



An Epic Use of Time

Outcomes Research using the Electronic Medical Record System

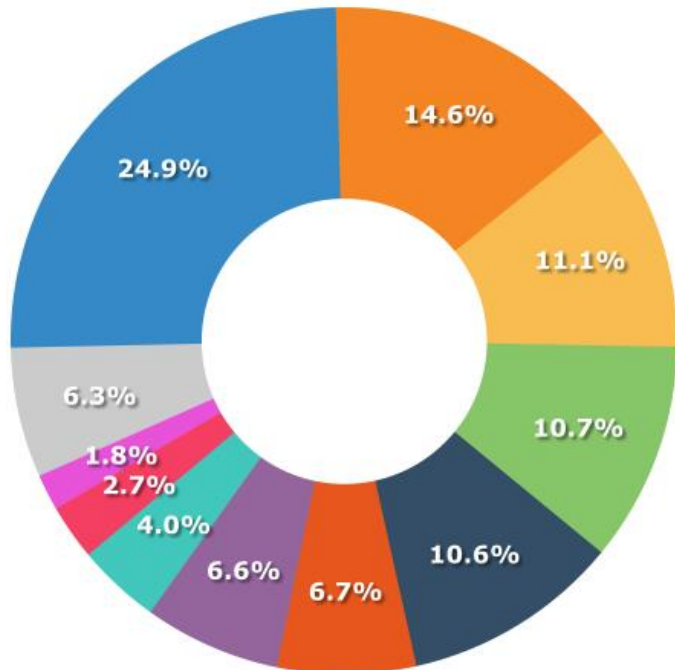
David Ouyang
November 30, 2015



Outline

- **Unique Opportunity** – Stanford is an early adopter of the dominant EMR System with significant institutional support for data extraction.
- **Unique Datasets** – EMR systems reveal uniquely granular data ripe for interrogation and analysis.
- **Unique Questions** – Novel projects now possible: “Outcomes of Patients Taken Care of By Housestaff Working More than 80 Hours per Week” as example

Epic Systems is a dominant EMR system

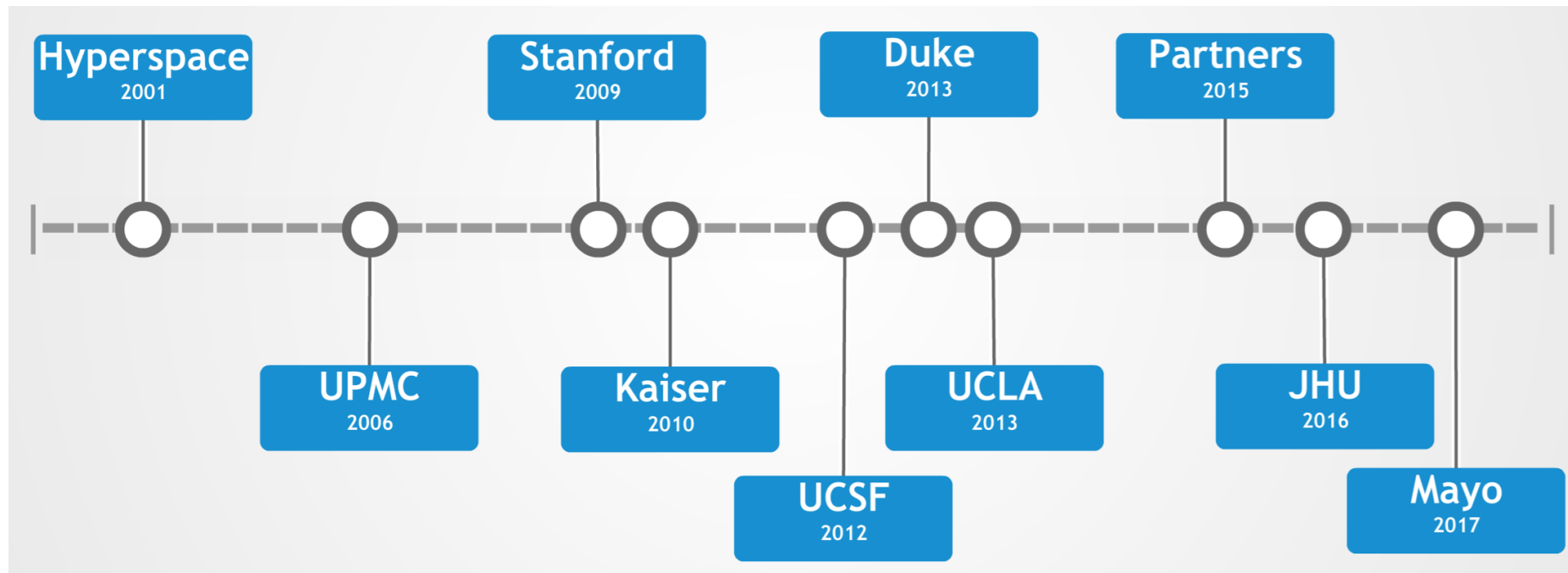


March 2013

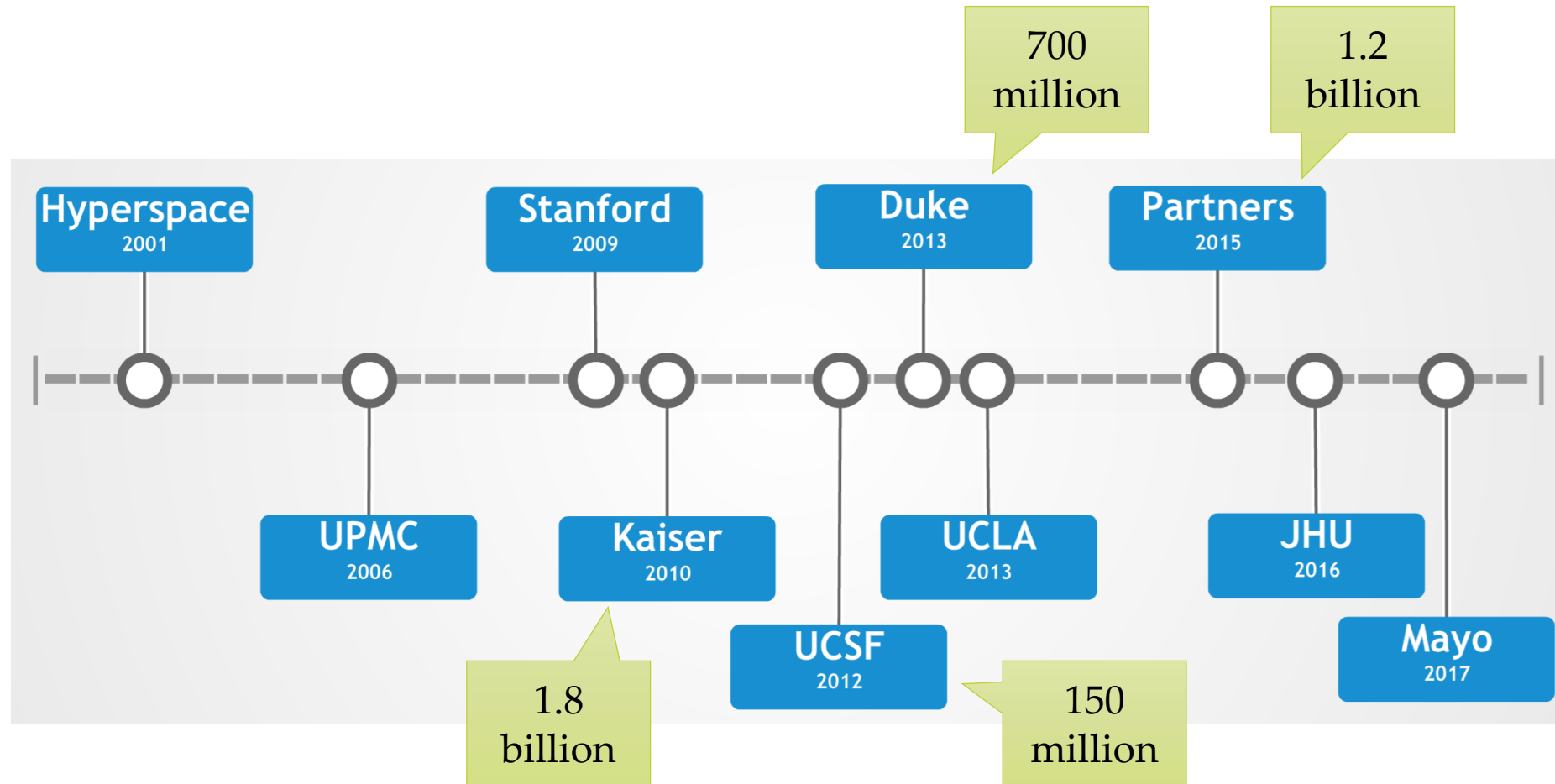
Currently Epic medical records serve 54% of U.S population, while covering 2.5% population worldwide.

Although another company, Cerner, which purchased competitor Siemens Health Services this year, claims to have more physicians and hospitals using its system, **Epic is considered the 300-pound gorilla of the health IT world.** That's in part because of the enormous size of its contracts with some of the country's leading academic medical centers, such as the Mayo Clinic, Kaiser Permanente and Partners Healthcare in Boston.

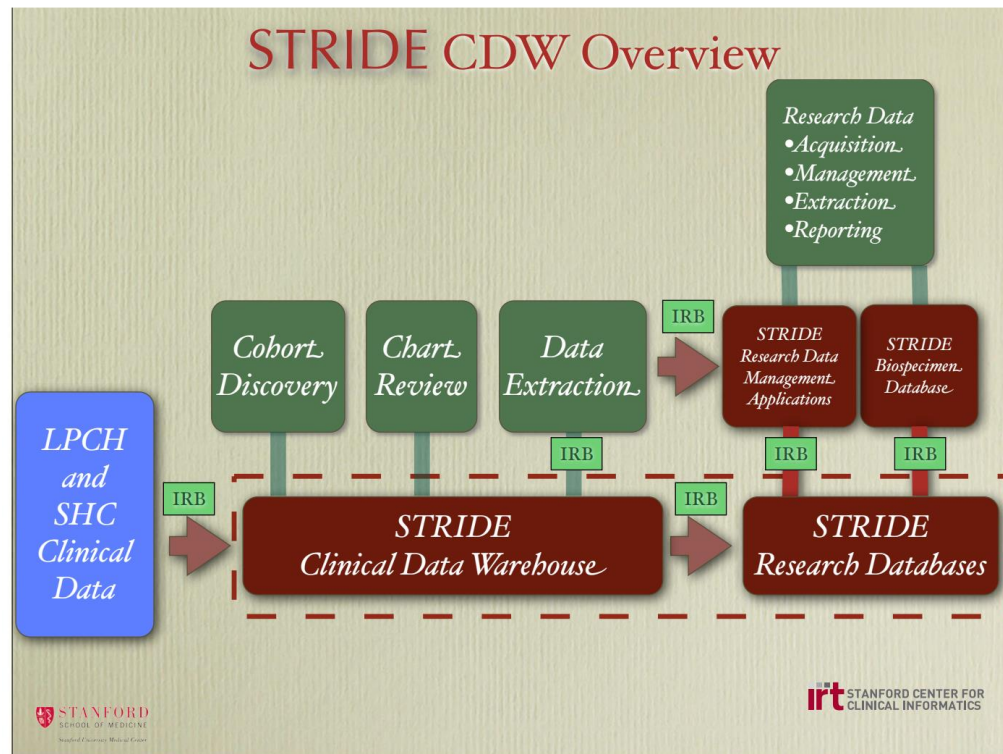
Stanford is an early adopter of Epic



Stanford is an early adopter of Epic



Stanford has superior data extraction support



STRIDE Clinical Data Warehouse
Combined Adult & Pediatric Data - October 2009

Observation Type	Start Year	Count
Patient Demographics	1994	1.3 million
Clinical Encounters (ADT)	1994	10.5 million
ICD9 Coded Diagnoses	1994	15 million
ICD9 & CPT Coded Procedures	1994	10 million
Surgical Pathology Reports	1995	1 million
Radiology Reports	2004	1.8 million
Other Clinical Transcriptions	2000	4.8 million
Laboratory Test Results	2000	93 million
Inpatient Pharmacy Orders	2006	4.3 million

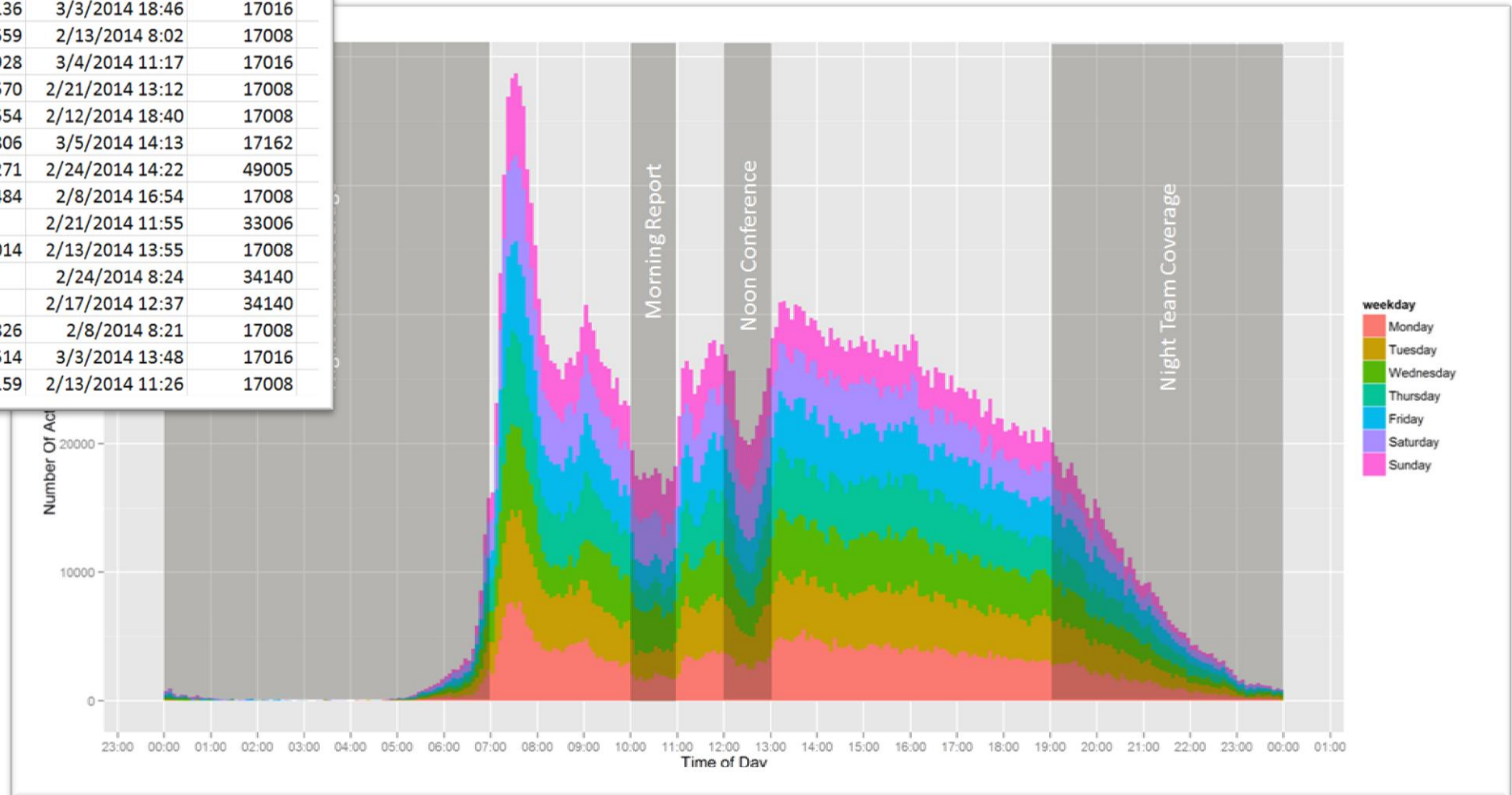
<http://clinicalinformatics.stanford.edu/STRIDE/patient-cohort.html>

STANFORD SCHOOL OF MEDICINE
Stanford University Medical Center

irt STANFORD CENTER FOR CLINICAL INFORMATICS

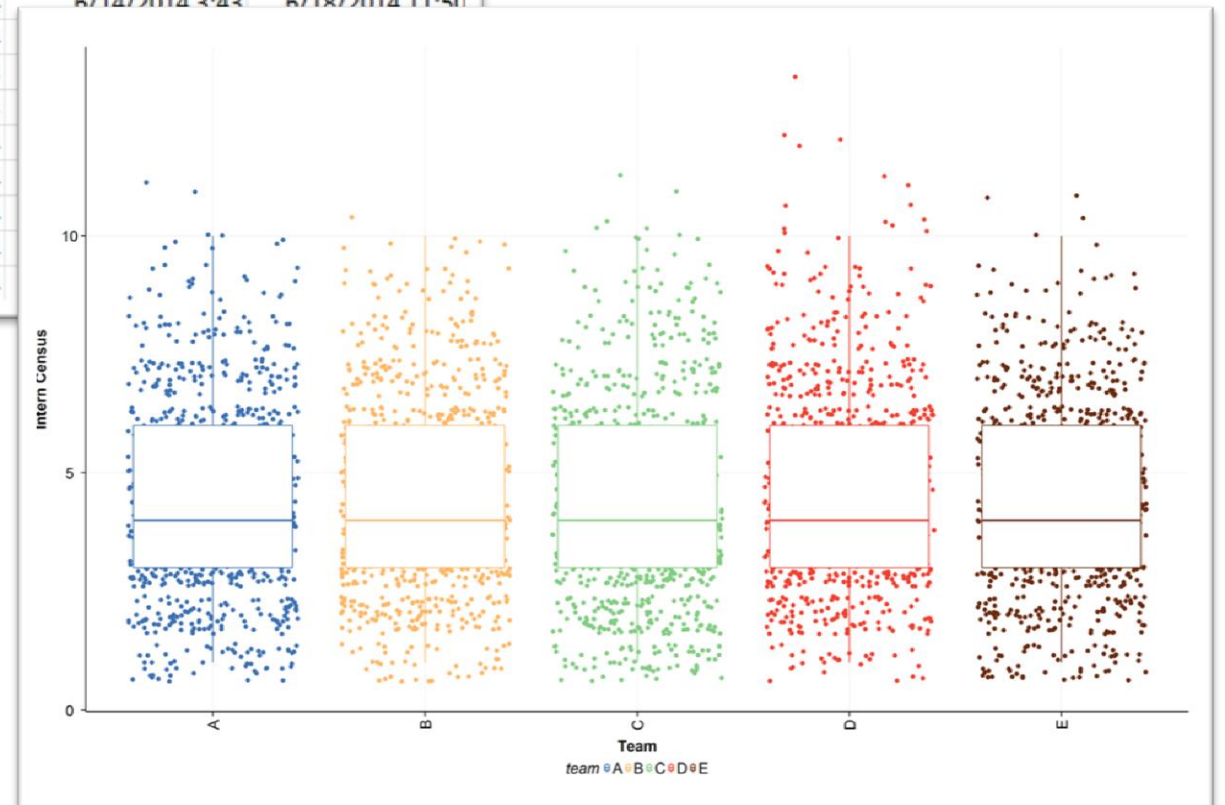
Resident Actions Dataset

1	access_log_id	user_id	de_pat_id	access_datetime	metric_id
2	40954		49497 None	2/10/2014 7:10	34140
3	40973		49497 1445761	2/16/2014 19:45	17015
4	40978		49497 3349091	2/28/2014 17:57	34010
5	40979		49497 661136	3/3/2014 18:46	17016
6	40984		49497 3381559	2/13/2014 8:02	17008
7	40985		49497 2318928	3/4/2014 11:17	17016
8	40986		49497 713570	2/21/2014 13:12	17008
9	40994		49497 525554	2/12/2014 18:40	17008
10	40998		49497 3383806	3/5/2014 14:13	17162
11	41002		49497 2062271	2/24/2014 14:22	49005
12	41005		49497 1618484	2/8/2014 16:54	17008
13	41006		49497 None	2/21/2014 11:55	33006
14	41009		49497 319014	2/13/2014 13:55	17008
15	41011		49497 None	2/24/2014 8:24	34140
16	41015		49497 None	2/17/2014 12:37	34140
17	41070		49497 2627826	2/8/2014 8:21	17008
18	41077		49497 297514	3/3/2014 13:48	17016
19	41080		49497 2618159	2/13/2014 11:26	17008



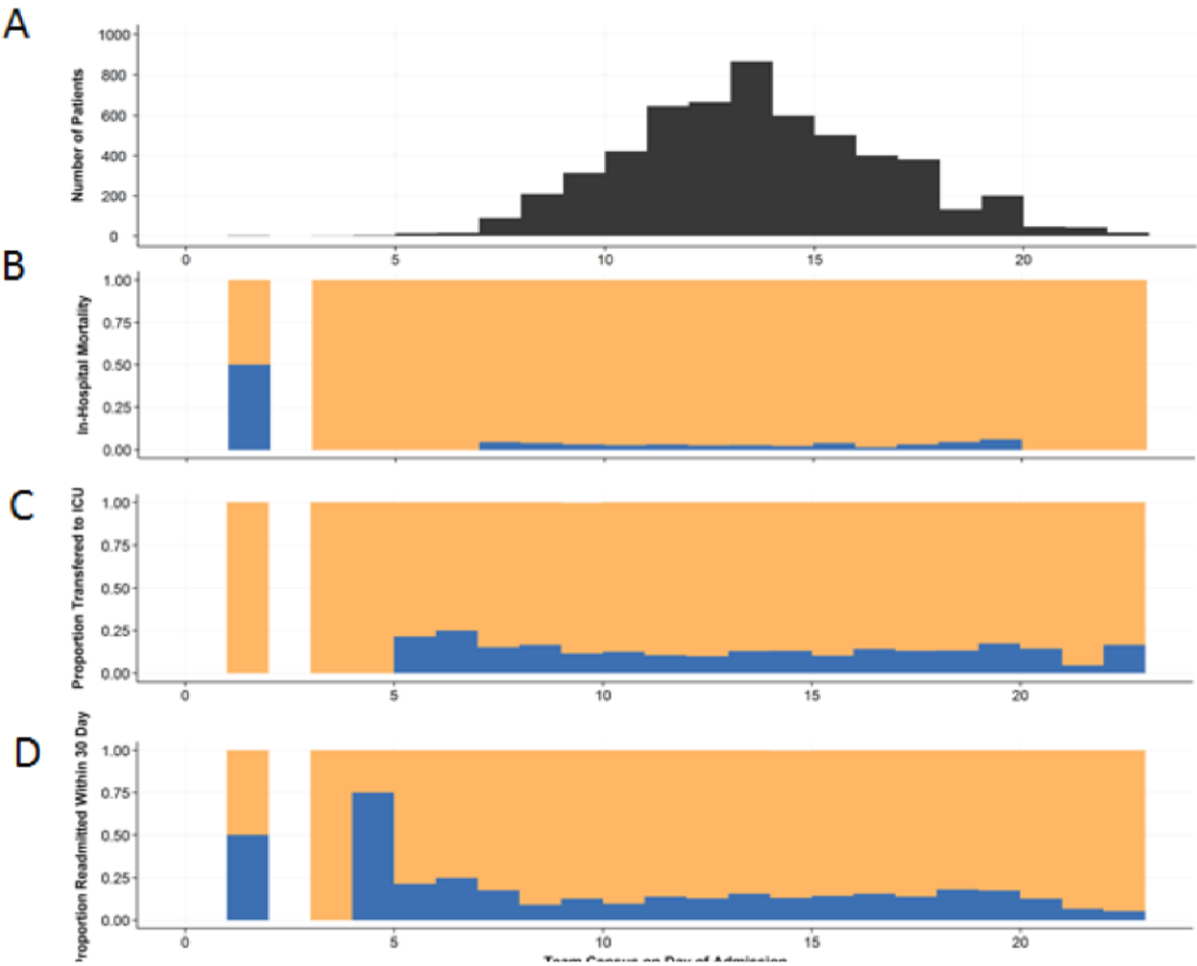
Treatment Team Dataset

1	USER_ID	DEAD_	PROV_NAME	DE_PAT_ID	ACCESS_DATE	HOSP_ADM SN_TIME	HOSP_DISCH_TIME
2	S0093286	N	TT MED UNIV E1, PGR 26400	2248746	15-Jun-14	6/14/2014 3:43	6/18/2014 11:50
3	S0093285	N	TT MED UNIV E1, PGR 26400	2248746	16-Jun-14	6/14/2014 3:43	6/18/2014 11:50
4	S0103586	N	TT HEMATOLOGY RESIDENT A, PGR 27090	3714385	24-Jun-14		
5	S0084431	N	TT MED UNIV B2, PGR 12023	3256705	9-Jul-13		
6	S0069131	N	TT MED UNIV B2, PGR 12023	3256705	15-Jul-13		
7	S0103553	Y	TT CCU/HF 1, PGR 27075	1967180	16-May-14		
8	S0093397	Y	TT CCU/HF 2, PGR 27076	1967180	15-May-14		
9	S0093287	Y	TT CCU/HF 3, PGR 27077	1967180	20-May-14		
10	S0093286	Y	TT CCU/HF 1, PGR 27075	1967180	19-May-14		
11	S0084461	Y	TT CCU/HF 1, PGR 27075	1967180	15-May-14		



Patient Outcomes Dataset

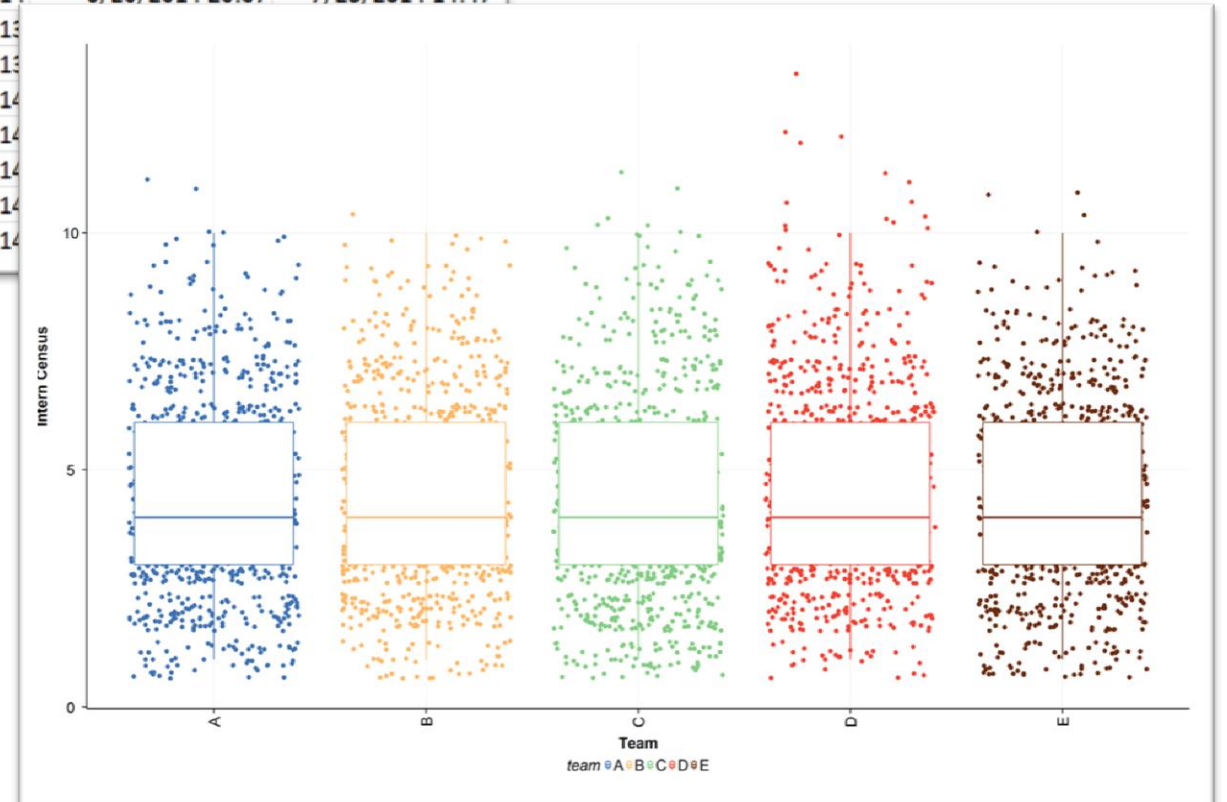
	uniqueHosp	DE_PAT_ID	HOSP_ADMSN_TIME	los.died	readmission	week	averageTeamCensus	ICU_Care	compo		
1	1	2013-06-04 17	1773363	6/4/2013 22:50	59	FALSE	FALSE	2013-22	11.15873016	FALSE	FAL
2	2	2013-06-16 31	3189688	6/16/2013 0:38	60	FALSE	FALSE	2013-24	12.2	FALSE	FAL
3	4	2013-06-22 15	1508865	6/22/2013 16:18	10	FALSE	FALSE	2013-24	8.125	FALSE	FAL
4	5	2013-06-22 26	2668901	6/22/2013 12:48	17	FALSE	TRUE	2013-24	6.333333333	FALSE	TRU
5	6	2013-06-22 25	2949969	6/22/2013 14:29	6	TRUE	FALSE	2013-24	10.5	FALSE	TRU
6	7	2013-06-22 31	3124523	6/22/2013 13:15	5	FALSE	FALSE	2013-24	10.33333333	FALSE	FAL
7	8	2013-06-22 32	3200258	6/22/2013 23:03	74	FALSE	FALSE	2013-24	8.4	TRUE	TRU
8	9	2013-06-24 15	1344319	6/24/2013 20:00	1	FALSE	TRUE	2013-25	7	FALSE	TRU
9	12	2013-06-24 17	1727837	6/24/2013 16:27	2	FALSE	TRUE	2013-25	9	FALSE	TRU
10	14	2013-06-24 25	2527464	6/24/2013 16:44	4	FALSE	TRUE	2013-25	5.25	FALSE	TRU
11	15	2013-06-24 31	3107364	6/24/2013 21:29	9	FALSE	TRUE	2013-25	9.444444444	FALSE	TRU
12	16	2013-06-24 31	3119596	6/24/2013 20:33	10	FALSE	FALSE	2013-25	6.714285714	FALSE	FAL
13	17	2013-06-24 32	3249771	6/24/2013 21:12	5	FALSE	FALSE	2013-25	5.4	FALSE	FAL
14	18	2013-06-24 45	491498	6/24/2013 17:29	5	FALSE	FALSE	2013-25	9.6	FALSE	FAL
15	19	2013-06-24 54	545772	6/24/2013 12:33	4	FALSE	TRUE	2013-25	10.5	FALSE	TRU
16	20	2013-06-24 61	610828	6/24/2013 16:08	8	FALSE	FALSE	2013-25	9.666666667	TRUE	TRU
17	21	2013-06-25 27	2718932	6/25/2013 3:54	1	FALSE	FALSE	2013-25	9	FALSE	FAL
18	22	2013-06-25 32	3204942	6/25/2013 14:05	8	FALSE	FALSE	2013-25	10.125	FALSE	FAL



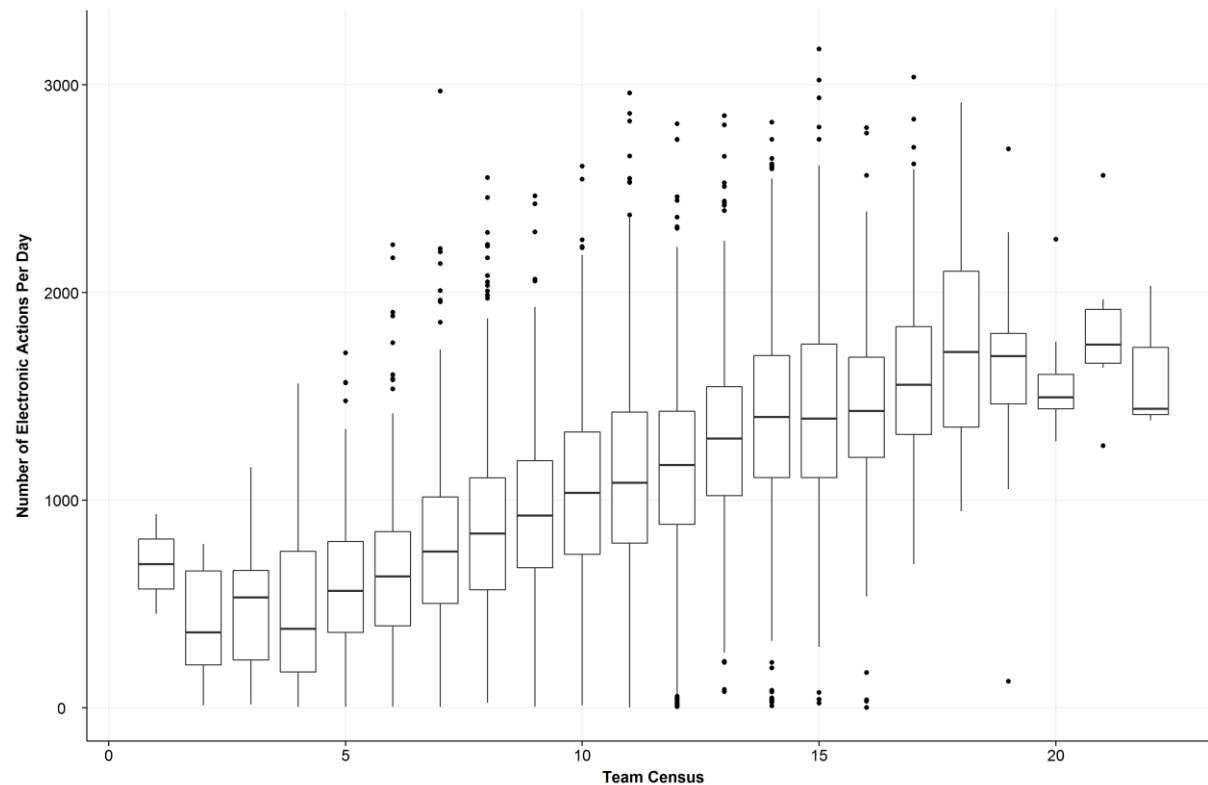
Male	Black or A	60	1	0.7
Female	White	80	1	3.75
Female	Asian	70	2	0.74
Female	Other	65	3	1

Treatment Team Dataset

1	USER_ID	DEAD_	PROV_NAME	DE_PAT_ID	ACCESS_DATE	HOSP_ADM SN_TIME	HOSP_DISCH_TIME
2	S0093286	N	TT MED UNIV E1, PGR 26400	2248746	15-Jun-14	6/14/2014 3:43	6/18/2014 11:50
3	S0093285	N	TT MED UNIV E1, PGR 26400	2248746	16-Jun-14	6/14/2014 3:43	6/18/2014 11:50
4	S0103586	N	TT HEMATOLOGY RESIDENT A, PGR 27090	3714385	24-Jun-14	6/20/2014 20:07	7/23/2014 14:47
5	S0084431	N	TT MED UNIV B2, PGR 12023	3256705	9-Jul-13		
6	S0069131	N	TT MED UNIV B2, PGR 12023	3256705	15-Jul-13		
7	S0103553	Y	TT CCU/HF 1, PGR 27075	1967180	16-May-14		
8	S0093397	Y	TT CCU/HF 2, PGR 27076	1967180	15-May-14		
9	S0093287	Y	TT CCU/HF 3, PGR 27077	1967180	20-May-14		
10	S0093286	Y	TT CCU/HF 1, PGR 27075	1967180	19-May-14		
11	S0084461	Y	TT CCU/HF 1, PGR 27075	1967180	15-May-14		



The Intersection of Datasets Can Answer Interesting Questions





Outcomes of Patients Taken Care of By Housestaff Working More than 80 Hours per Week

Jonathan H. Chen MD PhD
Gomathi Krishnan PhD
Jason Hom MD
Ronald Witteles MD
Jeffrey Chi MD

Use Time Stamps to Estimate Workhours

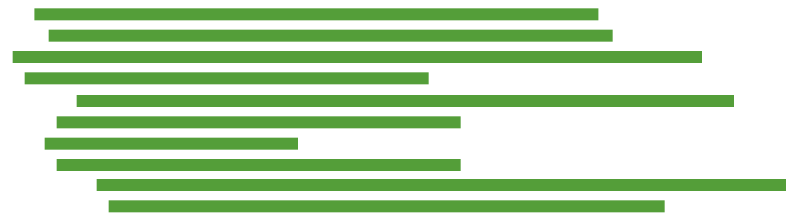


Table. Summary Statistics for General Medicine Inpatient EHR Use*

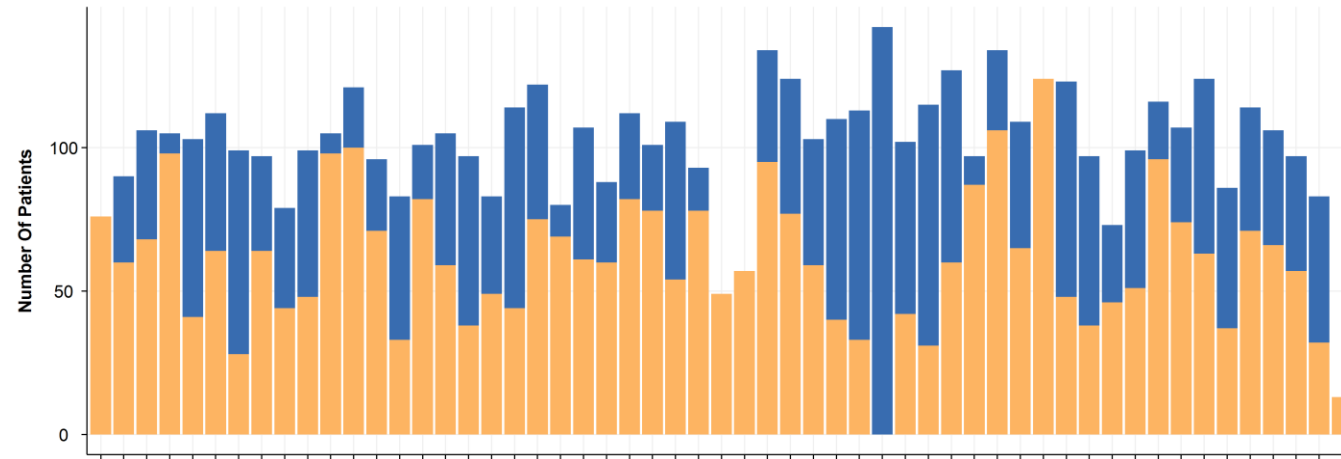
Variable	PGY-1 Interns (n = 46)	PGY-2/3 Residents (n = 45)
Hours per week, median (IQR)	67.2 (55.3-76.4)	73.5 (62.2-84.2)
EHR of total working time, median (IQR)	36.5 (29.2-43.7)	34.7 (26.7-42.0)
Patient medical charts per day, median (IQR)	11.9 (7.0-14.0)	25.8 (15.0-32.0)
Independent sessions per day, median (IQR)	30.5 (23.0-38.0)	29.4 (23.0-37.0)
EHR action/access type, No. (%)		
Medical chart review	1 142 893 (40.8)	699 444 (42.5)
Notes	263 289 (9.4)	116 208 (7.1)
Patient list review	150 377 (5.4)	152 791 (9.3)
Results review	151 556 (5.4)	97 069 (5.9)
Order entry	99 087 (3.5)	40 896 (2.5)

Abbreviations: EHR, electronic health record; IQR, interquartile range; PGY, postgraduate year.

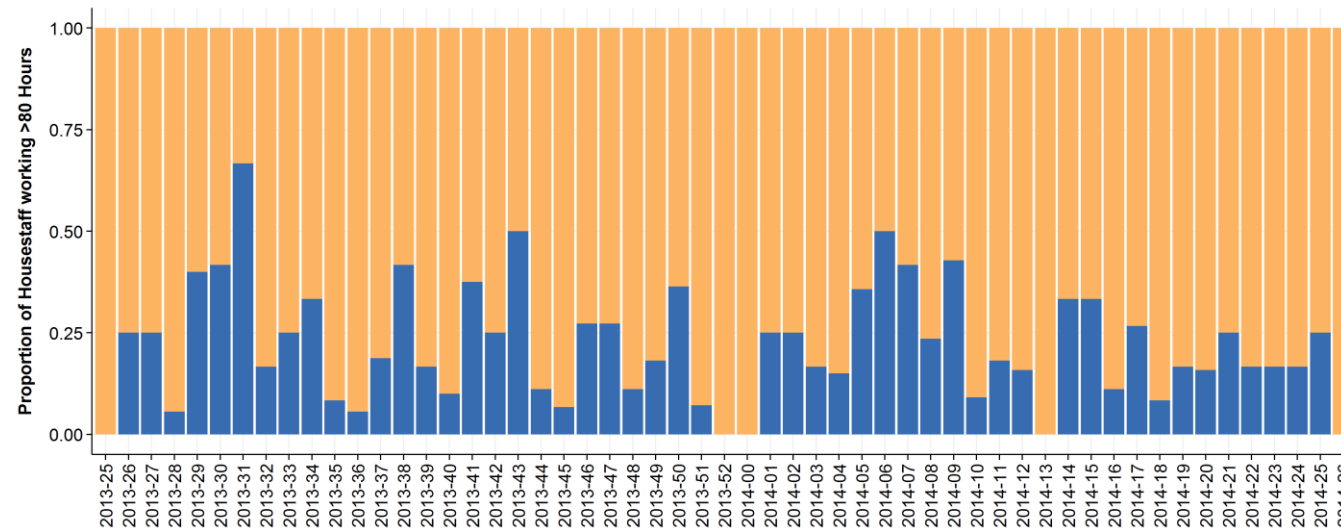
* $P < .001$ for all comparisons except for independent sessions per day ($P = .005$).

Identify Residents Working >80HPW

A



B



Taken Care of by Housestaff Working Over 80 Hours ■ TRUE ■ FALSE

Clinical Outcomes by Resident Workhours

Table 2. Clinical Outcomes for Patients Taken Care of by Housestaff Working more than Eighty Hours per Week

	>80 Hours/Week (n = 1952)	Control Group (n = 2815)	p-value
Length of Stay, mean (SD)	5.12 (8.20)	4.66 (7.20)	0.04796*
Composite Endpoint, n (%)	374 (19.16%)	470 (16.70%)	0.0314*
In-Hospital Mortality, n (%)	62 (3.18%)	67 (2.38%)	0.1152
Transfer to ICU, n (%)	69 (3.53%)	68 (2.42%)	0.0288*
30-Day Readmission, n (%)	267 (13.68%)	360 (12.79%)	0.3953

***p < 0.05**

Summary

Unique Opportunity

Unique Datasets

Unique Questions

Important People

Jeff Chi

Jason Hom

Jonathan Chen

Gomathi Krishnan

Ron Witteles

Resident Actions Dataset (2)

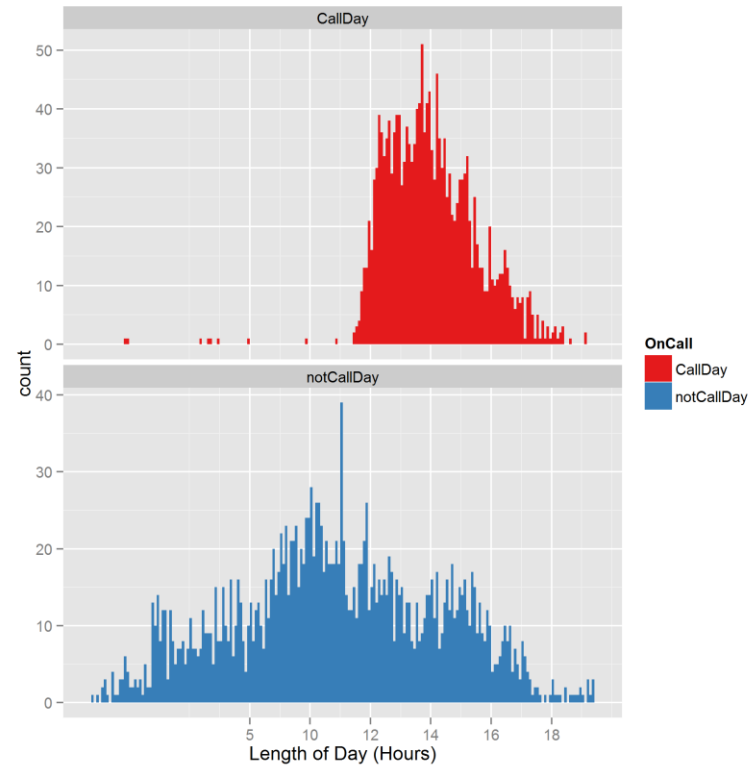
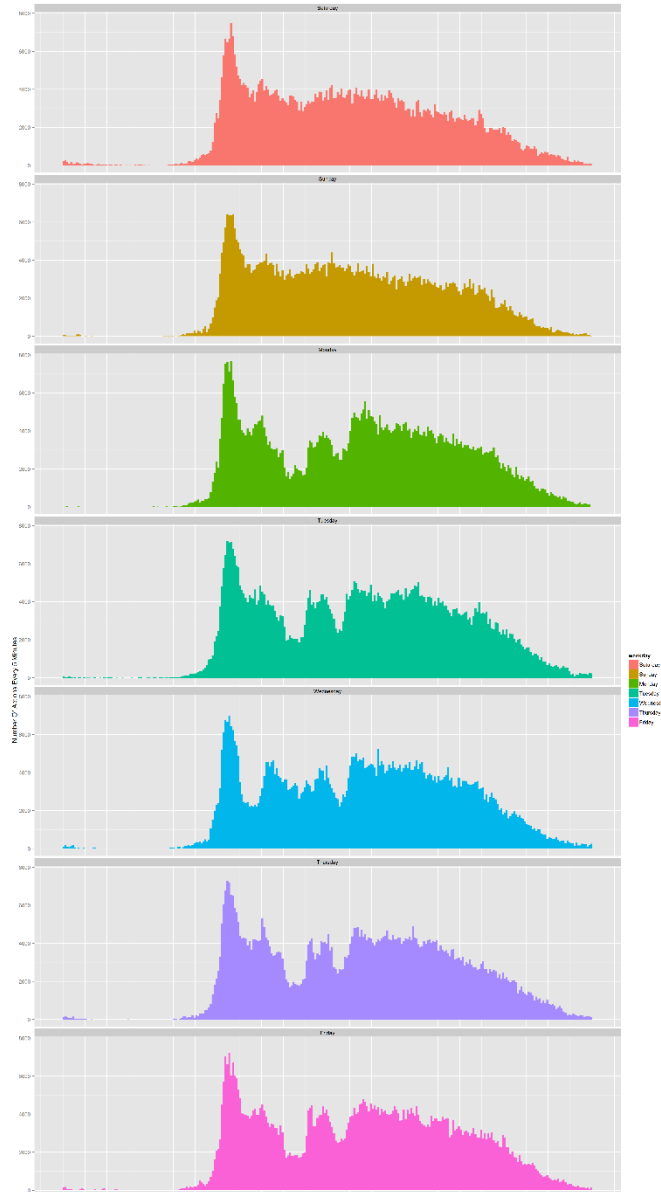



Table. Summary Statistics for General Medicine Inpatient EHR Use*

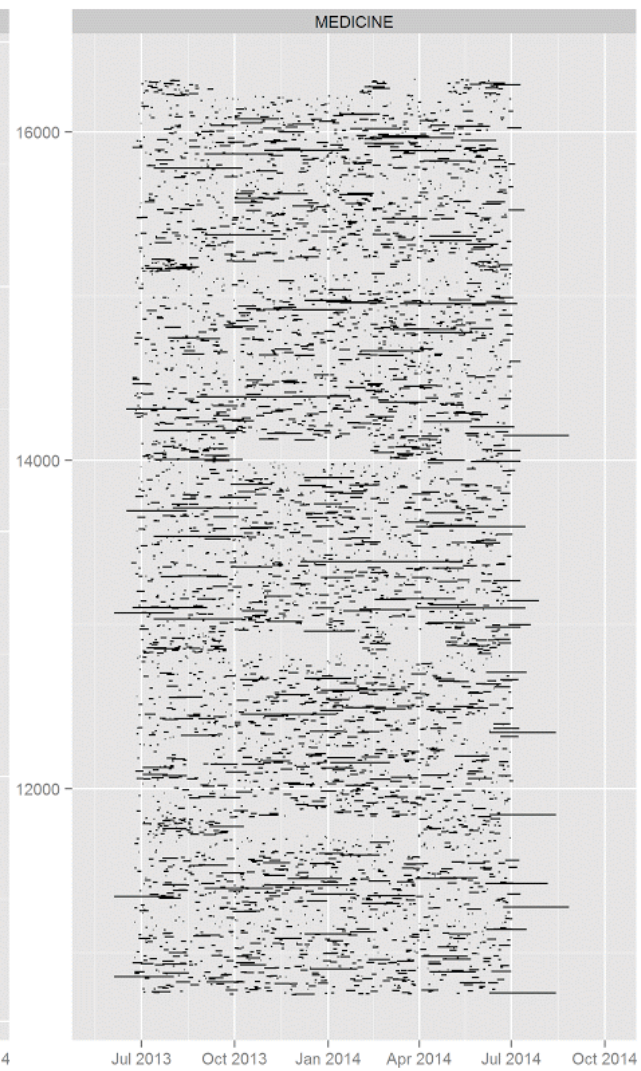
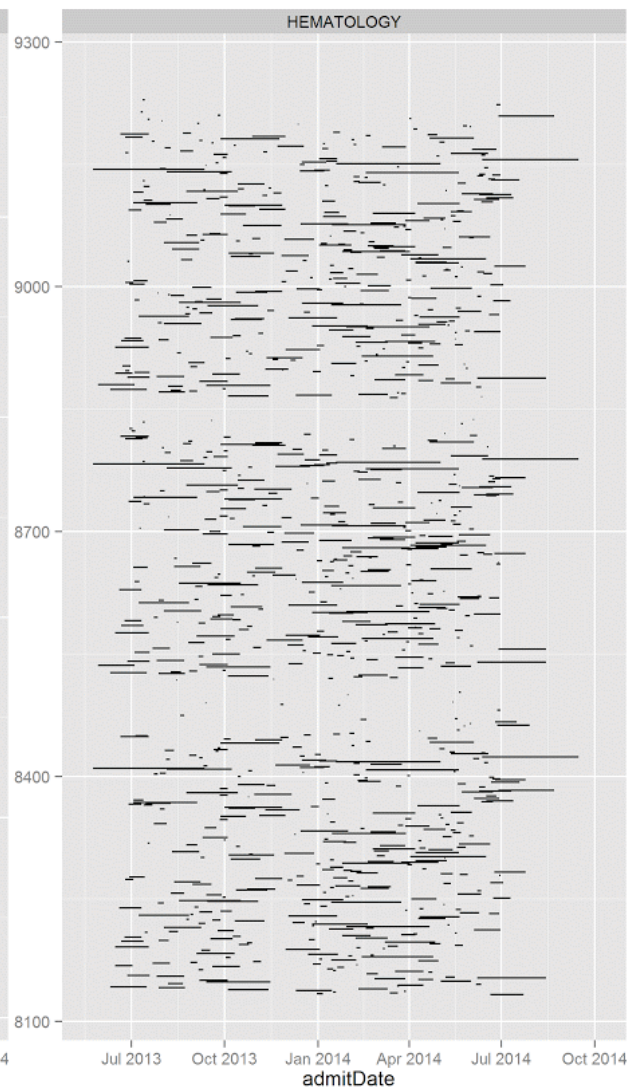
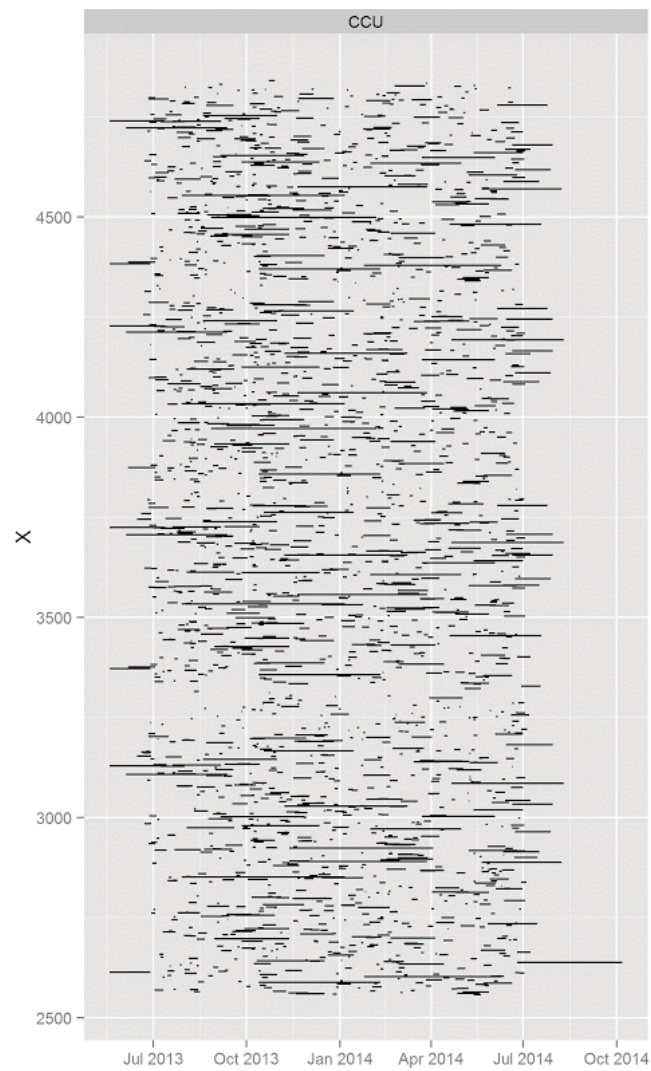
Variable	PGY-1 Interns (n = 46)	PGY-2/3 Residents (n = 45)
Hours per week, median (IQR)	67.2 (55.3-76.4)	73.5 (62.2-84.2)
EHR of total working time, median (IQR)	36.5 (29.2-43.7)	34.7 (26.7-42.0)
Patient medical charts per day, median (IQR)	11.9 (7.0-14.0)	25.8 (15.0-32.0)
Independent sessions per day, median (IQR)	30.5 (23.0-38.0)	29.4 (23.0-37.0)
EHR action/access type, No. (%)		
Medical chart review	1 142 893 (40.8)	699 444 (42.5)
Notes	263 289 (9.4)	116 208 (7.1)
Patient list review	150 377 (5.4)	152 791 (9.3)
Results review	151 556 (5.4)	97 069 (5.9)
Order entry	99 087 (3.5)	40 896 (2.5)

Abbreviations: EHR, electronic health record; IQR, interquartile range; PGY, postgraduate year.

* $P < .001$ for all comparisons except for independent sessions per day ($P = .005$).



Hospital System	Year of Go Live	Initial Cost
UPMC	2006	
Stanford	2009	
Cedars-Sinai	2009	\$1.8 billion
Kaiser Permanente	2010	
Sutter Health	2010	
UCSF	2012	\$150 million
Duke	2013	
UCLA	2013	
Partners (BWH – MGH)	2015	\$1.2 billion
Johns Hopkins	2016	
Mayo Clinic	2017	



Length of Day

Day 1 Call

Day 4 Call

Noncall Day

