

# ReHAP

## Rehabilitation and Healthcare Analytics Platform

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# Team



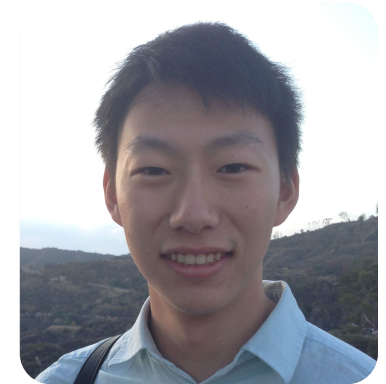
Krishnaj Gourab, MD  
Director PMR consults. JHH,  
JHBMC



John Adamovich, MHA  
Administrator R&I  
JHHCG



Michael Cohen, BS  
Sr Software Engineer, TIC



Tony Pan, BS Candidate  
JHU



David West, BME Candidate  
JHU



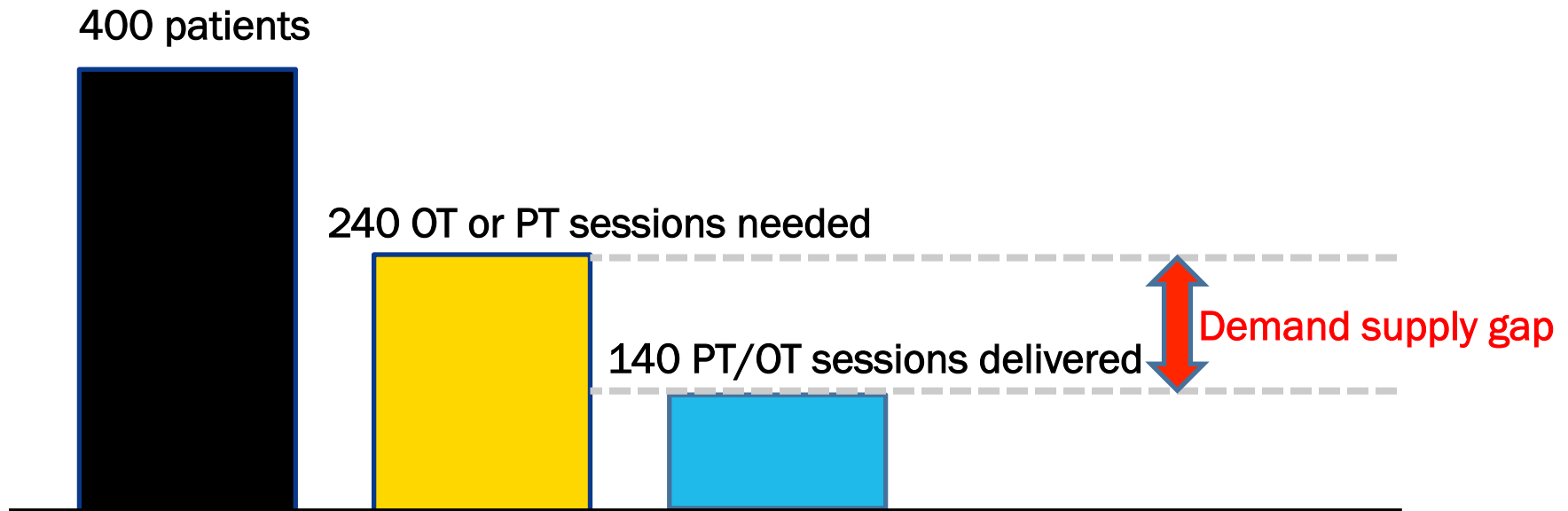
Gorkem Sevinc, MSE  
Managing Director, TIC



INNOVATIONCENTER  
TECHNOLOGY



# Problem: JHBMC



# Problem: Other Institutions



Cleveland Clinic

Beaumont  
HOSPITALS

GBMC

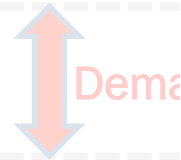


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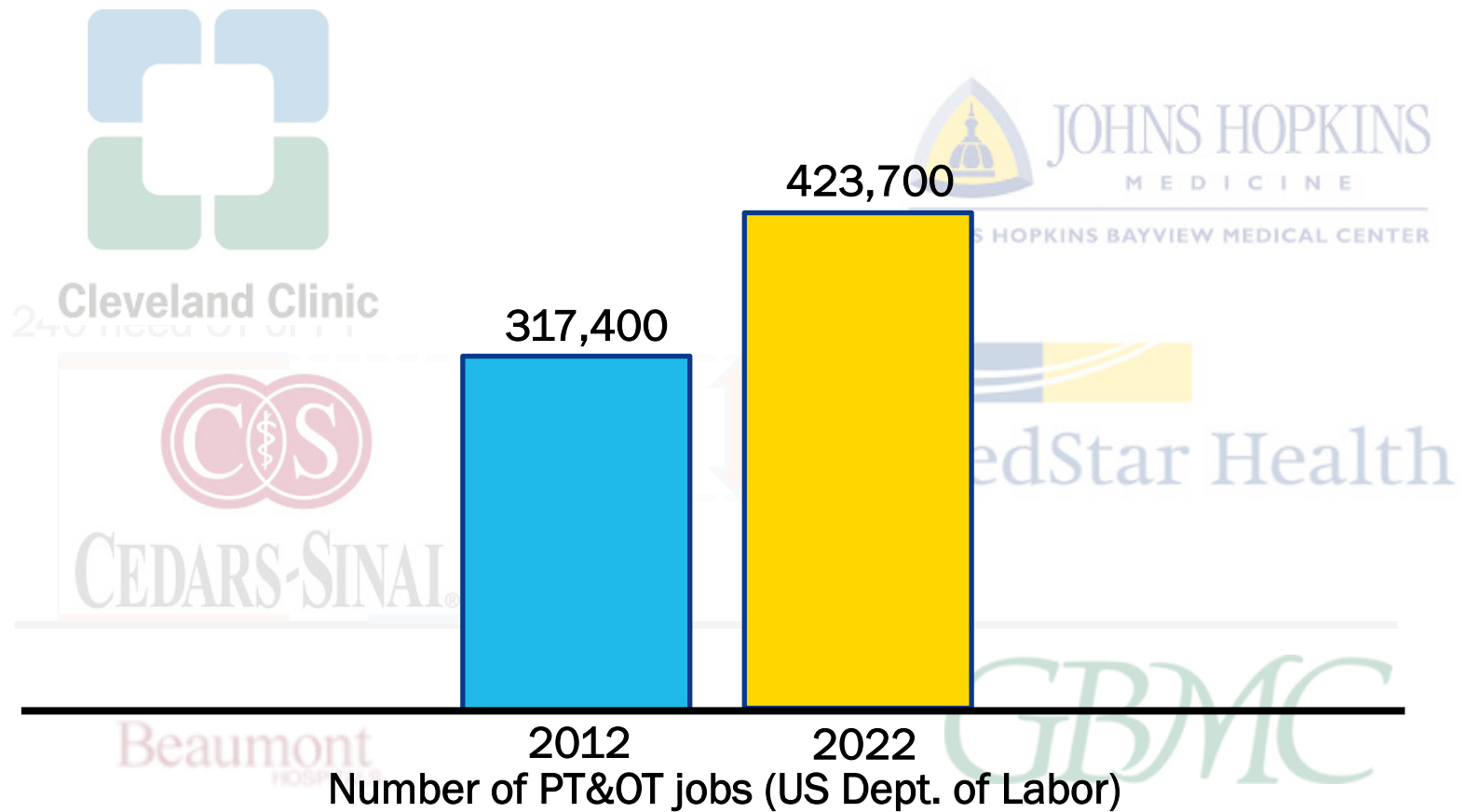
CEDARS-SINAI®

T/OT sessions



MedStar Health

# Projected Growth in Demand for PT & OT



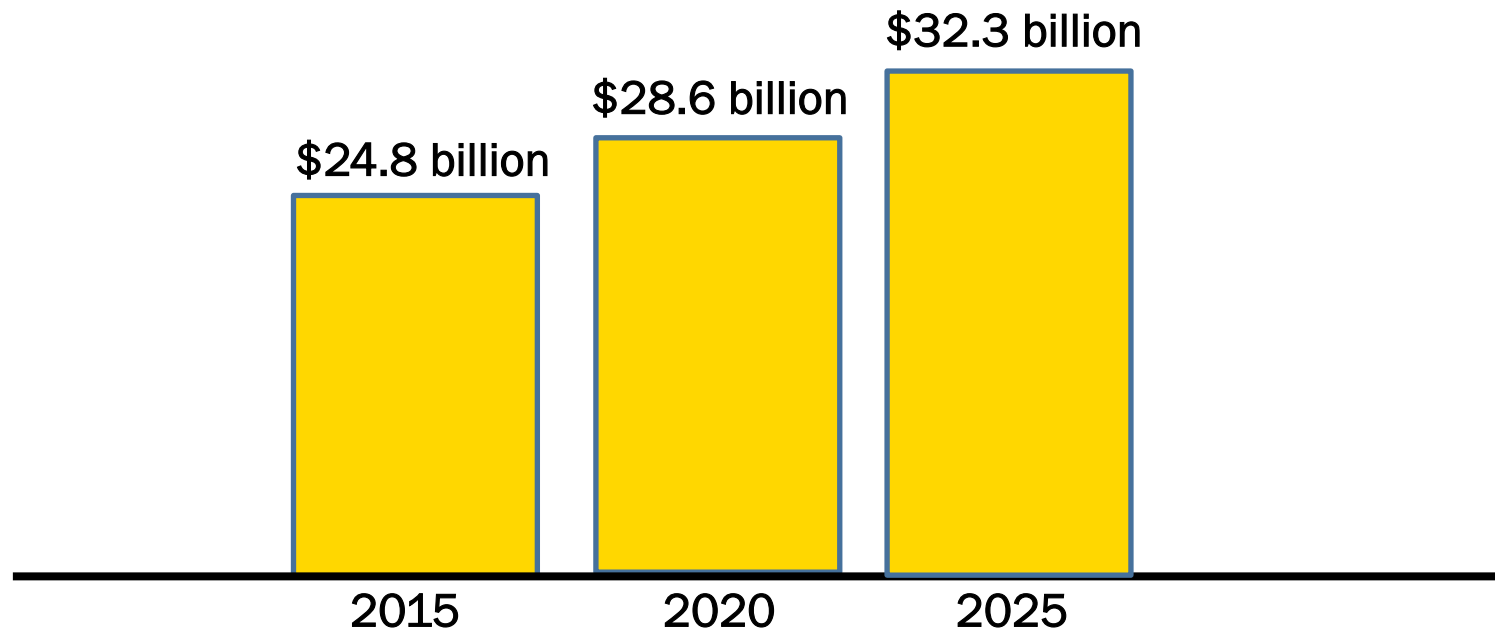
# Solution

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## 1. Hire to Increase the Number of Therapists

# Solution

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Estimated cost of providing therapy services to in-hospital patients



# Solution

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2. Don't hire more therapists. Decrease therapy (PT/OT) treatments for in-hospital patients

# Solution

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2. Don't hire more therapists. Decrease therapy (PT/OT) treatments for in-hospital patients

Decreased function

More post acute care

Reduced throughput

Poor Outcomes

Readmissions

Increased length of hospital stay

# Solution

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3. Use **evidence to prioritize** - Provide PT/OT services to patients who truly need it

and

**Increase efficiency** of therapy staff by informing them of these high priority patients in real time.

# Therapists' Time Saved

20 mins/therapy/day

15 to 20 therapists

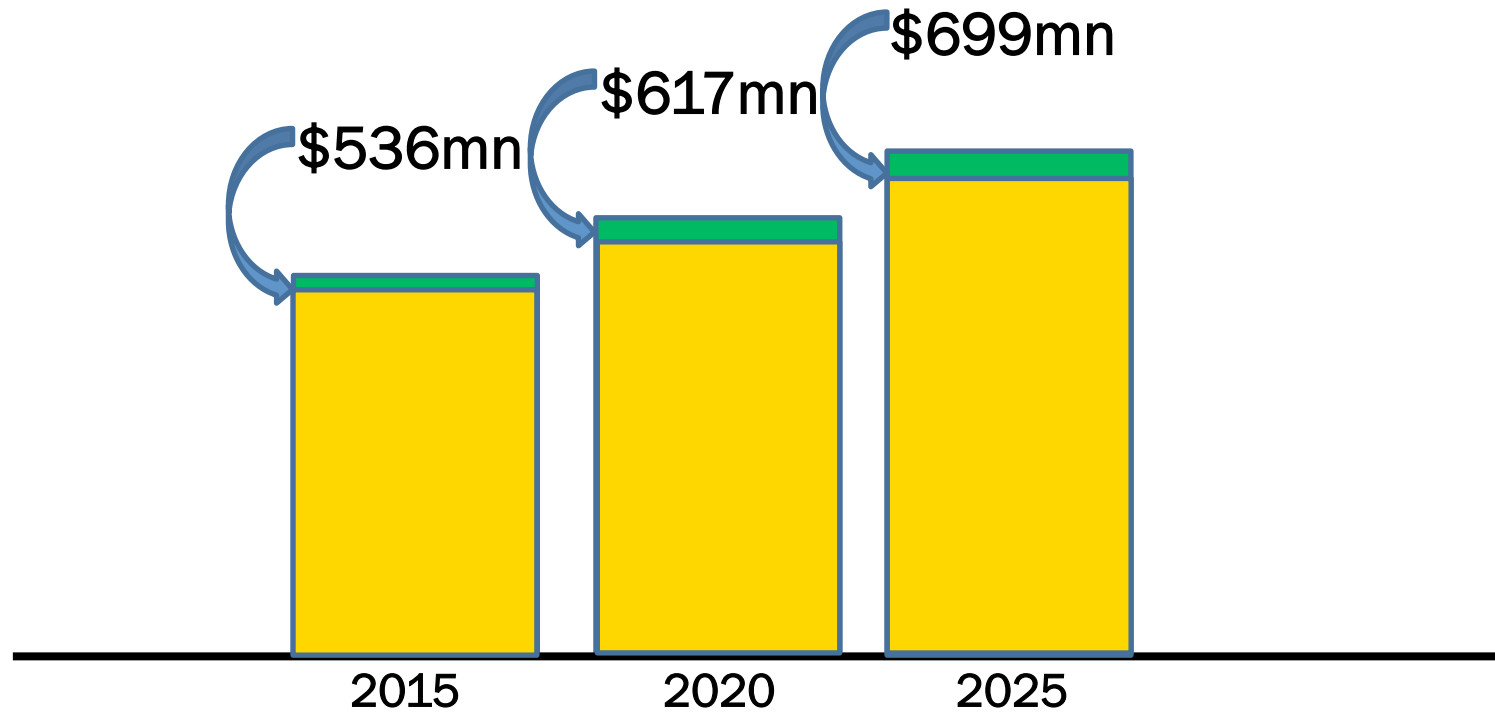
5 to 7 hrs therapy time per day

1.5 hrs of therapy coordinator/  
scheduling time/day

**8 hrs/day (1 FTE)**

**\$50,000 to 80,000/year**

# Projected Savings: U.S. Acute Care Hospitals



Estimated savings if in-hospital therapy services are optimized by using ReHAP

# Status Summary

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**Problem: Increasing demand for PT/OT services**

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**Solution: 1. System to prioritize patient  
2. Direct therapist to prioritized patients**

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**Opportunity: \$ 536 million, 1.3 billion**

---

# Status Summary

**Problem: Increasing demand for PT/OT services**

**Solution: 1. System to prioritize patient  
2. Direct therapist to prioritized patients**



Requirements



Develop MVP



Develop a prototype



Deploy – non JHM



Deploy clinically



Commercialize

**Opportunity: \$ 536 million, 1.3 billion**

# Status Summary

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**Solution: 1. System to prioritize patient  
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Deploy – non JHM



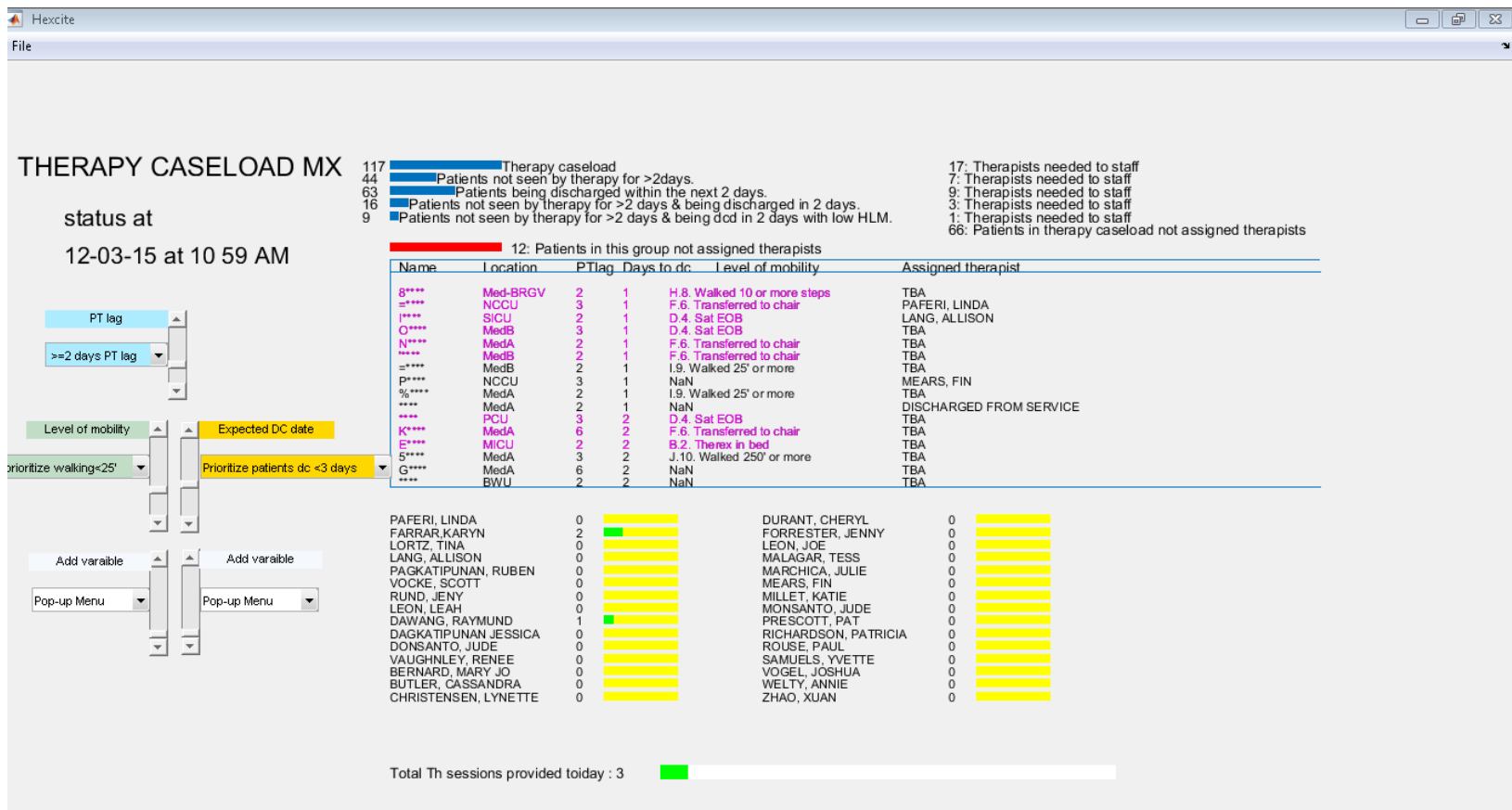
Commercialize

**Opportunity: \$ 536 million, 1.3 billion**



# ReHAP Prototype

# ReHAP Prototype



Written in MATLAB, on data extracted from therapy scheduling system at JHBMC

# “prioritization variables”

Hexcite

File

## THERAPY CASELOAD MIX

status at  
12-03-15 at 10:09 AM

117 Therapy caseload  
44 Patients not seen by therapy for >2days.  
63 Patients being discharged within the next 2 days.  
16 Patients not seen by therapy for >2 days & being discharged in 2 days.  
9 Patients not seen by therapy for >2 days & being dcd in 2 days with low HLM.

17: Therapists needed to staff  
7: Therapists needed to staff  
9: Therapists needed to staff  
3: Therapists needed to staff  
1: Therapists needed to staff  
66: Patients in therapy caseload not assigned therapists

12: Patients in this group not assigned therapists

Name	Location	PTlag	Days to dc	Level of mobility	Assigned therapist
8***	Med-BRGV	2	1	H.8. Walked 10 or more steps	TBA
=***	NCCU	3	1	F.6. Transferred to chair	PAFERI, LINDA
l***	SICU	2	1	D.4. Sat EOB	LANG, ALLISON
O***	MedB	3	1	D.4. Sat EOB	TBA
N***	MedA	2	1	F.6. Transferred to chair	TBA
***	MedB	2	1	F.6. Transferred to chair	TBA
=***	MedB	2	1	I.9. Walked 25' or more	TBA
p***	NCCU	3	1	NaN	MEARS, FIN
%***	MedA	2	1	I.9. Walked 25' or more	TBA
***	MedA	2	1	NaN	DISCHARGED FROM SERVICE
***	PCU	3	2	D.4. Sat EOB	TBA
K***	MedA	6	2	F.6. Transferred to chair	TBA
E***	MICU	2	2	B.2. Therax in bed	TBA
S***	MedA	3	2	J.10. Walked 250' or more	TBA
G***	MedA	6	2	NaN	TBA
***	BWU	2	2	NaN	TBA

PAFERI, LINDA 0

FARRAR, KARYN 2

LORTZ, TINA 0

LANG, ALLISON 0

PAGKATIPUNAN, RUBEN 0

VOCKE, SCOTT 0

RUND, JENY 0

LEON, LEAH 0

DAWANG, RAYMUND 1

DAGKATIPUNAN, JESSICA 0

DONSANTO, JUDE 0

VAUGHNLEY, RENEE 0

BERNARD, MARY JO 0

BUTLER, CASSANDRA 0

CHRISTENSEN, LYNETTE 0

DURANT, CHERYL 0

FORRESTER, JENNY 0

LEON, JOE 0

MALAGAR, TESS 0

MARCHICA, JULIE 0

MEARS, FIN 0

MILLET, KATIE 0

MONSANTO, JUDE 0

PRESCOTT, PAT 0

RICHARDSON, PATRICIA 0

ROUSE, PAUL 0

SAMUELS, YVETTE 0

VOGEL, JOSHUA 0

WELTY, ANNIE 0

ZHAO, XUAN 0

Total Th sessions provided today : 3

PT lag: >=2 days PT lag

Level of mobility: Prioritize walking <=25'

Expected DC date: Prioritize patients dc <3 days

Add variable: Add variable

Pop-up Menu: Pop-up Menu

# prioritization variables

Controls to add/change weight of “prioritization variables”

## THERAPY CASELOAD MIX

status at  
12-03-15 at 10:39 AM

PT lag

>=2 days PT lag

Level of mobility

Prioritize walking <=25'

Prioritize patients dc <3 days

Add variable

Pop-up Menu

- Therapy caseload
- Patients not seen by therapy for >2days.
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- 17: Therapists needed to staff
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- 66: Patients in therapy caseload not assigned therapists

12: Patients in this group not assigned therapists

Name	Location	PTlag	Days to dc	Level of mobility	Assigned therapist
8***	Med-BRGV	2	1	H.8. Walked 10 or more steps	TBA
=***	NCCU	3	1	F.6. Transferred to chair	PAFERI, LINDA
I***	SICU	2	1	D.4. Sat EOB	LANG, ALLISON
O***	MedB	3	1	D.4. Sat EOB	TBA
N***	MedA	2	1	F.6. Transferred to chair	TBA
***	MedB	2	1	F.6. Transferred to chair	TBA
=***	MedB	2	1	I.9. Walked 25' or more	TBA
P***	NCCU	3	1	NaN	MEARS, FIN
%***	MedA	2	1	I.9. Walked 25' or more	TBA
***	MedA	2	1	NaN	DISCHARGED FROM SERVICE
***	PCU	3	2	D.4. Sat EOB	TBA
K***	MedA	6	2	F.6. Transferred to chair	TBA
E***	MICU	2	2	B.2. Therax in bed	TBA
S***	MedA	3	2	J.10. Walked 250' or more	TBA
G***	MedA	6	2	NaN	TBA
***	BWU	2	2	NaN	TBA

PAFERI, LINDA	0	<div style="width: 0%;"></div>	DURANT, CHERYL	0	<div style="width: 0%;"></div>
FARRAR, KARYN	2	<div style="width: 20%;"></div>	FORRESTER, JENNY	0	<div style="width: 0%;"></div>
LORTZ, TINA	0	<div style="width: 0%;"></div>	LEON, JOE	0	<div style="width: 0%;"></div>
LANG, ALLISON	0	<div style="width: 0%;"></div>	MALAGAR, TESS	0	<div style="width: 0%;"></div>
PAGKATIPUNAN, RUBEN	0	<div style="width: 0%;"></div>	MARCHICA, JULIE	0	<div style="width: 0%;"></div>
VOCKE, SCOTT	0	<div style="width: 0%;"></div>	MEARS, FIN	0	<div style="width: 0%;"></div>
RUND, JENY	0	<div style="width: 0%;"></div>	MILLET, KATIE	0	<div style="width: 0%;"></div>
LEON, LEAH	0	<div style="width: 0%;"></div>	MONSANTO, JUDE	0	<div style="width: 0%;"></div>
DAWANG, RAYMUND	1	<div style="width: 10%;"></div>	PRESCOTT, PAT	0	<div style="width: 0%;"></div>
DAGKATIPUNAN, JESSICA	0	<div style="width: 0%;"></div>	RICHARDSON, PATRICIA	0	<div style="width: 0%;"></div>
DONSANTO, JUDE	0	<div style="width: 0%;"></div>	ROUSE, PAUL	0	<div style="width: 0%;"></div>
VAUGHNLEY, RENEE	0	<div style="width: 0%;"></div>	SAMUELS, YVETTE	0	<div style="width: 0%;"></div>
BERNARD, MARY JO	0	<div style="width: 0%;"></div>	VOGEL, JOSHUA	0	<div style="width: 0%;"></div>
BUTLER, CASSANDRA	0	<div style="width: 0%;"></div>	WELTY, ANNIE	0	<div style="width: 0%;"></div>
CHRISTENSEN, LYNETTE	0	<div style="width: 0%;"></div>	ZHAO, XUAN	0	<div style="width: 0%;"></div>

Total Th sessions provided today : 3

# prioritization variables

Controls to add/change weight of "prioritization variables"

Name & location of high priority patients

## THERAPY CASELOAD MIX

status at  
12-03-15 at 10:59 AM

PT lag

>=2 days PT lag

Level of mobility

Prioritize walking <=25'

Prioritize patients dc <3 days

Expected DC date

Add variable

Pop-up Menu

12: Patients in this group not assigned therapists

Name	Location	PTlag	Days to dc	Level of mobility	Assigned therapist
8***	Med-BRGV	2	1	F.6. Walked 10 or more steps	TBA
9***	NCCU	3	1	F.6. Transferred to chair	PAFERI, LINDA
10***	SICU	2	1	D.4. Sat EOB	LANG, ALLISON
11***	MedB	1	1	D.4. Sat EOB	TBA
12***	MedA	2	1	F.6. Transferred to chair	TBA
13***	MedB	2	1	F.6. Transferred to chair	TBA
14***	MedB	2	1	I.9. Walked 25' or more	TBA
15***	NCCU	3	1	NaN	MEARS, FIN
16***	MedA	2	1	I.9. Walked 25' or more	TBA
17***	MedA	2	1	NaN	DISCHARGED FROM SERVICE
18***	PCU	3	2	D.4. Sat EOB	TBA
19***	MedA	6	2	F.6. Transferred to chair	TBA
20***	MICU	2	2	B.2. Therax in bed	TBA
21***	MedA	3	2	J.10. Walked 250' or more	TBA
22***	MedA	6	2	NaN	TBA
23***	BWU	2	2	NaN	TBA

PAFERI, LINDA	0	<div style="width: 0%; height: 10px; background-color: yellow;"></div>	DURANT, CHERYL	0	<div style="width: 0%; height: 10px; background-color: yellow;"></div>
FARRAR, KARYN	2	<div style="width: 20%; height: 10px; background-color: yellow;"></div>	FORRESTER, JENNY	0	<div style="width: 0%; height: 10px; background-color: yellow;"></div>
LORTZ, TINA	0	<div style="width: 0%; height: 10px; background-color: yellow;"></div>	LEON, JOE	0	<div style="width: 0%; height: 10px; background-color: yellow;"></div>
LANG, ALLISON	0	<div style="width: 0%; height: 10px; background-color: yellow;"></div>	MALAGAR, TESS	0	<div style="width: 0%; height: 10px; background-color: yellow;"></div>
PAGKATIPUNAN, RUBEN	0	<div style="width: 0%; height: 10px; background-color: yellow;"></div>	MARCHICA, JULIE	0	<div style="width: 0%; height: 10px; background-color: yellow;"></div>
VOCKE, SCOTT	0	<div style="width: 0%; height: 10px; background-color: yellow;"></div>	MEARS, FIN	0	<div style="width: 0%; height: 10px; background-color: yellow;"></div>
RUND, JENY	0	<div style="width: 0%; height: 10px; background-color: yellow;"></div>	MILLET, KATIE	0	<div style="width: 0%; height: 10px; background-color: yellow;"></div>
LEON, LEAH	0	<div style="width: 0%; height: 10px; background-color: yellow;"></div>	MONSANTO, JUDE	0	<div style="width: 0%; height: 10px; background-color: yellow;"></div>
DAWANG, RAYMUND	1	<div style="width: 10%; height: 10px; background-color: yellow;"></div>	PRESCOTT, PAT	0	<div style="width: 0%; height: 10px; background-color: yellow;"></div>
DAGKATIPUNAN, JESSICA	0	<div style="width: 0%; height: 10px; background-color: yellow;"></div>	RICHARDSON, PATRICIA	0	<div style="width: 0%; height: 10px; background-color: yellow;"></div>
DONSANTO, JUDE	0	<div style="width: 0%; height: 10px; background-color: yellow;"></div>	ROUSE, PAUL	0	<div style="width: 0%; height: 10px; background-color: yellow;"></div>
VAUGHNLEY, RENEE	0	<div style="width: 0%; height: 10px; background-color: yellow;"></div>	SAMUELS, WYETTE	0	<div style="width: 0%; height: 10px; background-color: yellow;"></div>
BERNARD, MARY JO	0	<div style="width: 0%; height: 10px; background-color: yellow;"></div>	VOGEL, JOSHUA	0	<div style="width: 0%; height: 10px; background-color: yellow;"></div>
BUTLER, CASSANDRA	0	<div style="width: 0%; height: 10px; background-color: yellow;"></div>	WELTY, ANNIE	0	<div style="width: 0%; height: 10px; background-color: yellow;"></div>
CHRISTENSEN, LYNETTE	0	<div style="width: 0%; height: 10px; background-color: yellow;"></div>	ZHAO, XUAN	0	<div style="width: 0%; height: 10px; background-color: yellow;"></div>

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S***	MedA	3	2	J.10. Walked 250' or more	TBA
G***	MedA	6	2	NaN	TBA
***	BWU	2	2	NaN	TBA

Therapists available to see these patients

PAFERI, LINDA	0		DURANT, CHERYL	0	
FARRAR, KARYN	2		FORRESTER, JENNY	0	
LORTZ, TINA	0		LEON, JOE	0	
LANG, ALLISON	0		MALAGAR, TESS	0	
PAGKATIPUNAN, RUBEN	0		MARCHIONNI, MARIE	0	
VOCKE, SCOTT	0		MELTZER, JIN	0	
RUND, JENY	0		MELLET, KATIE	0	
LEON, LEAH	0		MONSANTO, JUDE	0	
DAWANG, RAYMUND	1		PRESCOTT, PAT	0	
DAGKATIPUNAN, JESSICA	0		RICHARDSON, PATRICIA	0	
DONSANTO, JUDE	0		ROUSE, PAUL	0	
VAUGHNLEY, RENEE	0		SAMUELS, WYETTE	0	
BERNARD, MARY JO	0		VOGEL, JOSHUA	0	
BUTLER, CASSANDRA	0		WELTY, ANNIE	0	
CHRISTENSEN, LYNETTE	0		ZHAO, XUAN	0	

Total Th sessions provided today : 3

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# ReHAP MVP

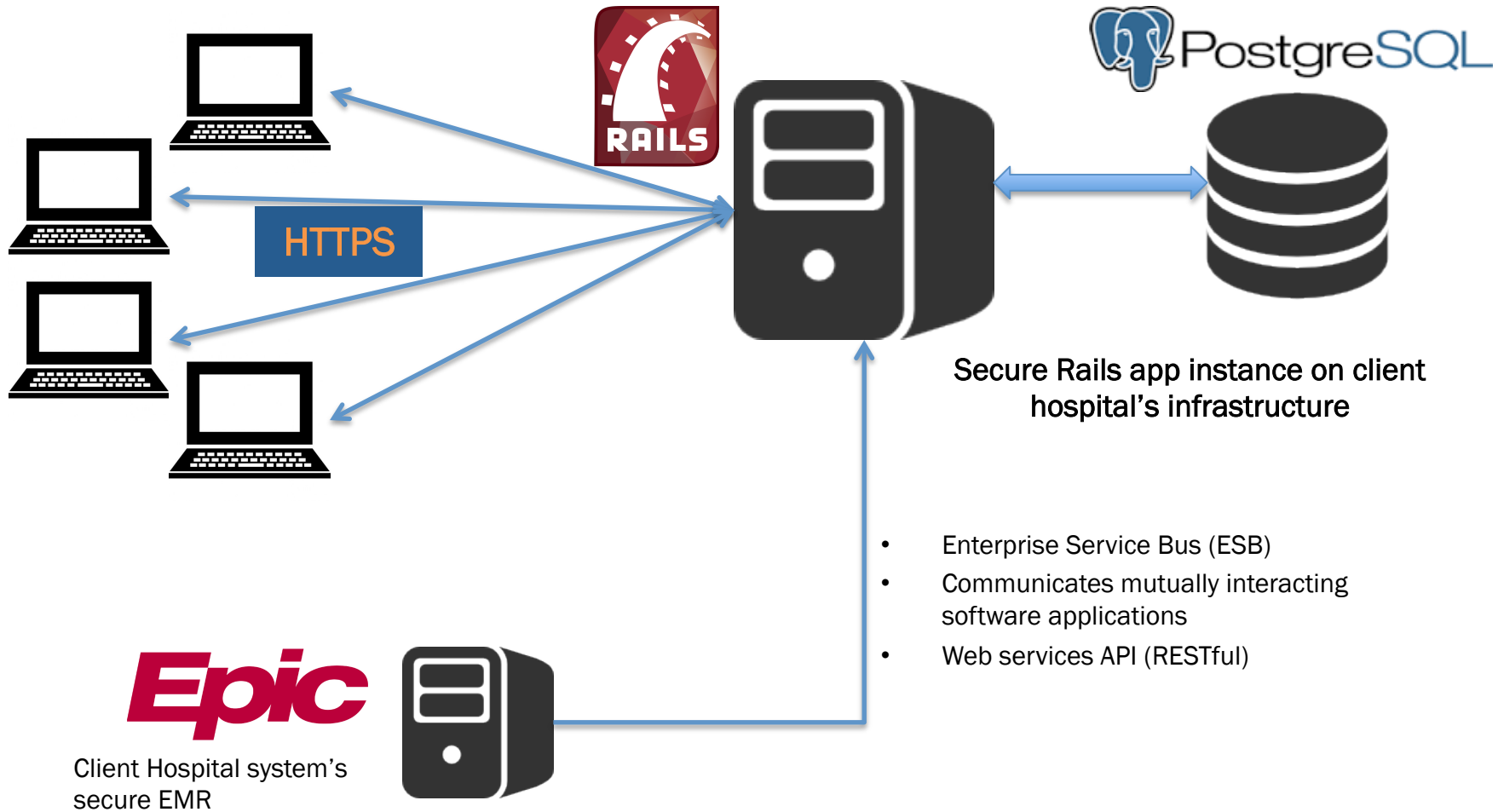
# ReHAP MVP Basic Aims

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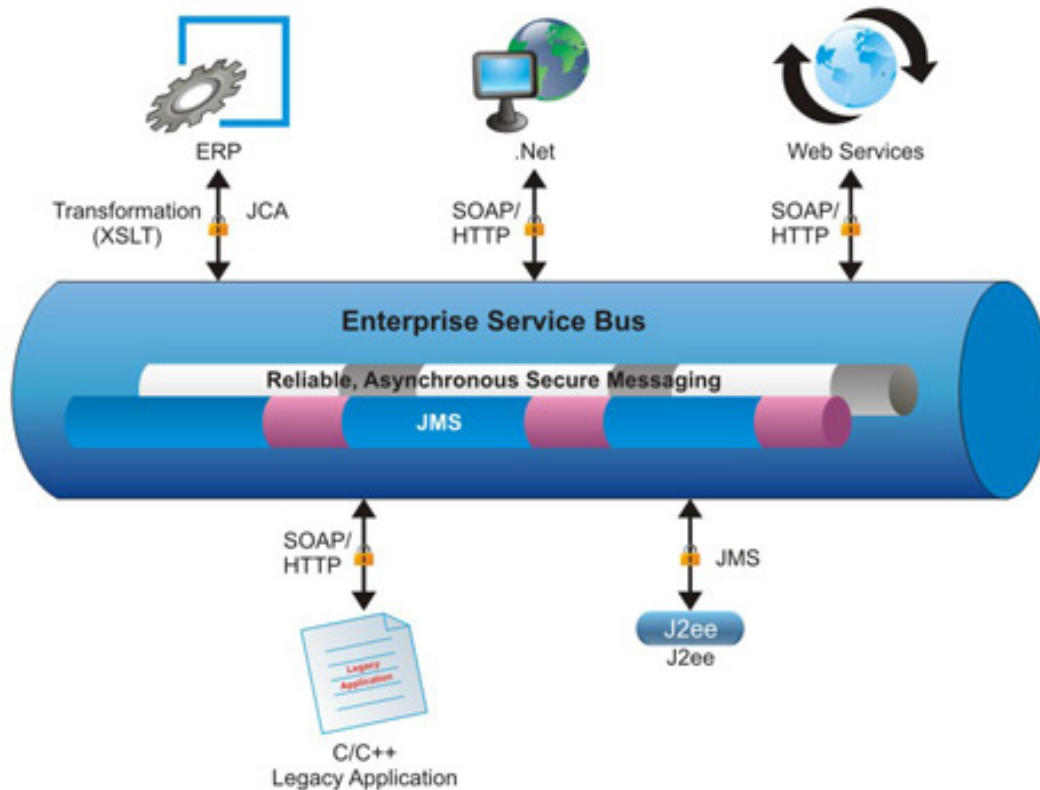
- ✓ Web-based tool
- ✓ ReHAP “Priority List” on every therapists’ laptop
- ✓ Connect to live EMR (EPIC) data
  - ✓ Auto refresh every 5 min
- ✓ Modes for PT, OT, Manager, Physician
- ✓ Instance of application to be deployable on-site
- ✓ Simple and seamless to use



# Technical Approach: MVP Design



# Technical Approach: ESB Overview



- Enterprise Service Bus (ESB)
- Communicates mutually interacting software applications
- Web Services API (RESTful)
- Working with Web Services team





### Inpatient Therapist Utilization Manager

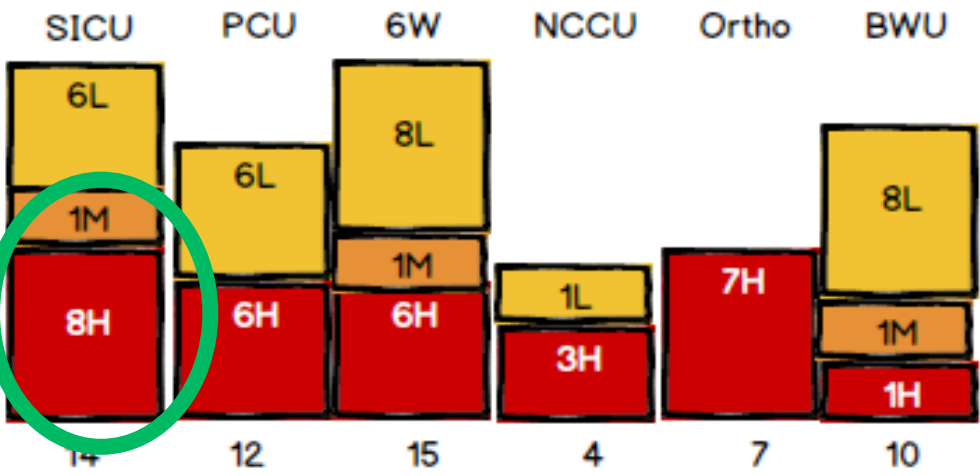
10/30/2015 8:00AM

Patients highest priority for PT eval today

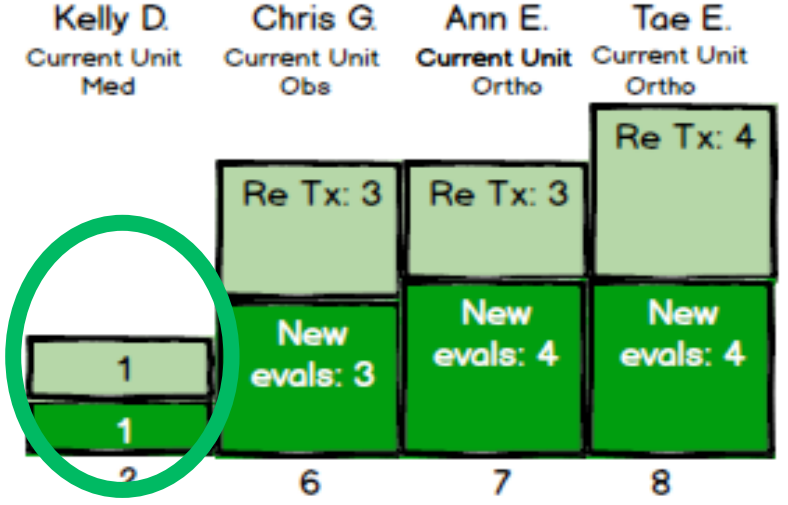
Patient Name	Unit	Order of Highest Priority	Covering therapist Yesterday/Today
M. Polo	SICU	[Red bar]	TBA
J. Hopkins	PCU	[Red bar]	TAB
T. Swift	6W	[Red bar]	TBA
K. Bryant	NCCU	[Red bar]	TBA
B. Knowles	Ortho	[Red bar]	TBA
Z. Deschanel	BWU	[Red bar]	TBA

less impaired ————— more impaired

### Patients needing therapy



### Caseload per therapist







### Inpatient Therapist Utilization Manager

Patients highest priority for PT eval today

10/30/2015 8:00AM

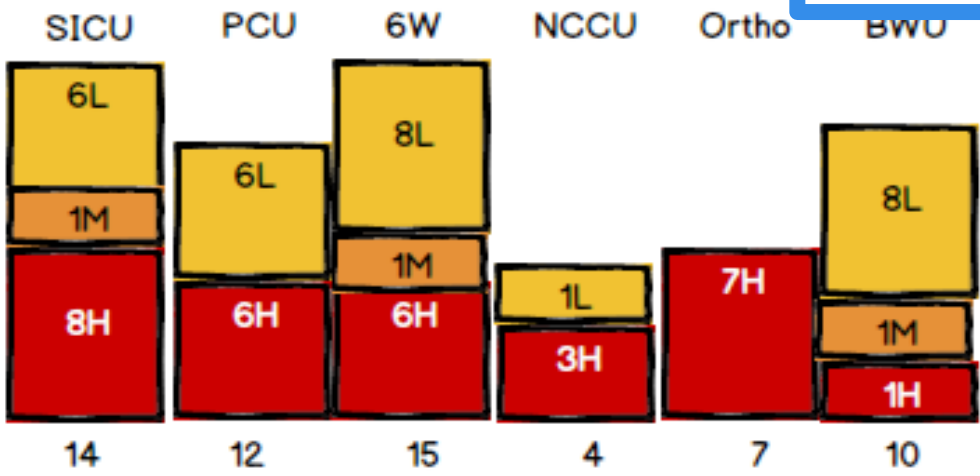
Covering therapist  
Yesterday/Today

Patient Name	Unit	Order of Highest Priority	Covering therapist Yesterday/Today
M. Polo	SICU	[Red bar]	TBA
J. Hopkins	PCU	[Red bar]	TAB
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Z. Deschanel	BWU	[Red bar]	TBA

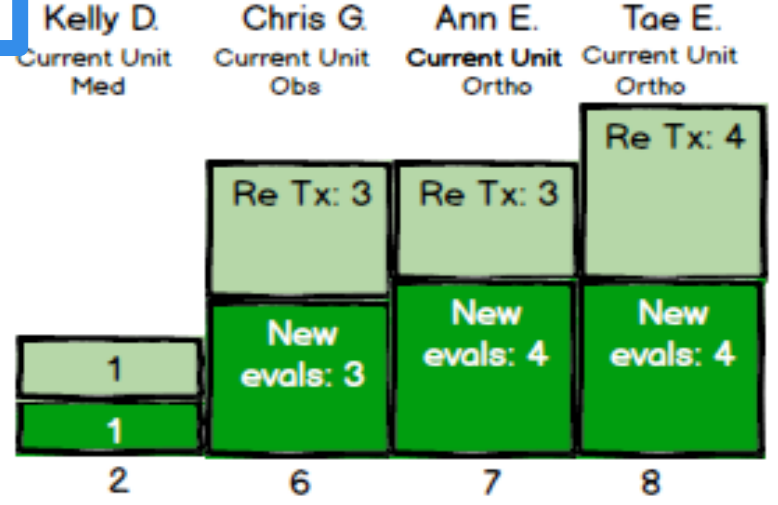
less impaired ← → more impaired



#### Patients needing therapy



#### Caseload per therapist







### Inpatient Therapist Utilization Manager

10/30/2015



4:00 PM

Patients highest priority for PT eval today

Covering therapist

Yesterday/Today

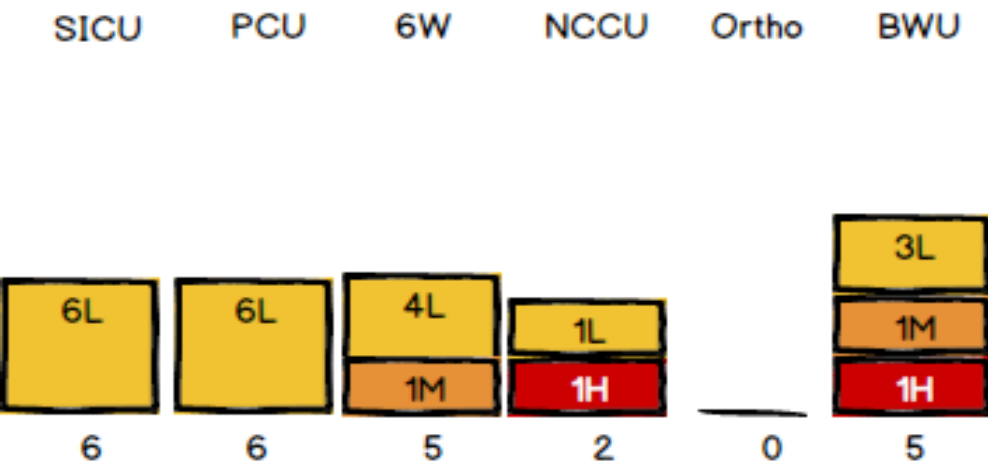
Patient Name      Unit      Order of Highest Priority

N. Prom	Med B	[Red bar]
K. Tan	NCCU	[Red bar]
M. Mayo	Sx floor	[Orange bar]
S. Kat	NSU	[Orange bar]
T. Mock	PCU	[Orange bar]
L. Zach	Med A	[Orange bar]

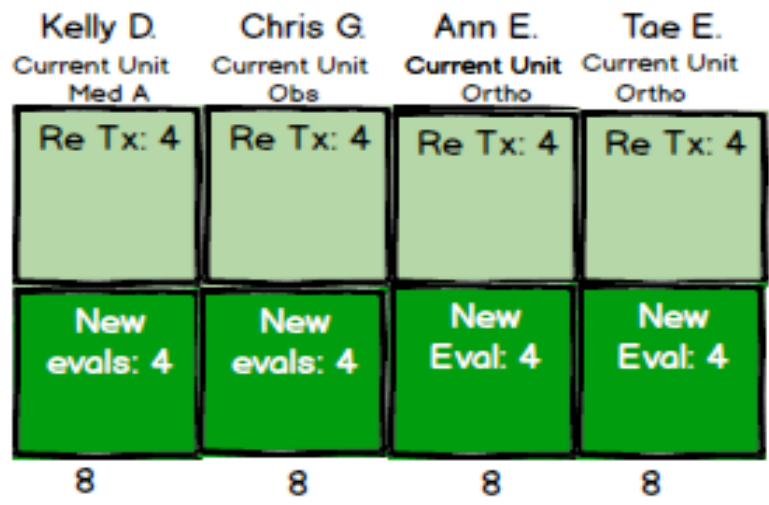
Mat K
Sota P
TBA
TBA
TBA
TBA

less impaired ----- more impaired

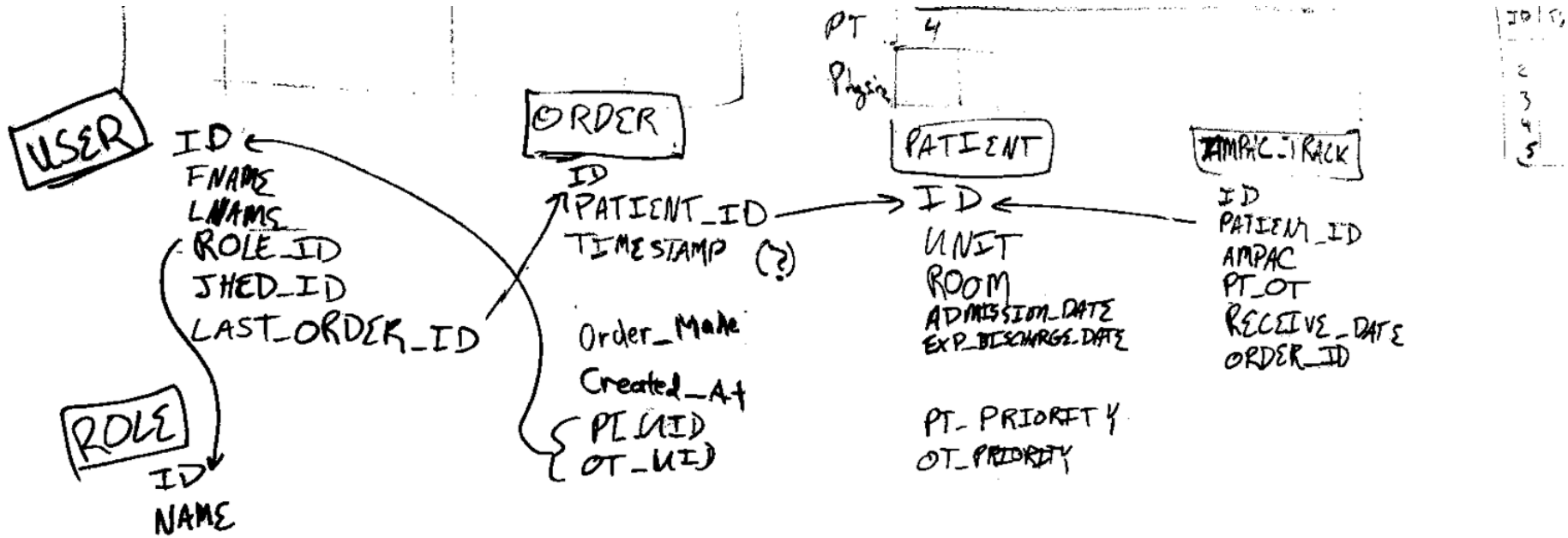
#### Patients needing therapy



#### Caseload per therapist



# Technical Approach: DB Design



# Deliverables

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## Minimum

- Create and populate database
- Implement Rails app framework
- PT/OT view and permissions
- Shadow-informed front-end mockups for all users
- Prioritization algorithm implemented in Rails app

## Expected

- Manager view + permissions
- ESB set up and integrated with Rails app
  - Refreshing every 5 mins
- Single-sign-on server configuration

## Maximum

- Physician view + premissions
- Deployed at JHBMC
- Tested by PT/OT teams at JHBMC
- Instances deployed or configured to be deployed at non-JH facilities

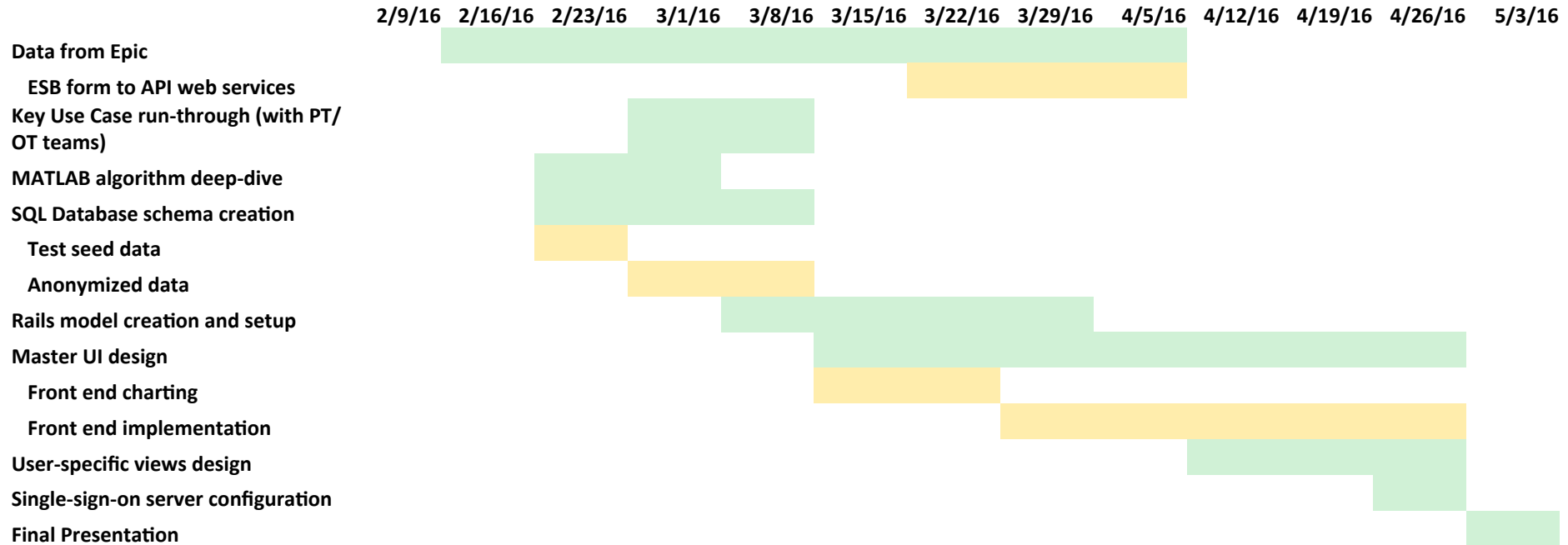
# Dependencies

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- Enterprise Service Bus (ESB) integration
- Cooperation between Web Services
- Secure development environment
  - SSL into Hopkins server
- Knowledge of Rails
- PostgreSQL
- JIRA + Bitbucket (SCRUM)
- Cooperation with JHBMC PT/OT team for shadowing
- HIPAA compliance (intermediate certification)
- D3.js for visualization
- Possibly DataTables.js + DTEditor.js
- Weekly team meetings Tuesdays on Hangout and at FF East
- Cooperation with Tony Pan (dev partner)



# Milestones



# ReHAP

## Rehabilitation and Healthcare Analytics Platform

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