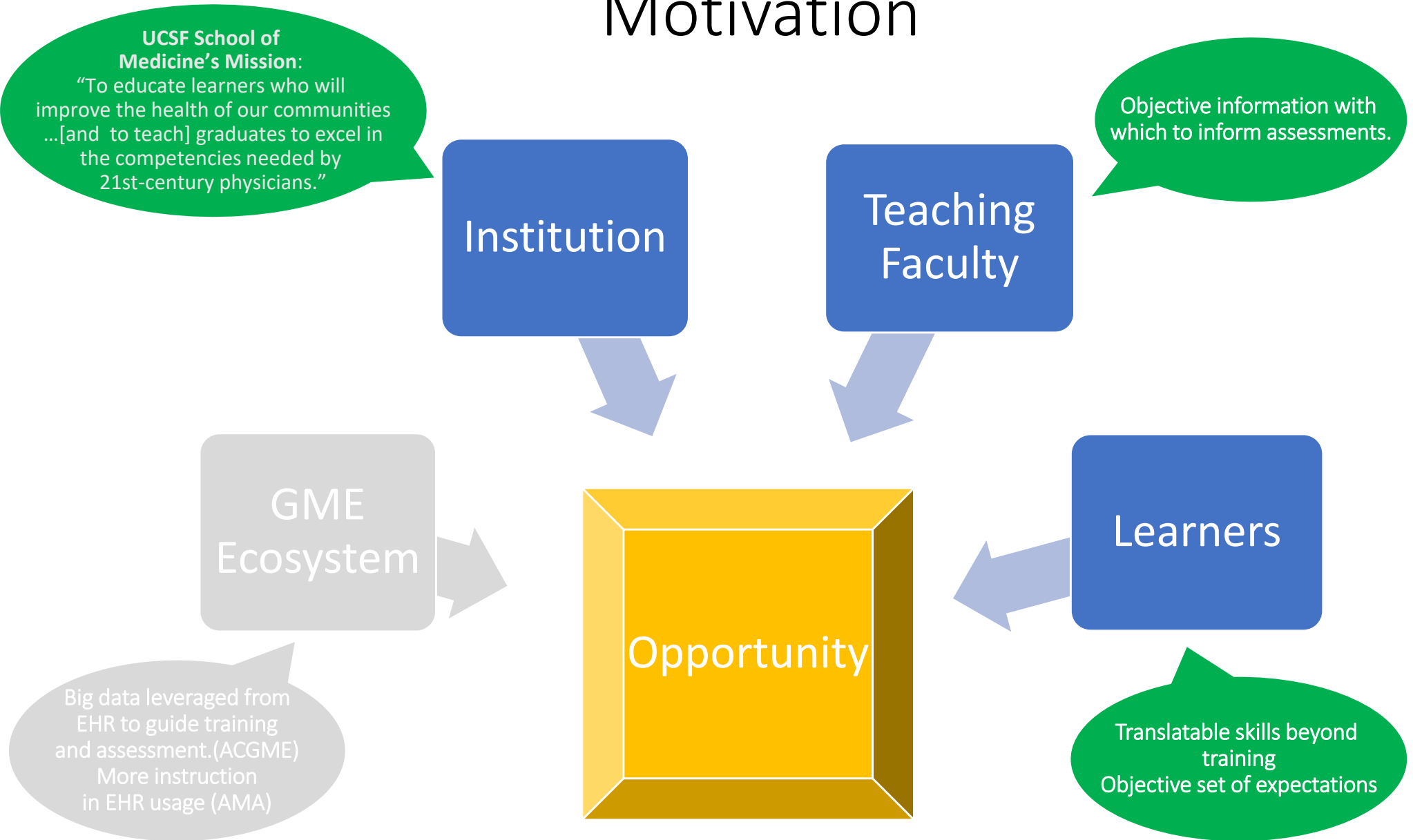
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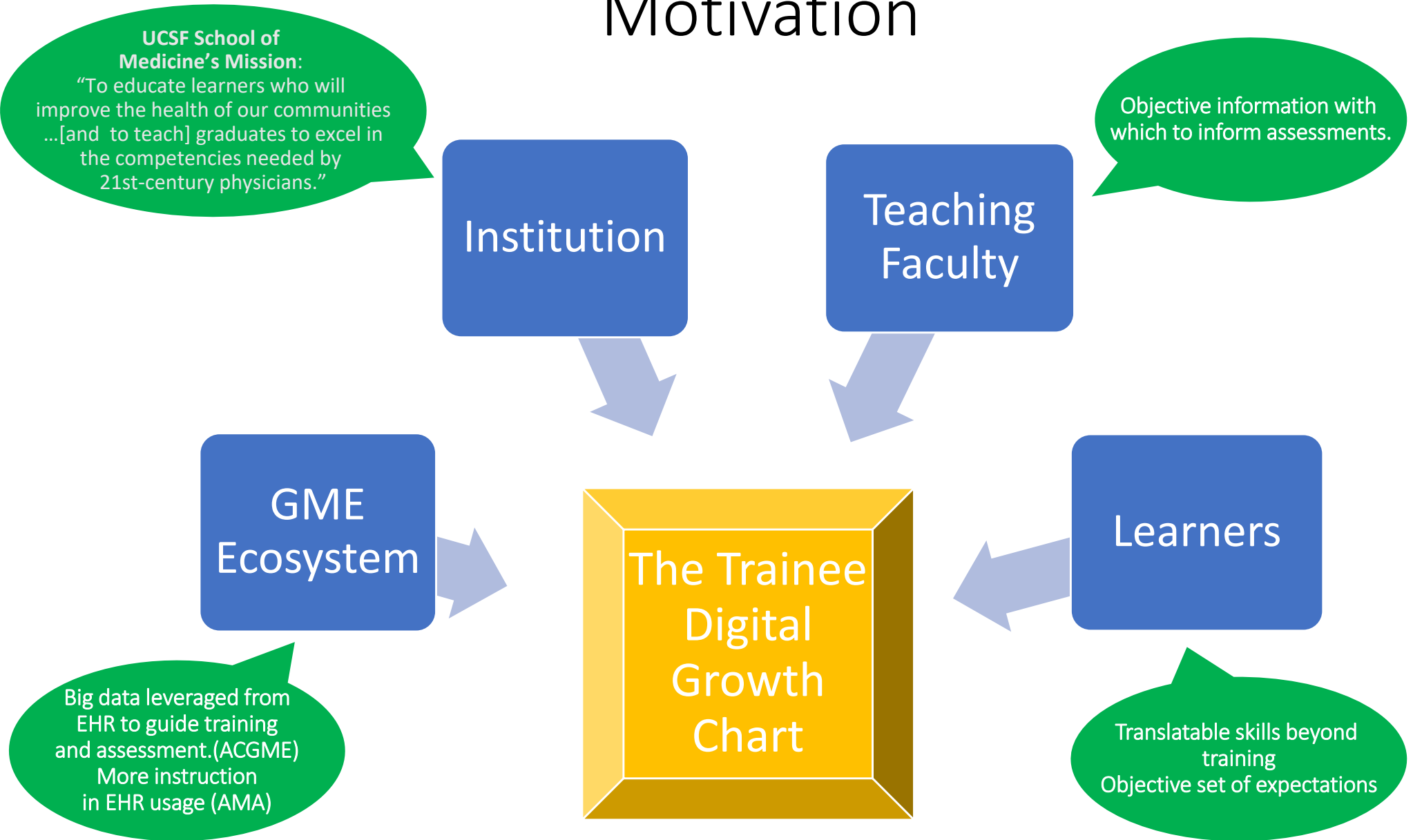
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Assessment Guidebook

Eric S. Holmboe, MD
William F. Iobst, MD

Components of Clinical Reasoning:

1. Information gathering
2. Hypothesis generation
3. Problem representation
4. Differential diagnosis
5. Leading or working diagnosis
6. Diagnostic justification
7. Management

Trainee Digital Growth Chart



Trainee Digital Growth Chart

Specialty Category

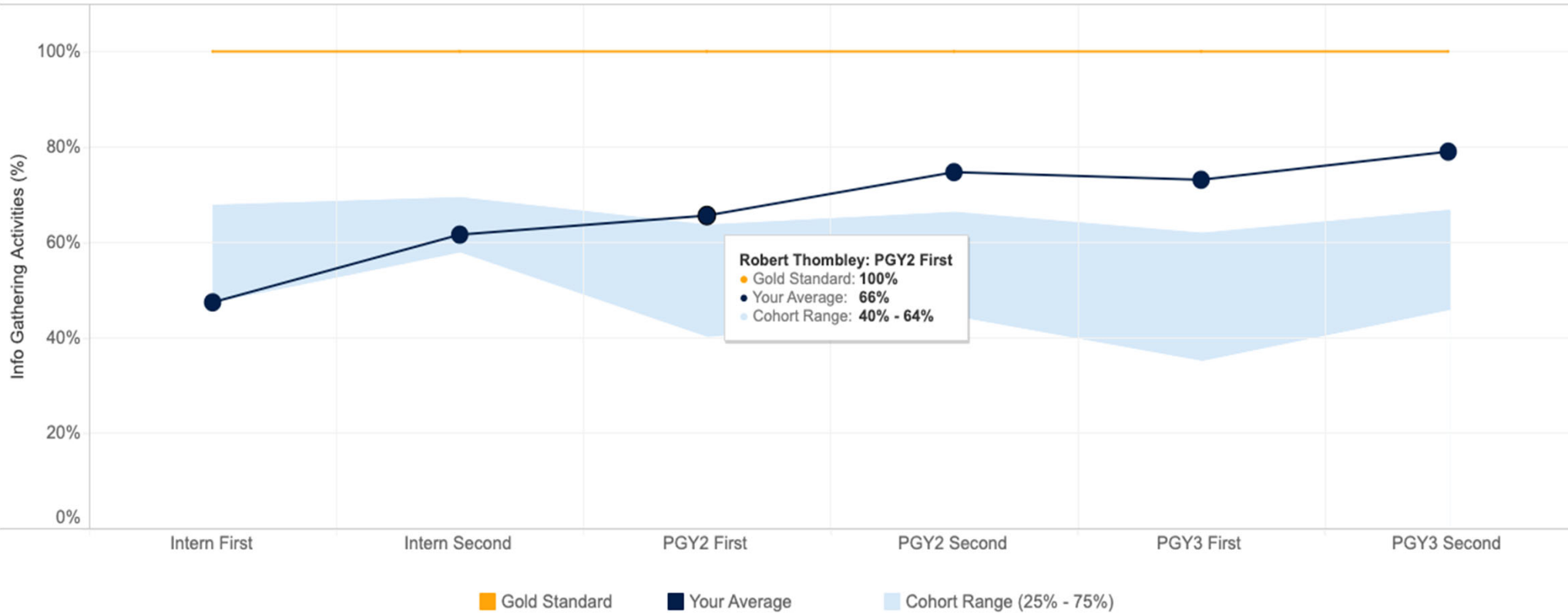
(All)

Trainee

Robert Thombley (@Robert.Tho...)

Admissions

[View Admission Details](#)



Trainee Digital Growth Chart



Rounds Details

Specialty Category

Trainee

(All)

Robert Thombley (@Robert.Tho...)

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

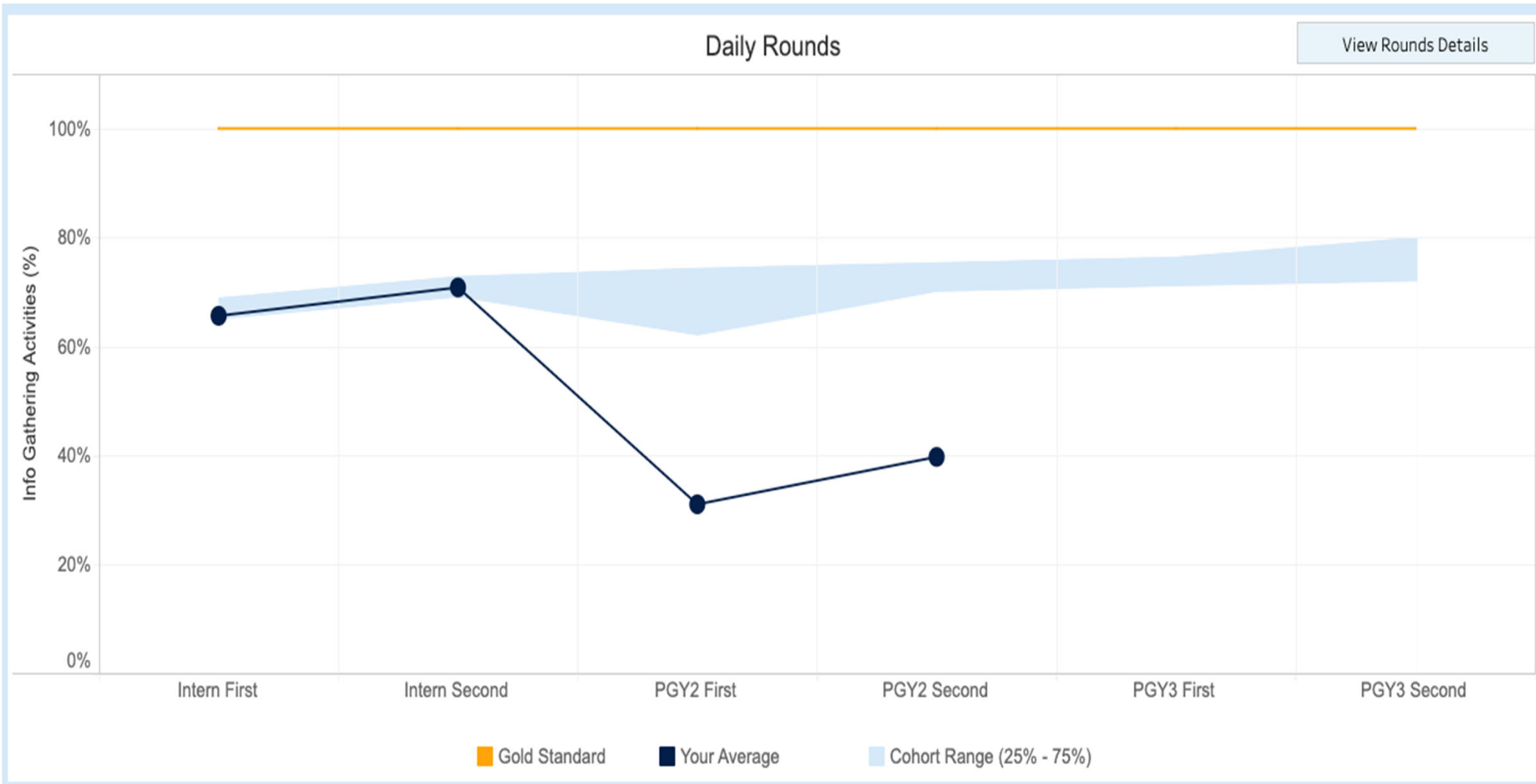
[Back to Chart](#)

EHR Activity	Intern First	Intern Second	PGY2 First	PGY2 Second	PGY3 First	PGY3 Second
R1: Checked Lab Results	34%	43%	64%	65%	72%	75%
R2: Viewed Consult Notes	21%	51%	53%	44%	80%	98%
R3: Reviewed Orders from Others	75%	62%	47%	54%	69%	80%
R4: Viewed Social Work Notes	-	-	38%	25%	75%	73%
R5: Viewed Case Manager Notes	-	-	37%	58%	58%	67%
R6: Viewed PACS Images	-	-	29%	30%	-	-
R7: Reviewed Home Meds during Encounter	65%	61%	46%	47%	51%	42%
R8: Completed Home Med Rec	2%	2%	-	-	-	-

Robert Thombley: R5: Viewed Case Manager Notes - PGY2 Second

- Gold Standard: 100%
- Your Average: 58%
- Cohort 25%: 25%

Trainee Digital Growth Chart



Educational Policy Implications

Assessing learners during clinical rotations is subjective, time intensive, and not without bias, including inference, recall, and implicit gender bias.

Organizations such as the ACGME, NASEM, and have called for novel assessment approaches that are:

- Automated
- Low burden
- Objective
- Realistic
- Can be derived from big data in the EHR

Invited meeting: Next Era in Assessment Invitational Summit, May, 2022

“A core group of medical education researchers and policy makers, who have an interest in the development and use of clinical performance measures, that will be the future of assessment in GME.”

CLIIR Research “Pillars”

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Event/Audit Log Data

PGHD Use and Adoption

Patient generated health data (PGHD) have not achieved widespread clinical adoption. However, the COVID-induced shift to telemedicine may have created opportunities for PGHD as surrogates for vital signs collected in-person.

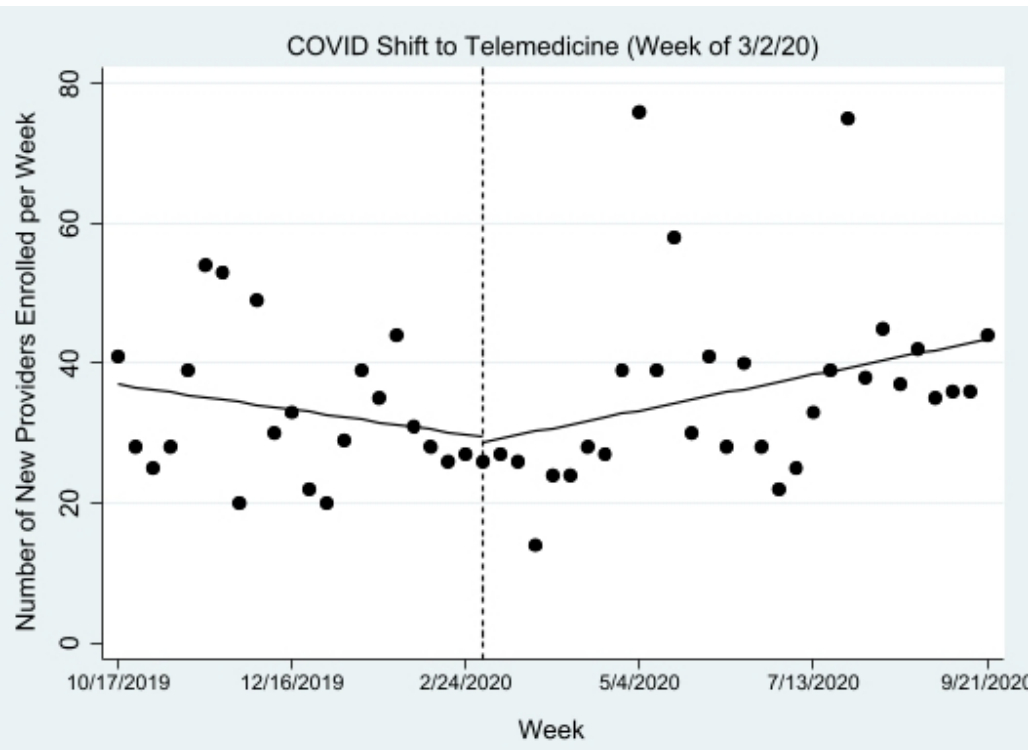
We conducted an interrupted time series analysis of physician enrollment in, and patient-initiated vital sign transmission of non-COVID associated PGHD through, a national PGHD platform (Validic).

Results

Eleven health systems, 4,735 physicians, and 51,341 patients were included.

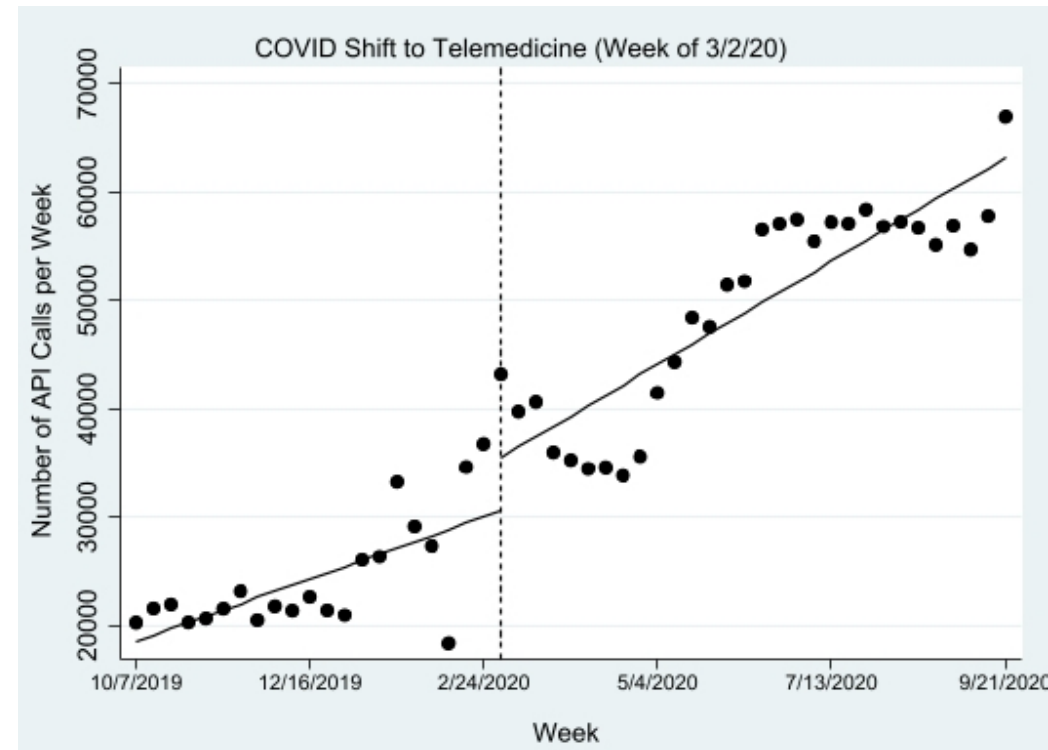
National Trends in Peri-COVID PGHD Adoption

New Provider Enrollment



Significant increase in rate of new provider enrollment ($P = .02$, $CI = [0.14, 1.58]$)

API Call Volume



Rate of change of API call volume did not reach statistical significance, ($P = .06$, $CI = [-22.8, 783.2]$), but far outpaced a dramatic decrease in overall encounter rate.

PGHD Policy

- Stage 3 Meaningful Use
- Limited and often Challenging Reimbursement

Policy Actions

- IA-BE-14 “Engage Patients and Families to Guide Improvement in the Systems of Care”
- Letter in response to White House Office of Science and Technology Policy, RFI on Strengthening Community Health Through Technology

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SANTA BARBARA • SANTA CRUZ

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San Francisco, CA 94143

SAN FRANCISCO, CALIFORNIA 94118
PHONE: (415) 502-1371
E-MAIL: Benjamin.rosner@ucsf.edu

February 28, 2022

To: Stacy Murphy, White House Office of Science and Technology Policy

Re: Request for Information on Strengthening Community Health Through Technology

Dear Ms. Murphy:

Conclusion

Interoperability: Adoption, Use, & Impact

Clinician and Care Team Work & Well-being

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