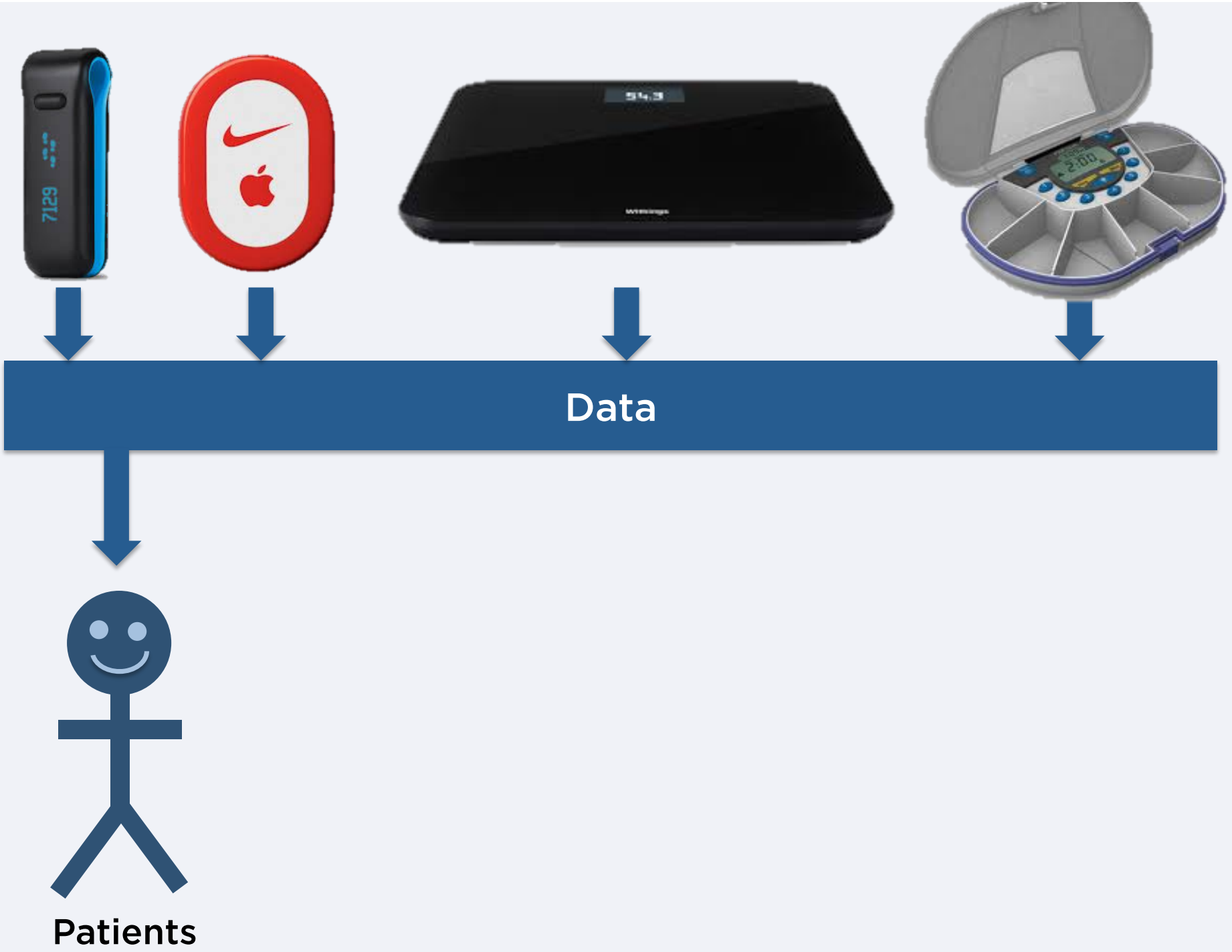
Getting more value from behavioral self-monitoring

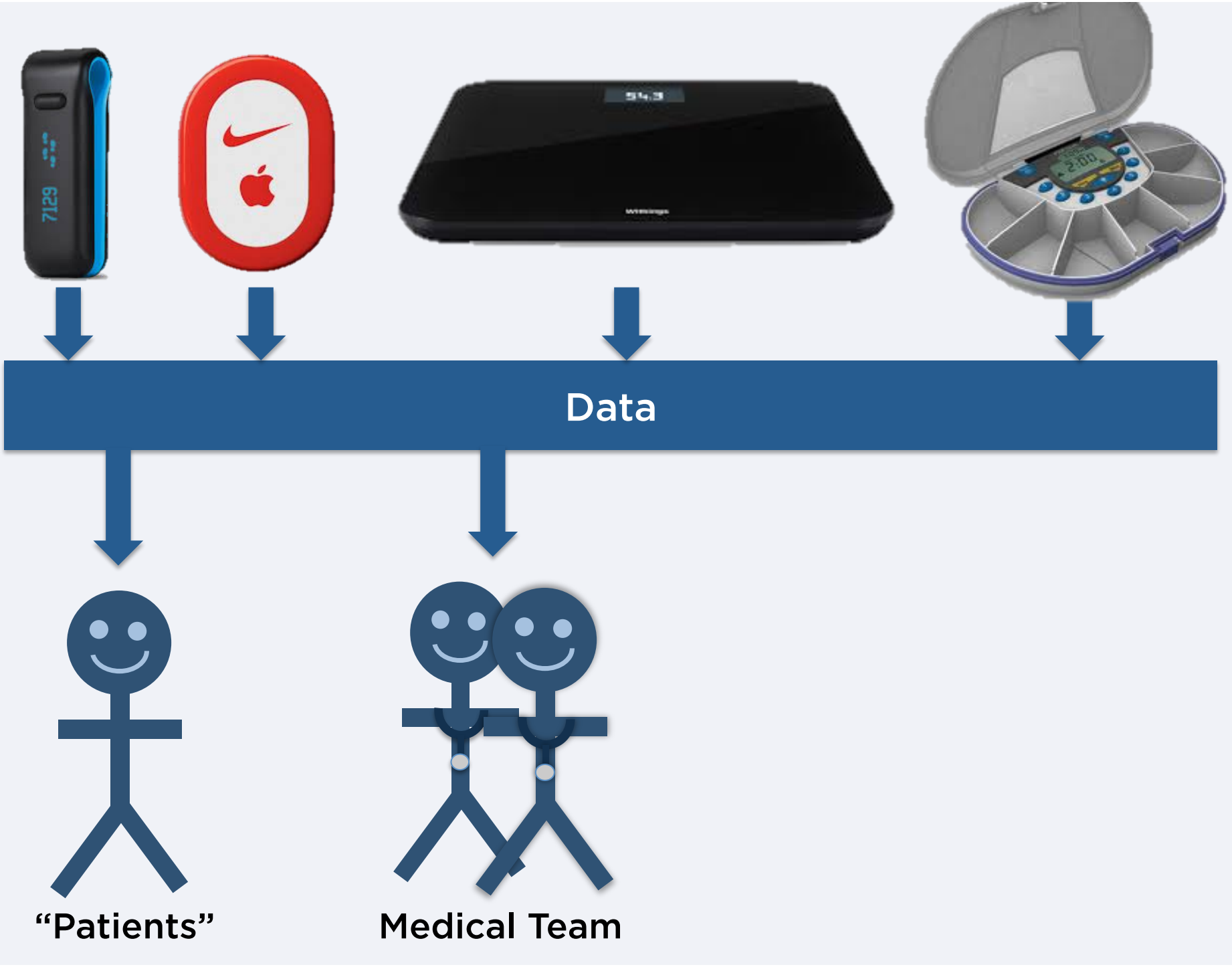
Sean A. Munson


7129


54.3


Data


Data
Patients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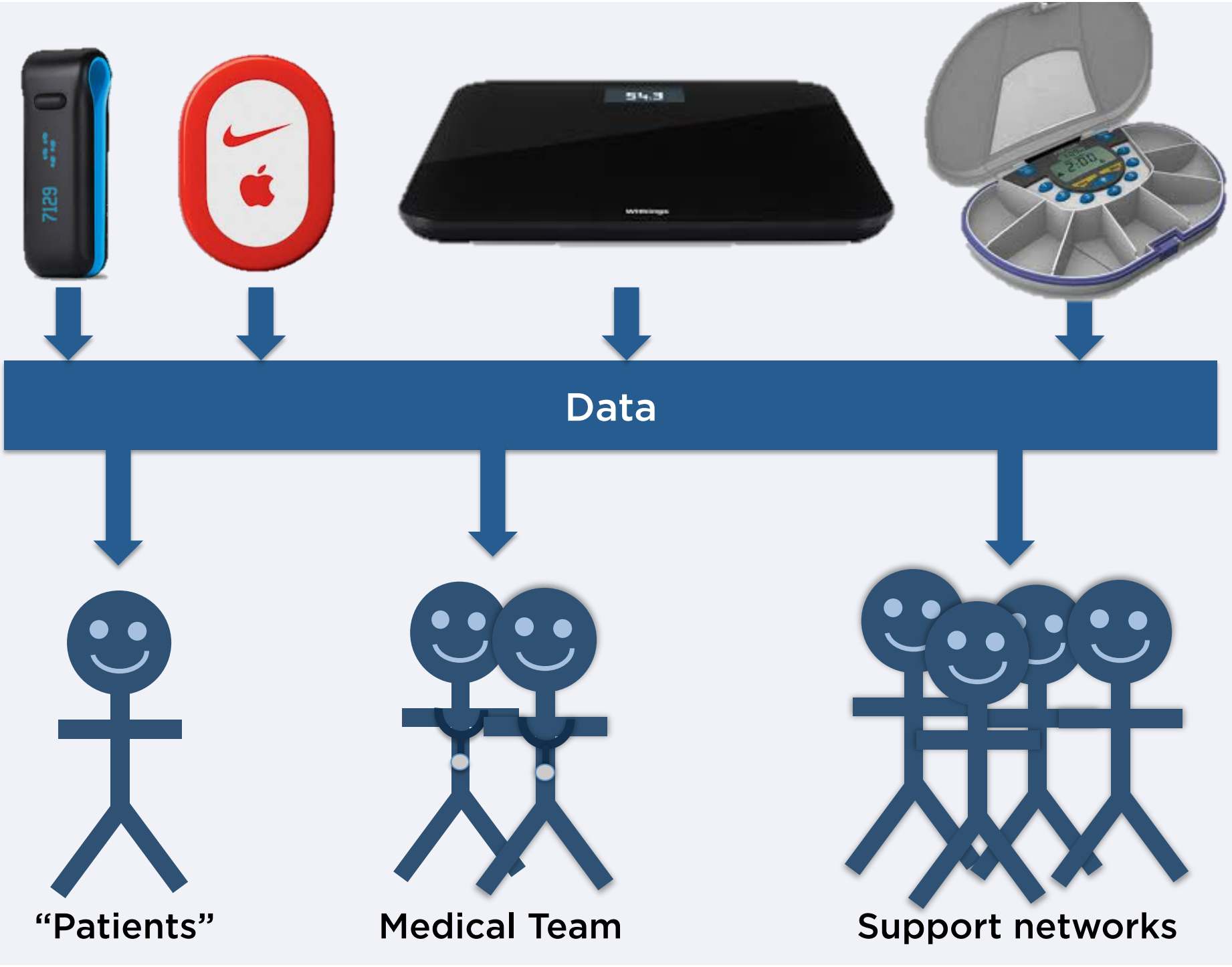
Medical Team


Data
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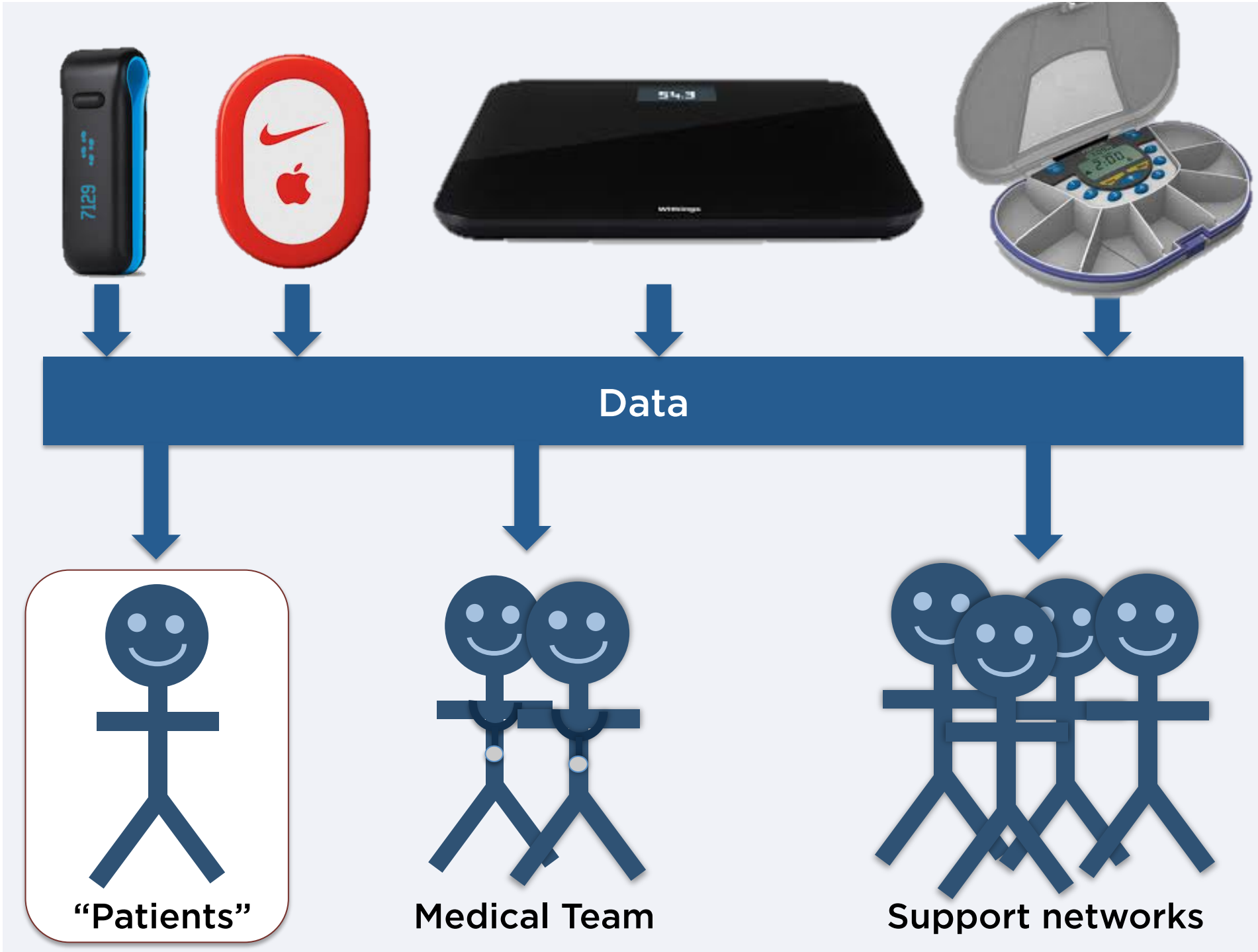
Medical Team
Support networks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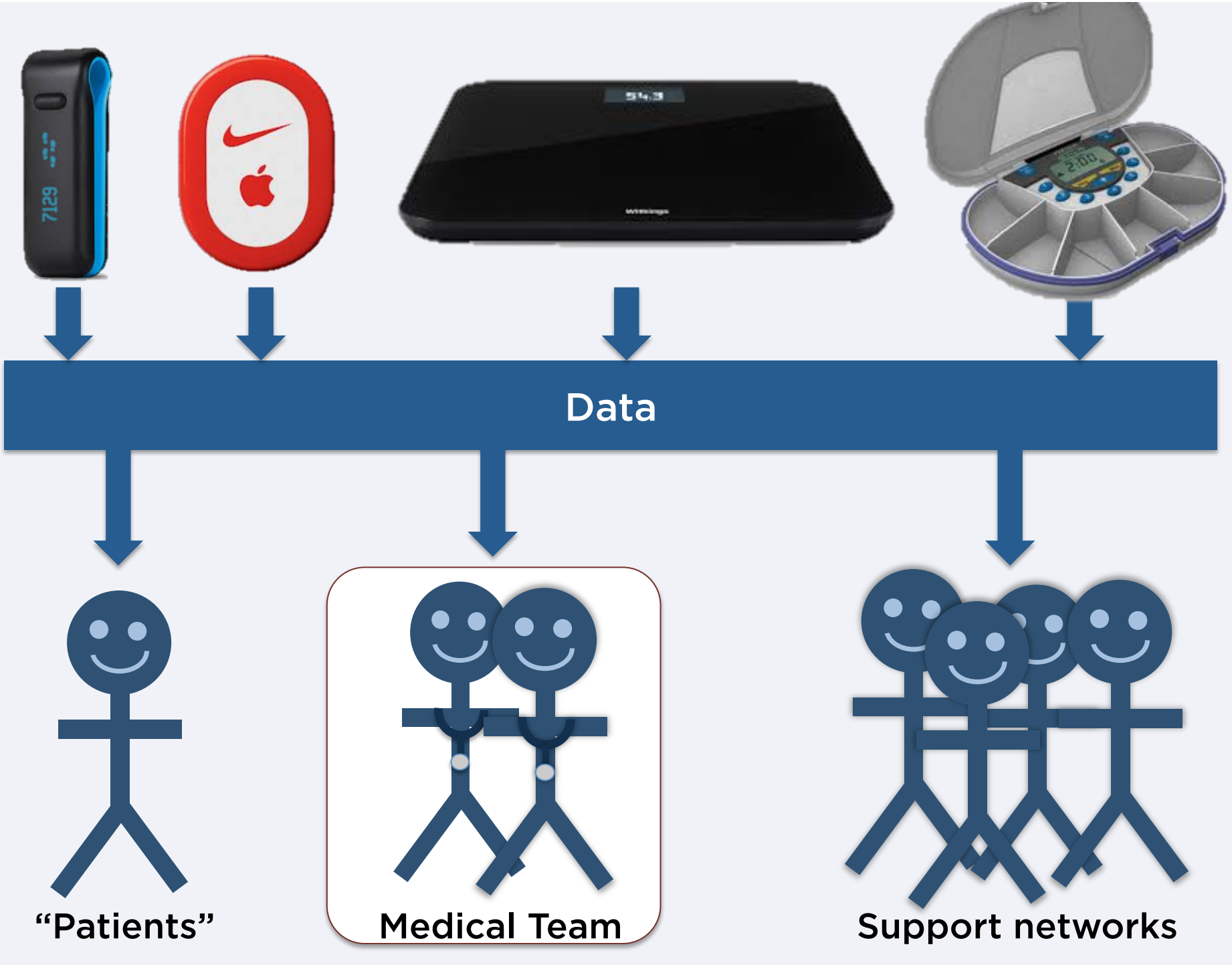
Medical Team
Support networks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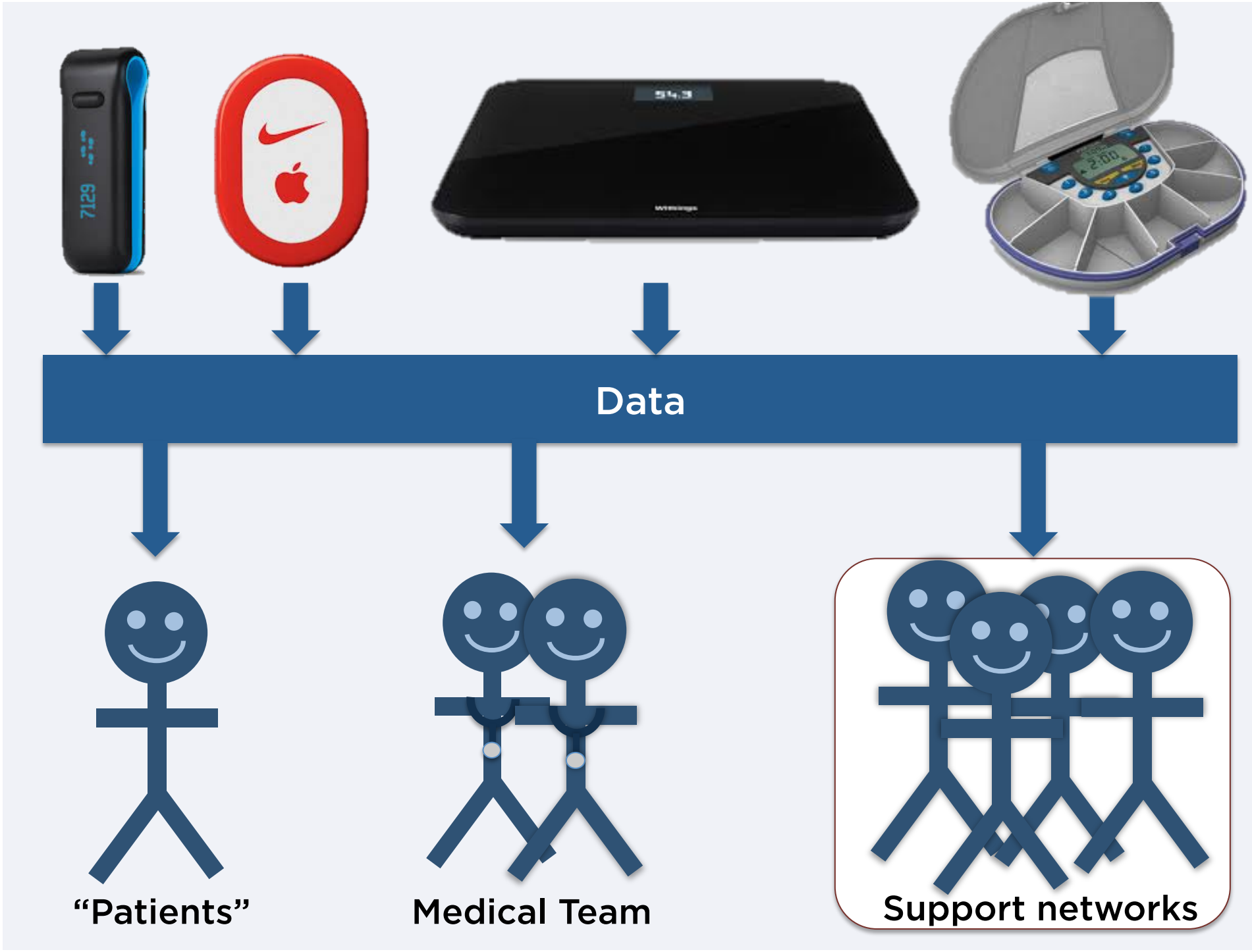
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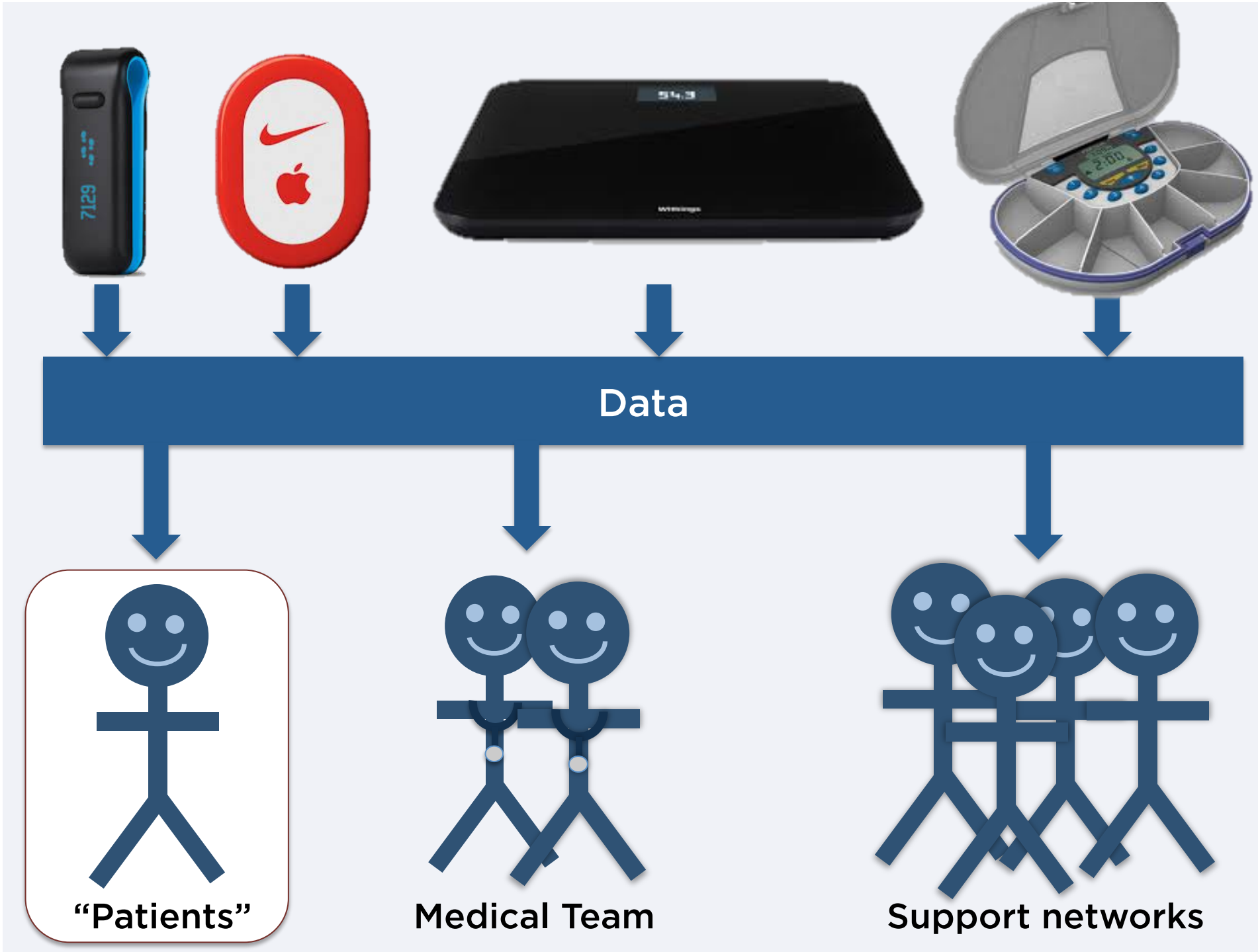
Support networks


Data
"Patients"
Medical Team
Support networks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YARDS
ABERCROMBIE & FITCH CO
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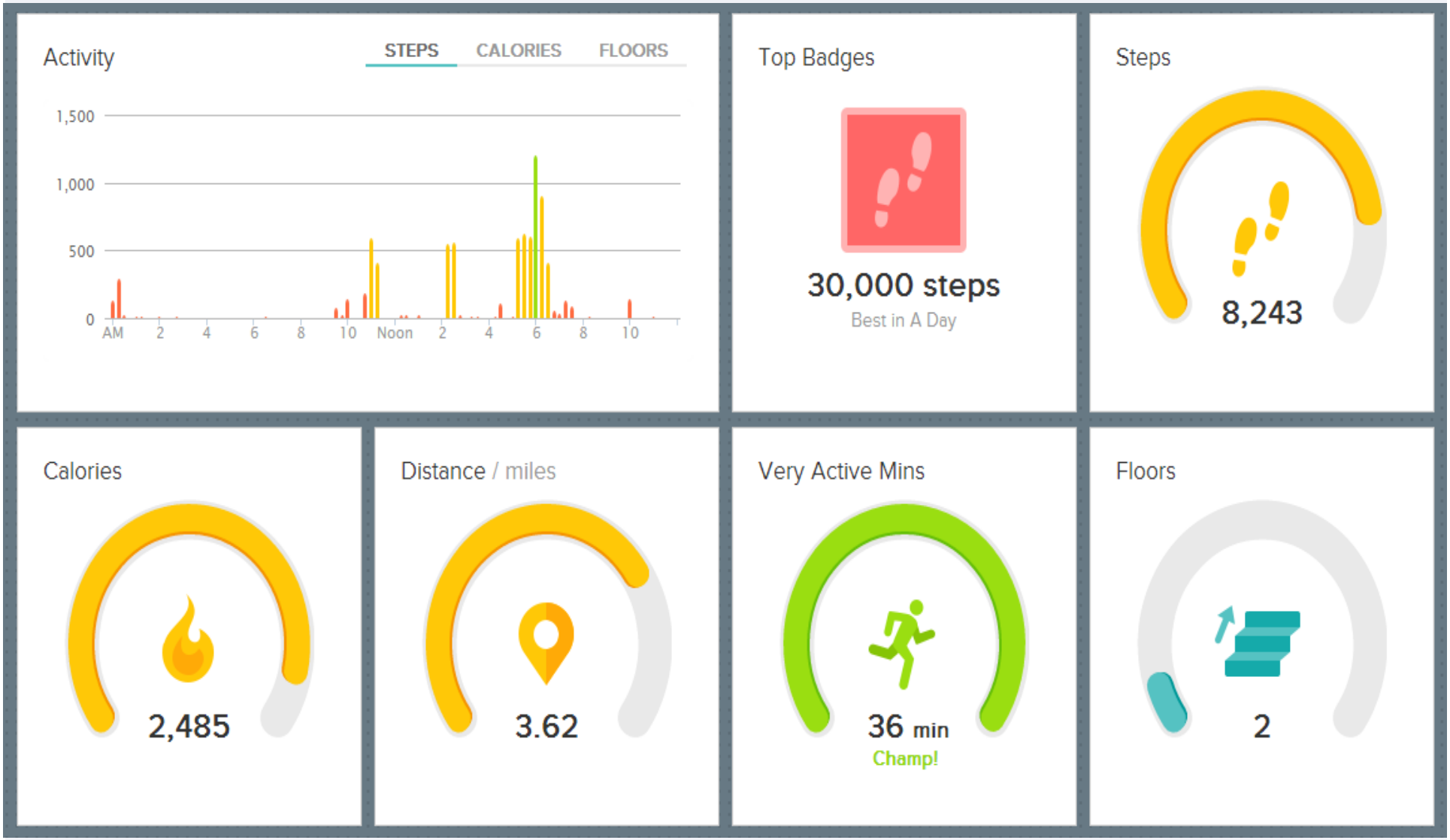
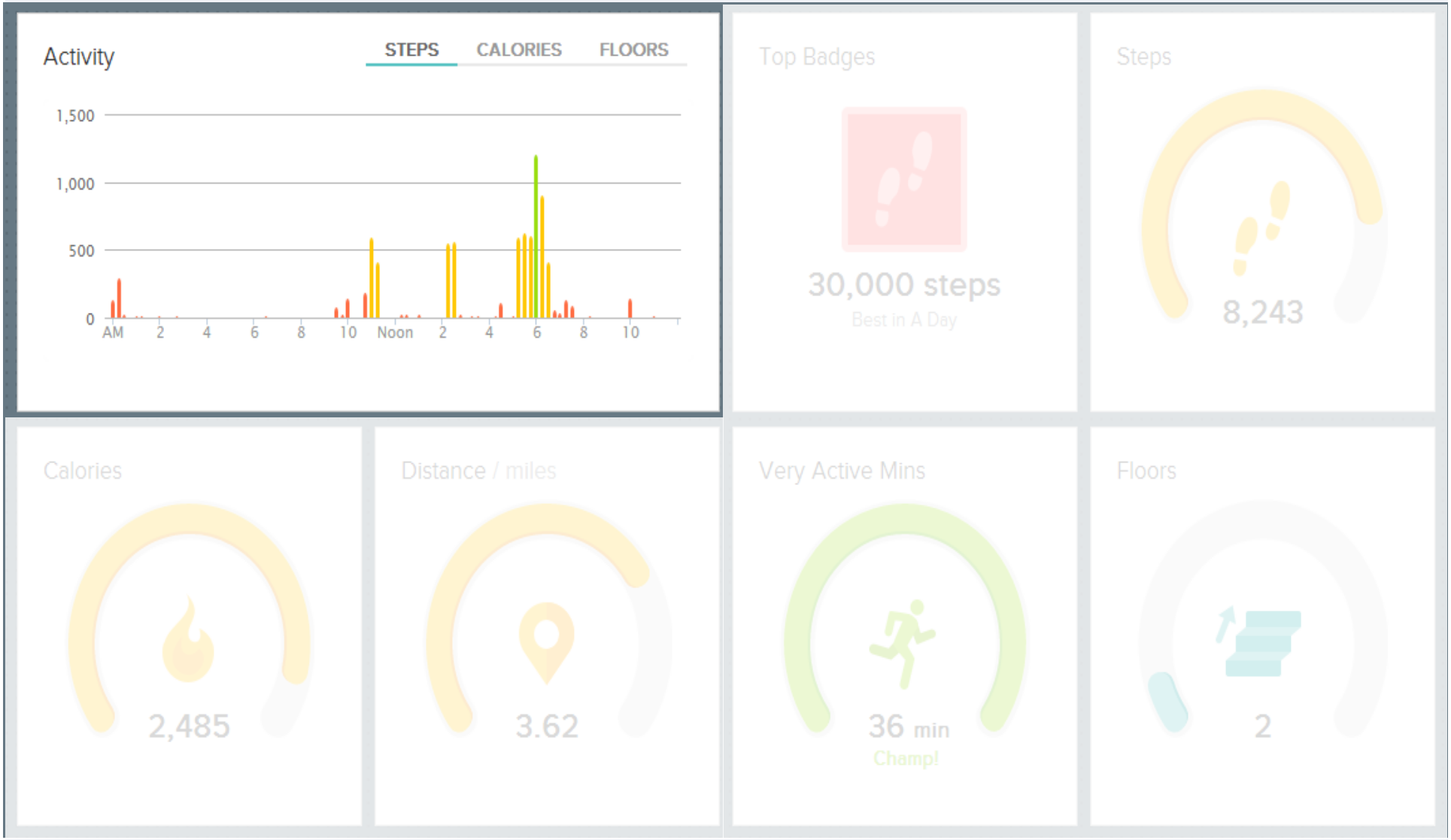
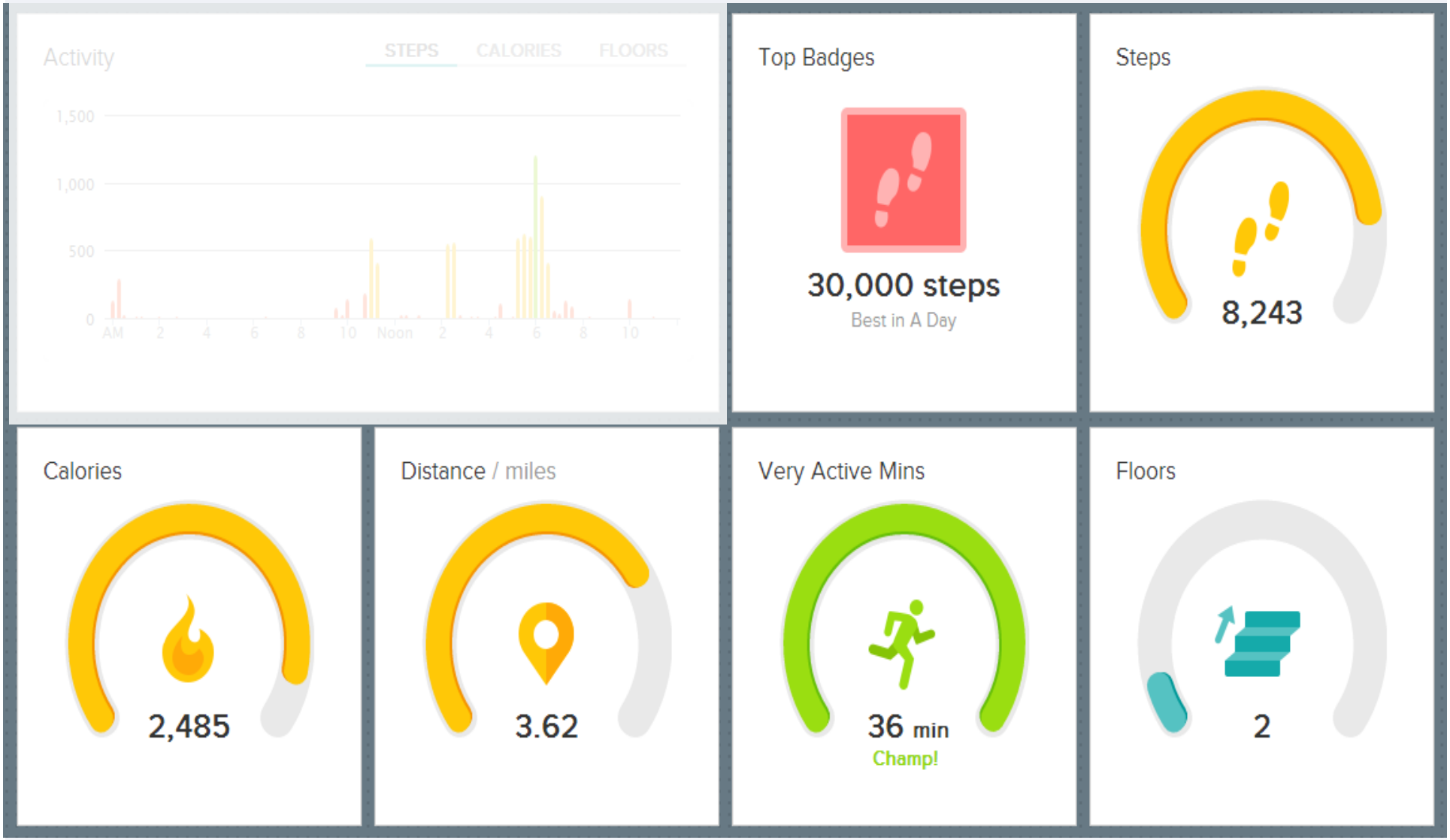


"Taming Data Complexity in Lifelogs: Exploring Visual Cuts of Personal Informatics Data," DA Epstein; F Cordeiro; E Bales; J Fogarty; SA Munson. *DIS* 2014.


Activity
STEPS
CALORIES
FLOORS
1,500
1,000
500
0
AM
2
4
6
8
10
Noon
2
4
6
8
10
Top Badges
30,000 steps
Best in A Day
Steps
8,243
Calories
2,485
Distance / miles
3.62
Very Active Mins
36 min
Champ!
Floors
2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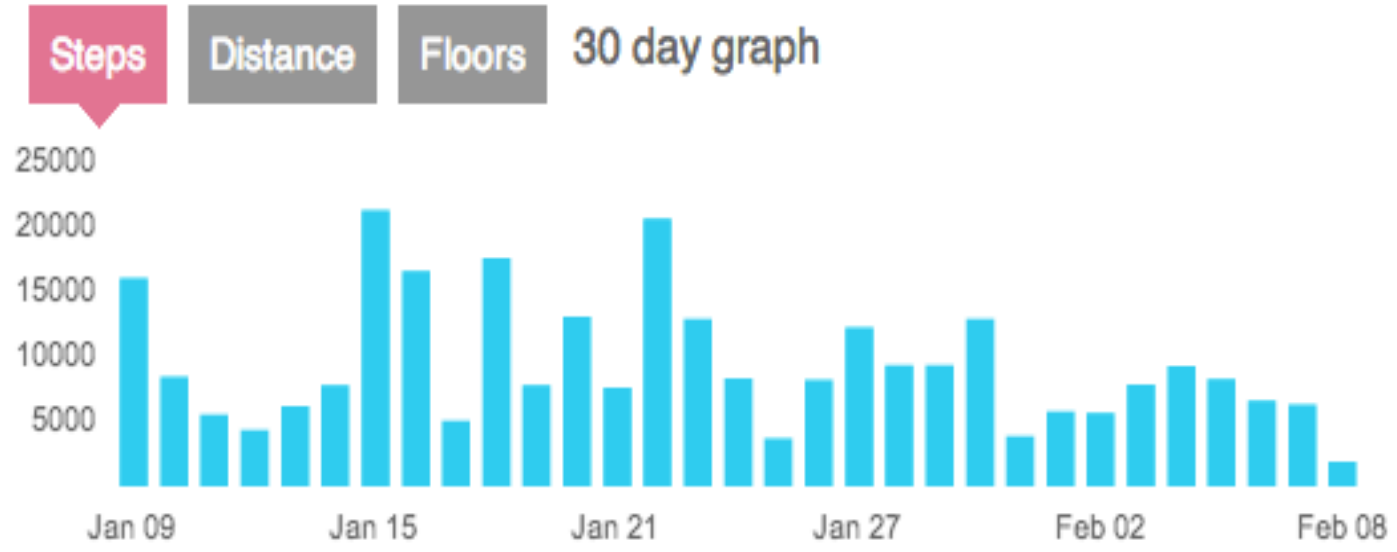
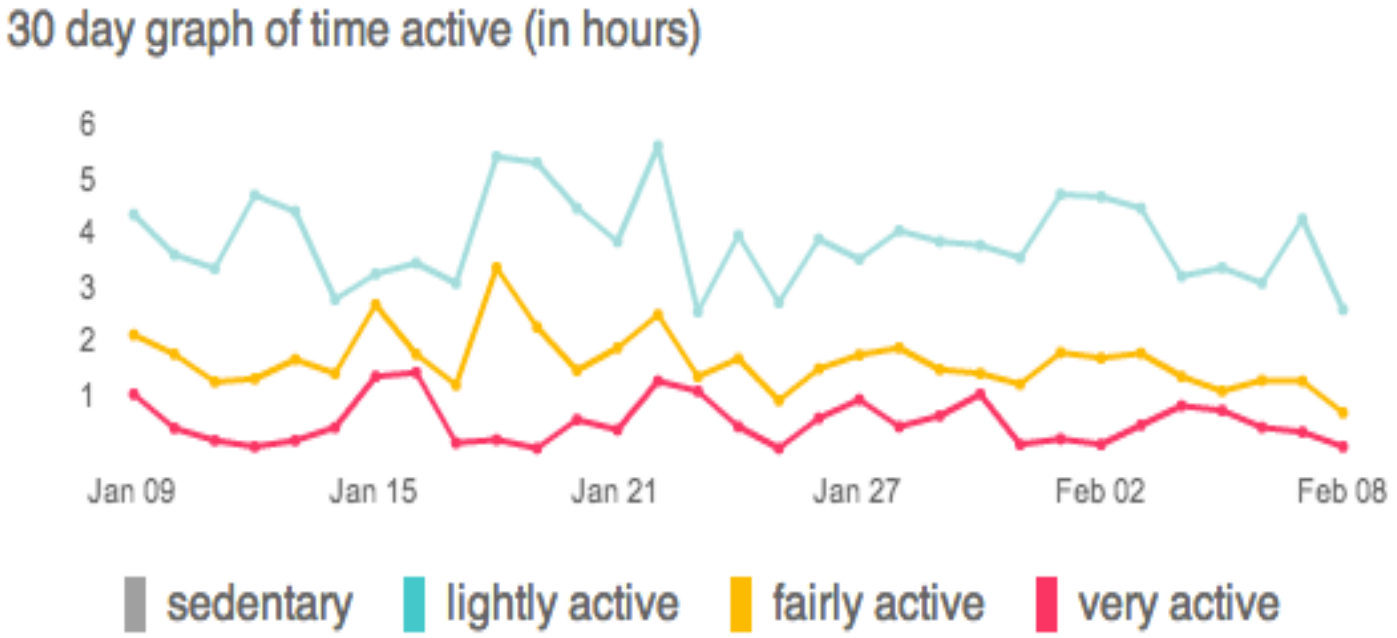
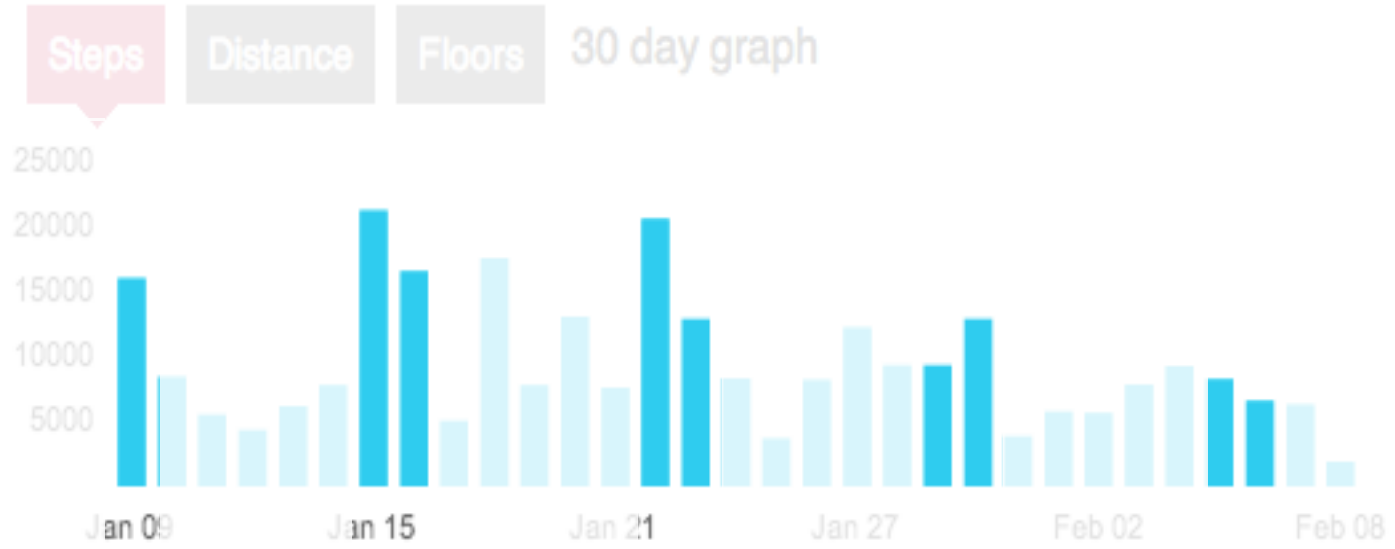

Steps
Distance
Floors
30 day graph
25000
20000
15000
10000
5000
Jan 09
Jan 15
Jan 21
Jan 27
Feb 02
Feb 08


30 day graph of time active (in hours)
6
5
4
3
2
1
Jan 09
Jan 15
Jan 21
Jan 27
Feb 02
Feb 08
sedentary
lightly active
fairly active
very active


Steps
Distance
Floors
30 day graph
25000
20000
15000
10000
5000
Jan 09
Jan 15
Jan 21
Jan 27
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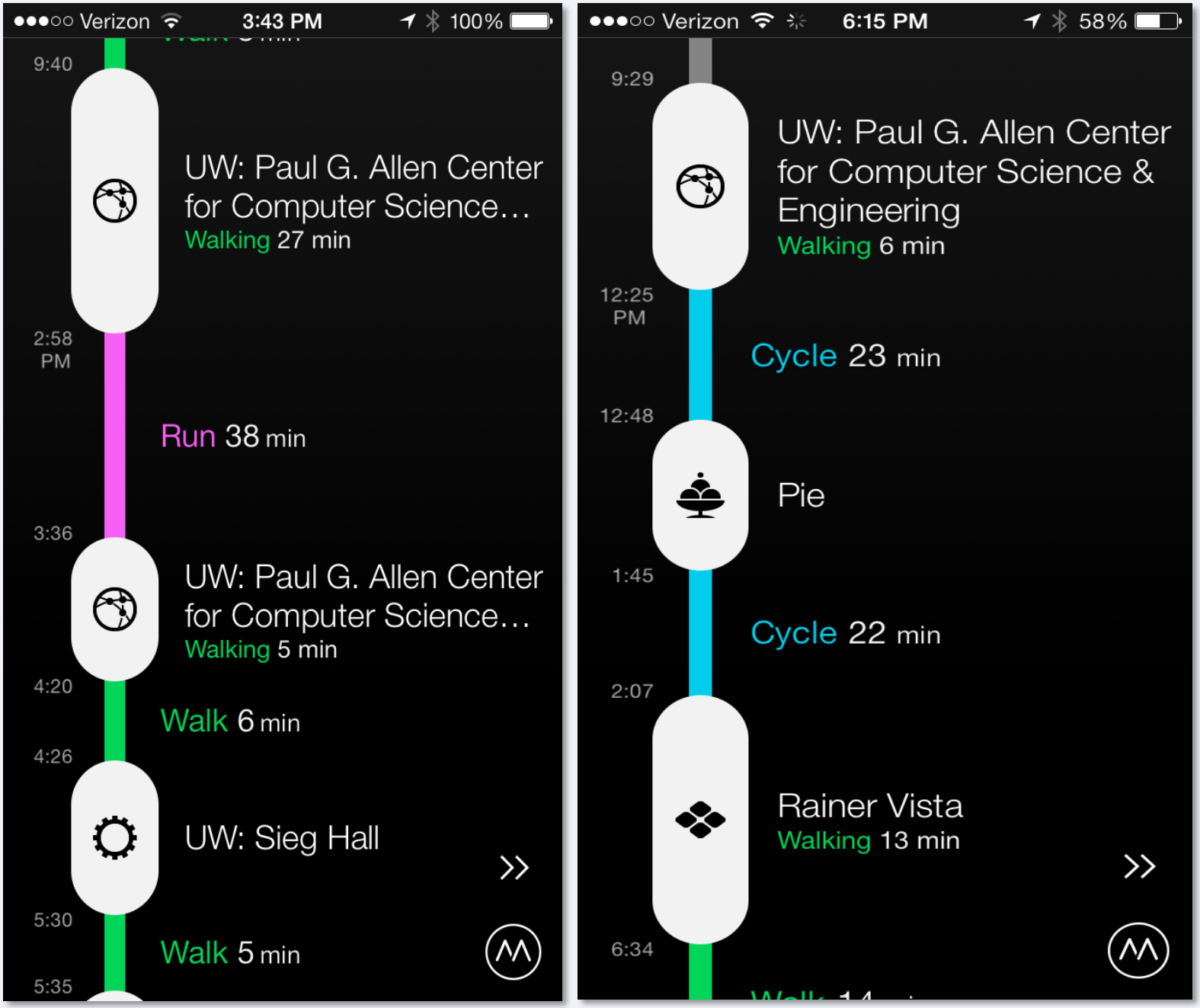
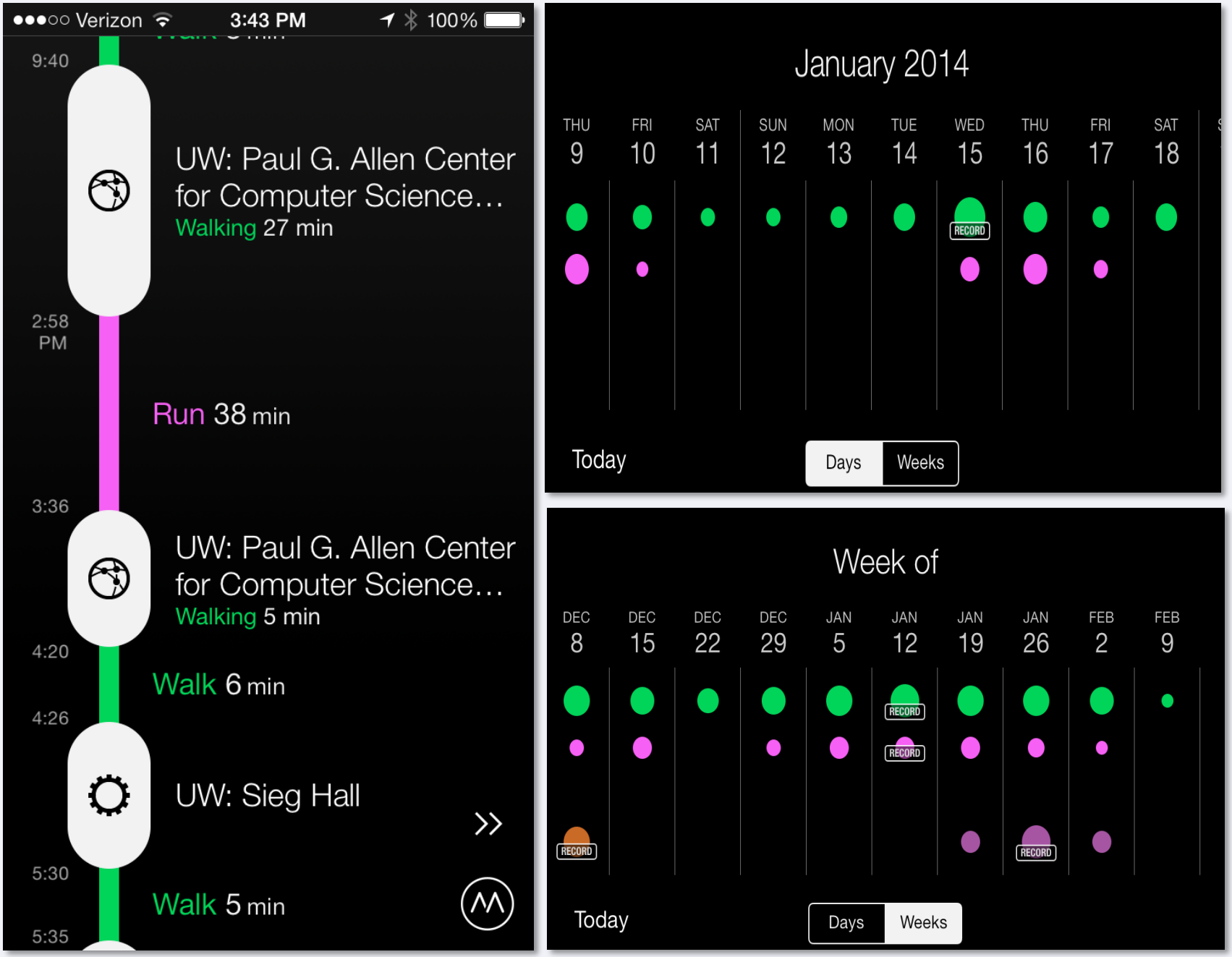
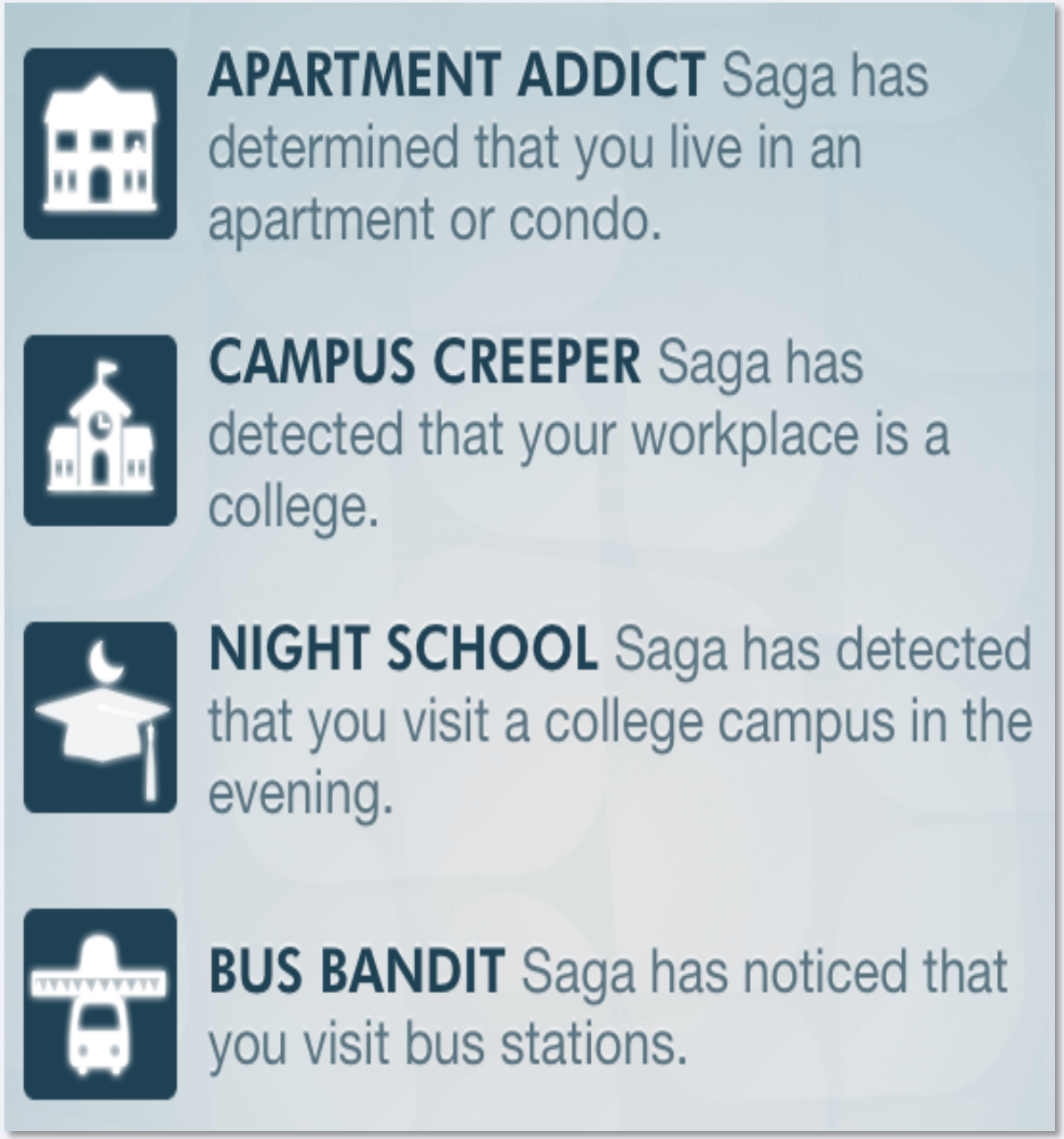


Moves, commercial lifelogging application developed by ProtoGeo



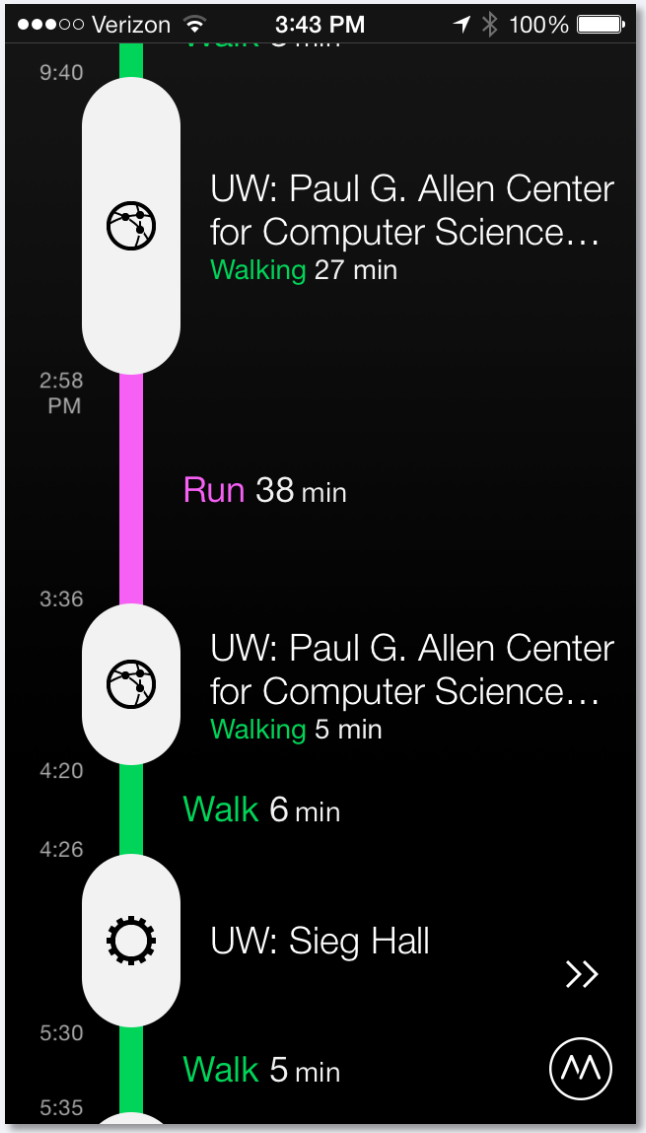
Moves, commercial lifelogging application developed by ProtoGeo

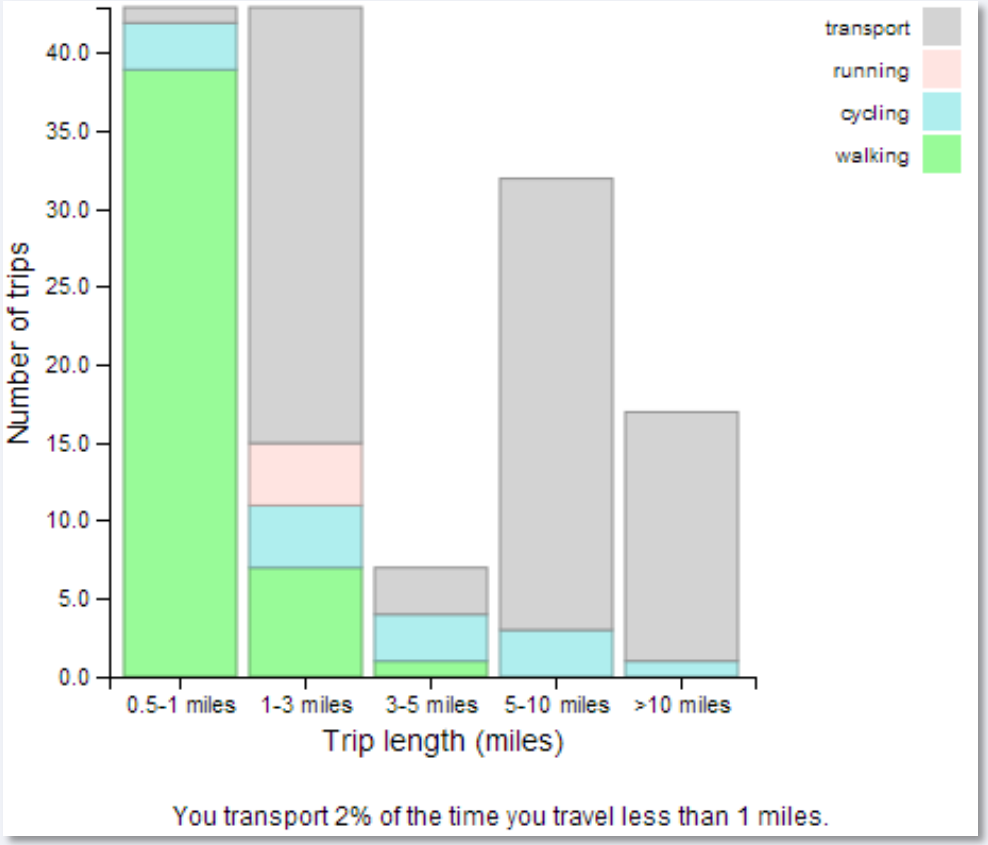


Saga, commercial lifelogging application developed by ARO Inc.

"**Does it really matter** that I walk more on Tuesdays? Or that I eat more when I sleep less?"

F Bentley; K Tollmar; P Stephenson; L Levy; B Jones; S Robertson; E Price; R Catrambone; J Wilson. "Health Mashups: Presenting Statistical Patterns between Wellbeing Data and Context in Natural Language to Promote Behavior Change." *ACM Transactions on Computer-Human Interaction* (TOCHI) 2013; 20(5): 30.





This requires tools for:

- selecting data to investigate
- reviewing data

Selecting data: Cuts

A subset of collected data with a common feature, e.g.:

- Temporal cuts
- Visit a particular type of location
- Follow a transit pattern

to enable people to interrogate their data to identify opportunities for change or behaviors to maintain.

but what cuts should we show?

What cuts should we show?

Surveyed 113 physical activity self-trackers

- 68 female, 45 male
- *FitBit*: 104, *RunKeeper*: 9, *Nike+*: 7, *MapMyRun*: 5, *other*: 17; 24 used multiple tools
- Tracking duration: <1 month: 23, 1-3 months: 27, 4-6 months: 12, 7 months-1 year: 22, more than one year: 29

Start with trackers' goals

Long-term health goals

- Maintain / Increase Activity (41)
- Maintain / Lose Weight (35)

Tracking goals

- Awareness of Activity Levels (34)
- Increase Motivation (14)
- Be Held Accountable (10)
- Have a Record of Activity (8)
- Find Patterns (7)
- Competition (6)

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… and the factors which affect them

- Work schedule (35)
- Weather (29)
- Travel (21)
- Injury and fatigue (20)
- Changes in daily schedule (18)
- Sleep amount and quality (16)
- Schedule of spouses and children (13)
- Stress and mood (13)
- Socializing (12)
- Food consumption (11)
- Errands (7)

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- Socializing (12)
- Food consumption (11)
- Errands (7)

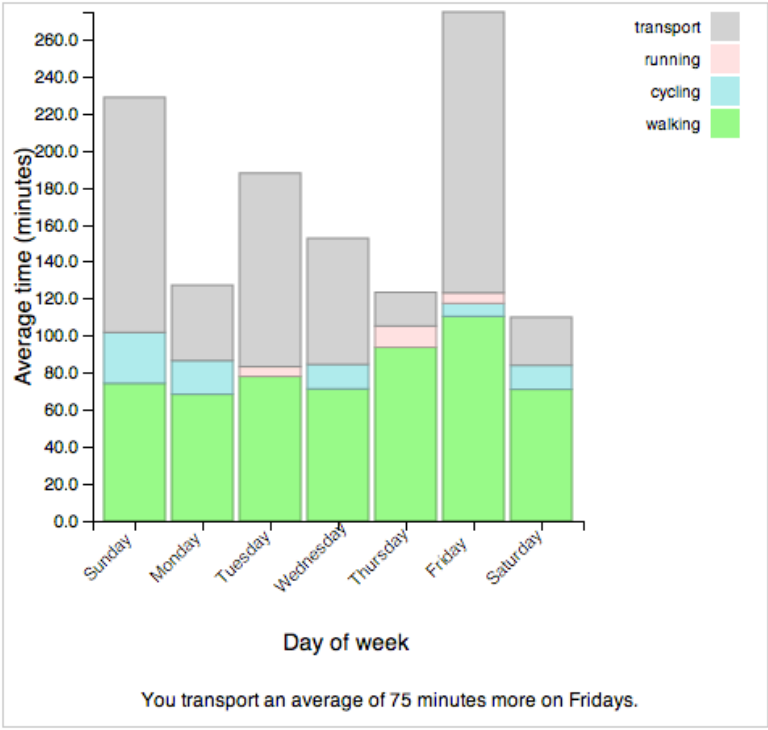
to evaluate the following cuts

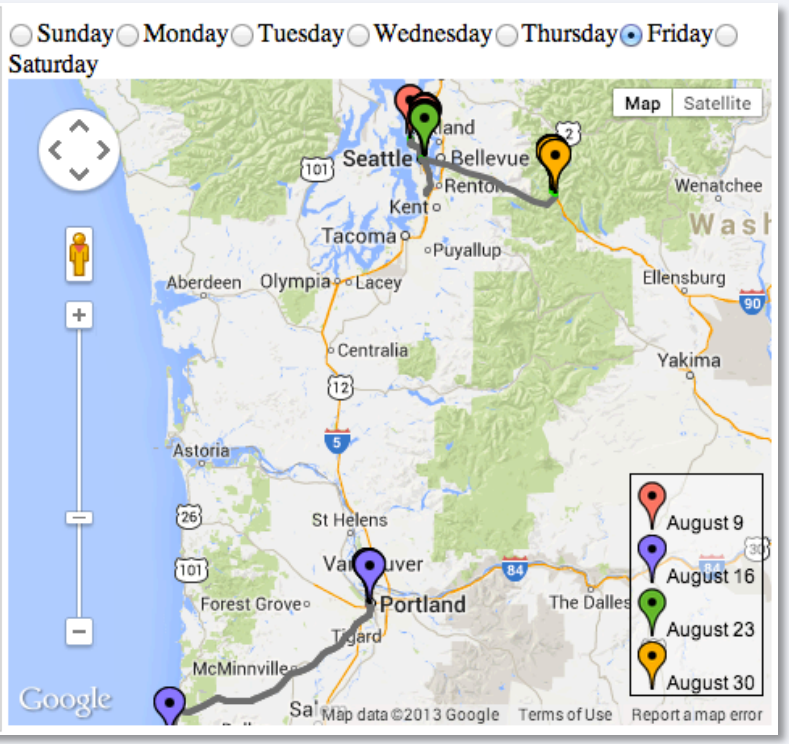
Cut	Description
TT1	Average time in different modes of transit (walking, running, cycling, and transporting) by the day of week.
TT2	All trips to and from the same location by transit type.
TT3	Number of trips in each transit mode by trip distance.
CM1	Amount of time spent at each of home and work by the day of the week.
CM2	Average arrival time at work and departure time from work by the day of the week.
CM3	Time taken to commute to and from work by the type of weather. (e.g., clear, partly cloudy, rainy)
FD1	Categories of food places visited by day of week.
FD2	Categories of food places visited by time of day.
AB1	5 days with the most and least number of places visited.
AB2	10 days with the most physical activity.
WW1	Total minutes of physical activity by week.
WW2	Number of unique places visited by week.
WW3	All places visited only on weekdays or weekends.

cuts: transit type and activity

Cut	Description
TT1	Average time in different modes of transit (walking, running, cycling, and transporting) by the day of week.
TT2	All trips to and from the same location by transit type.
TT3	Number of trips in each transit mode by trip distance.

TT1:





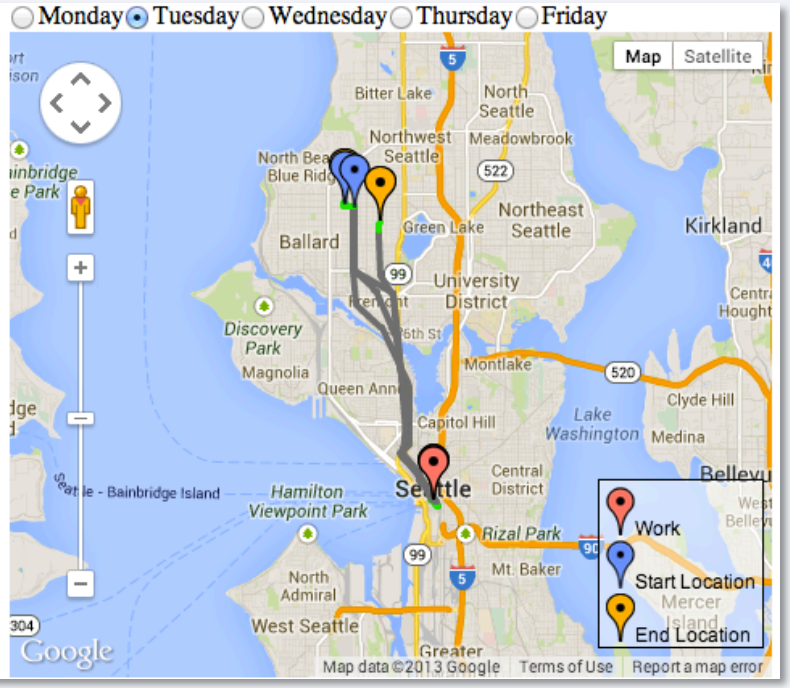
cuts: commutes

Cut	Description
CM1	Amount of time spent at each of home and work by the day of the week.
CM2	Average arrival time at work and departure time from work by the day of the week.
CM3	Time taken to commute to and from work by the type of weather. (e.g., clear, partly cloudy, rainy)

CM2:

Day of week	Average arrival time	Average departure time
Sunday (0 days)	--	--
Monday (2 days)	8:10 AM	4:46 PM
Tuesday (2 days)	8:39 AM	5:08 PM
Wednesday (4 days)	9:49 AM	5:11 PM
Thursday (5 days)	8:35 AM	4:59 PM
Friday (3 days)	9:07 AM	3:01 PM
Saturday (0 days)	--	--

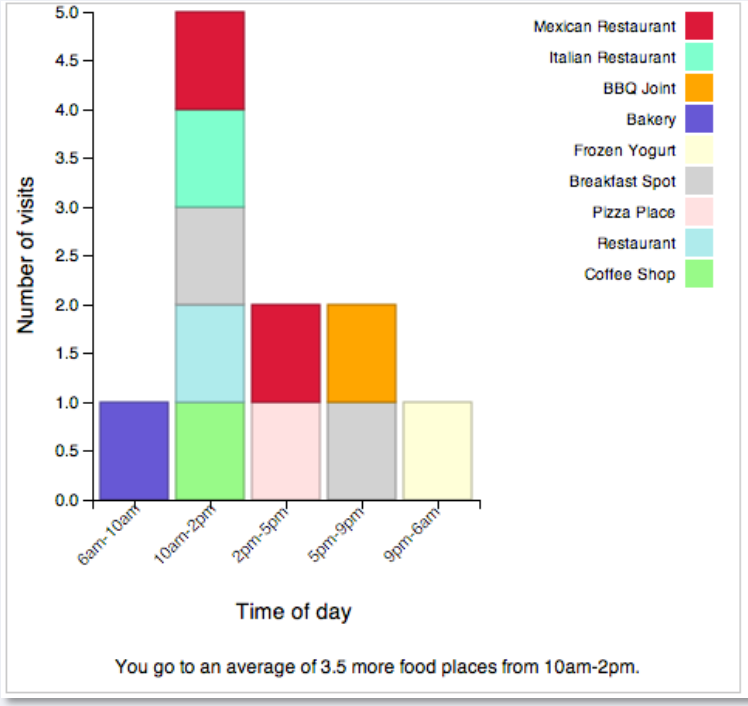
On average, you arrive at work 0.9 hours later on Wednesdays and leave 1.6 hours earlier on Fridays.

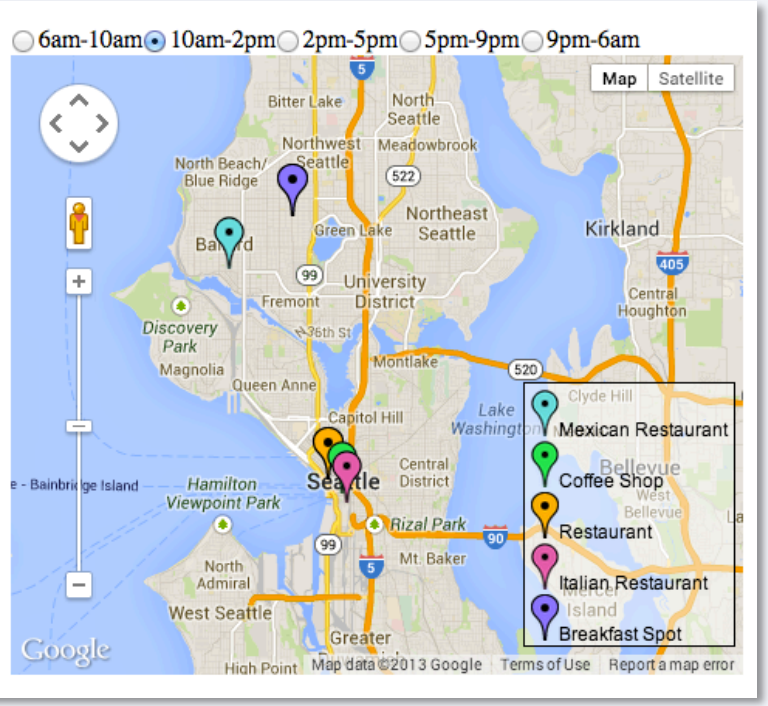


cuts: food places

Cut	Description
FD1	Categories of food places visited by day of week.
FD2	Categories of food places visited by time of day.

FD2:





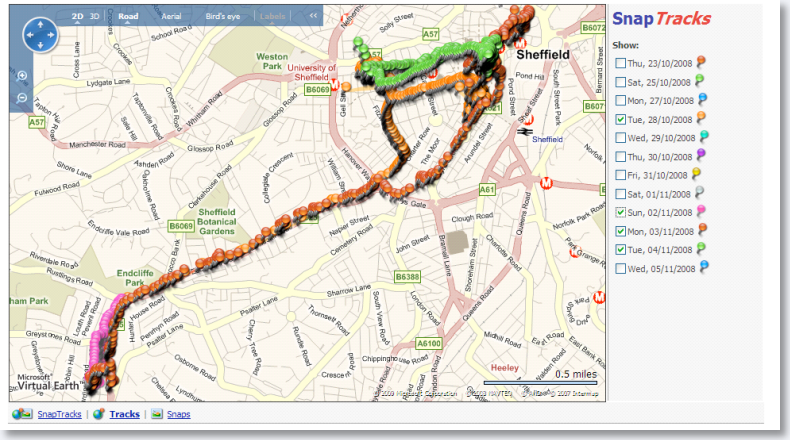
cuts: anomalies

Cut	Description
AB1	5 days with the most and least number of places visited.
AB2	10 days with the most physical activity.

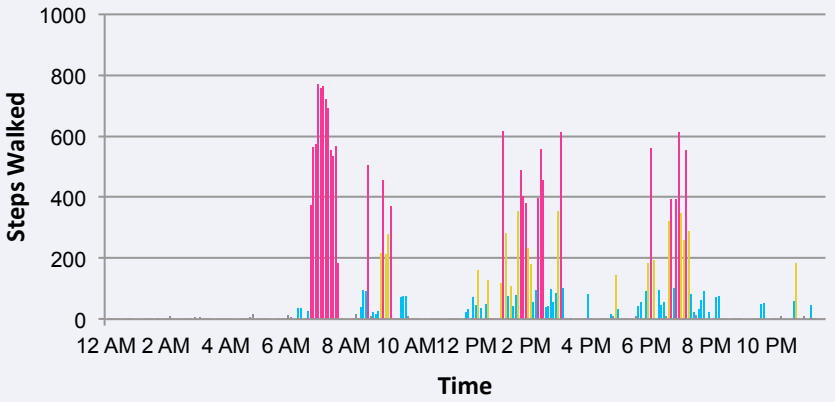
cuts: weekly summaries

Cut	Description
WW1	Total minutes of physical activity by week.
WW2	Number of unique places visited by week.
WW3	All places visited only on weekdays or weekends.

cut representations: prior work



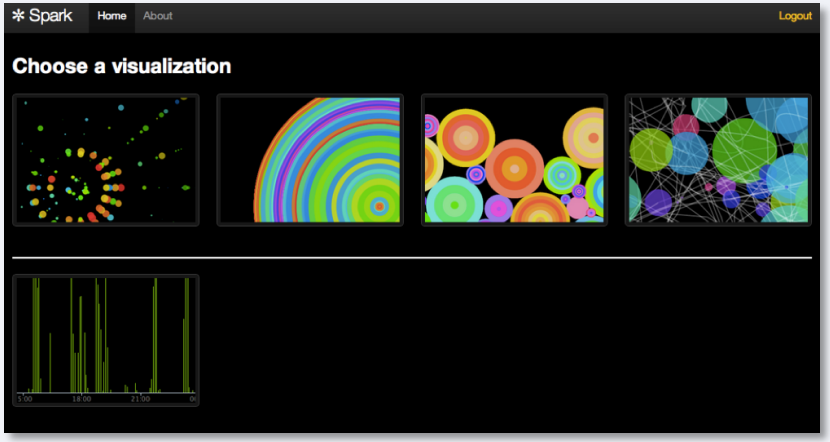
Kalnikaite et al, Not Let Me See Where I Was: Understanding How Lifelogs Mediate Memory, *CHI* 2010.



Epstein et al, Fine-Grained Sharing of Sensed Personal Activity: A Value Sensitive Approach, *UbiComp* 2013.

The number of website that you've visited is 0.71 times the number that exists in 1994.

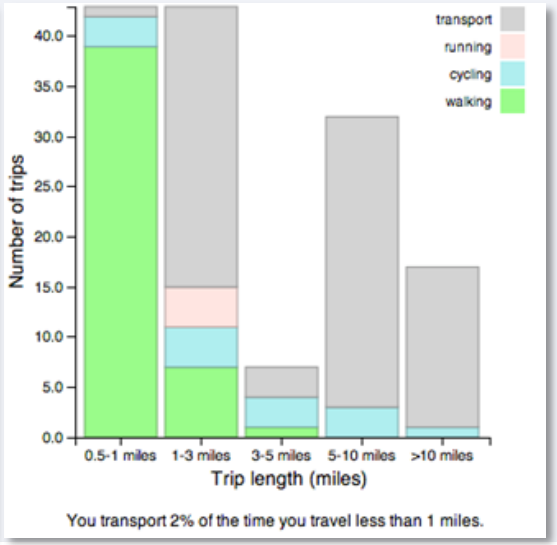
Khovanskaya et al, "Everybody Knows What You're Doing": A Critical Design Approach to Personal Informatics, *CHI* 2013.

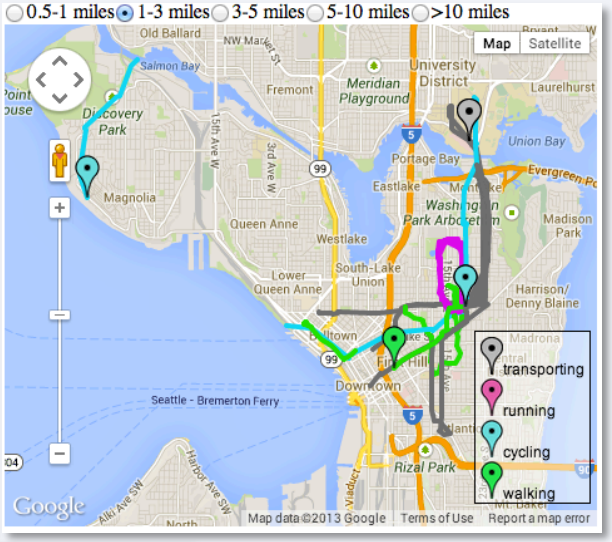


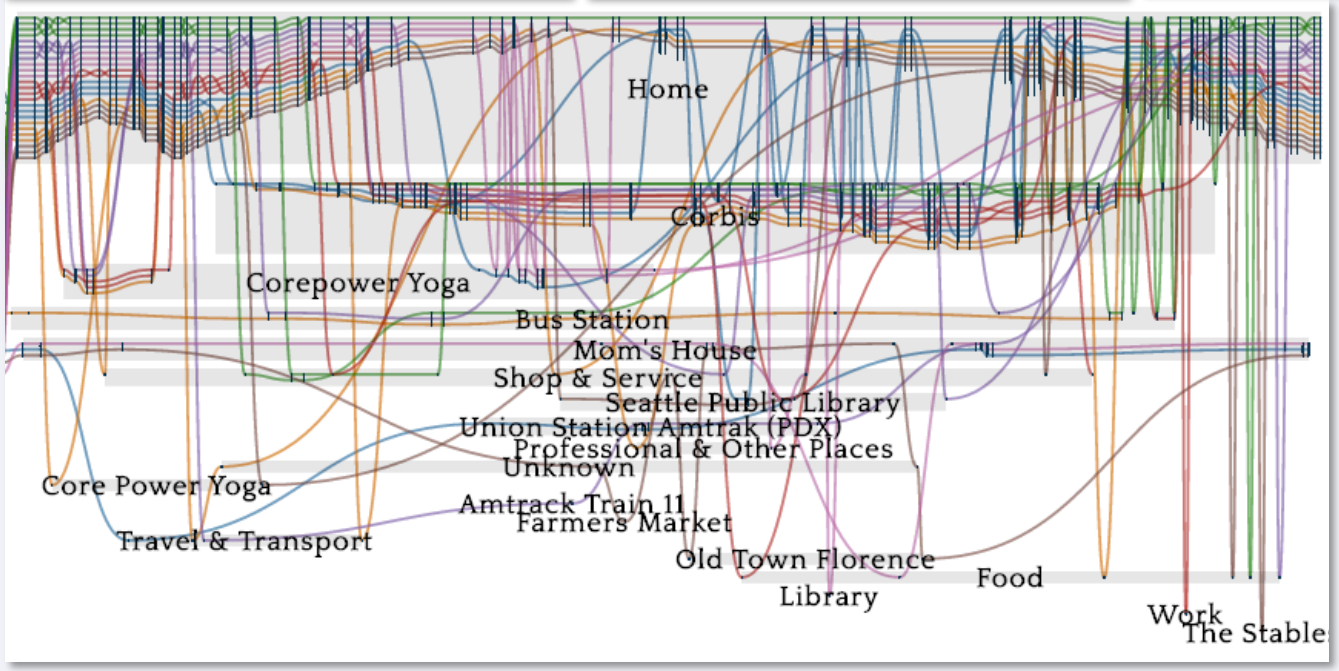
Fan et al, A Spark Of Activity: Exploring Informative Art As Visualization For Physical Activity, *UbiComp* 2012.

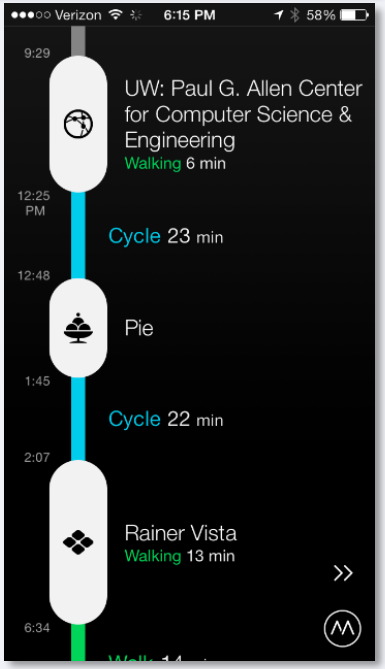
cut representations: our study

Day of week	Time (in hours)
Sunday (0 days)	--
Monday (2 days)	8 hours, 21 minutes
Tuesday (2 days)	7 hours, 49 minutes
Wednesday (4 days)	7 hours, 10 minutes
Thursday (4 days)	7 hours, 48 minutes
Friday (3 days)	5 hours, 47 minutes
Saturday (0 days)	--
On average, you spend 1.6 fewer hours at work on Fridays.	









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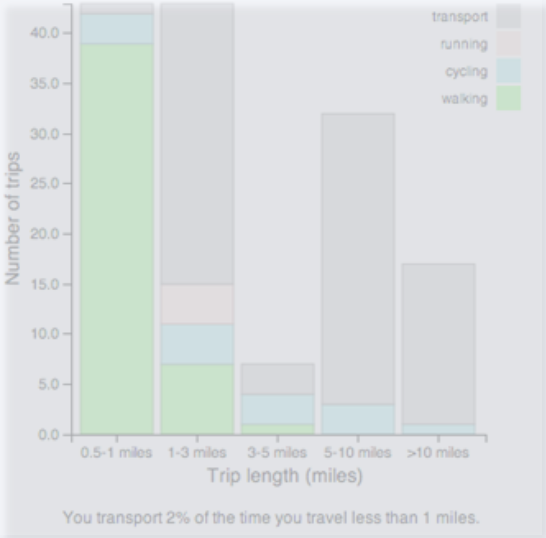
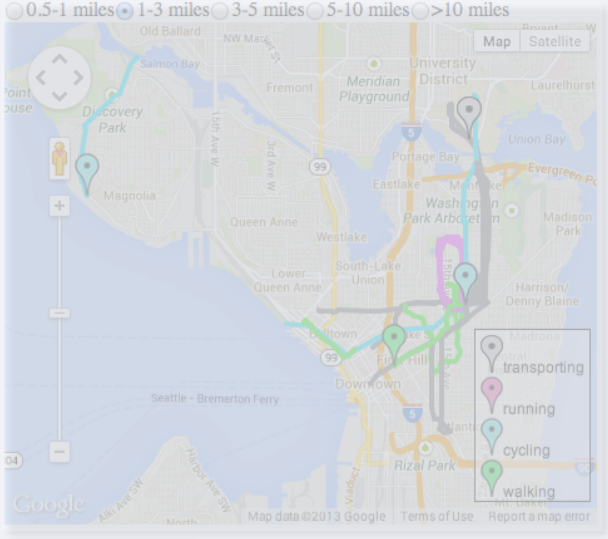
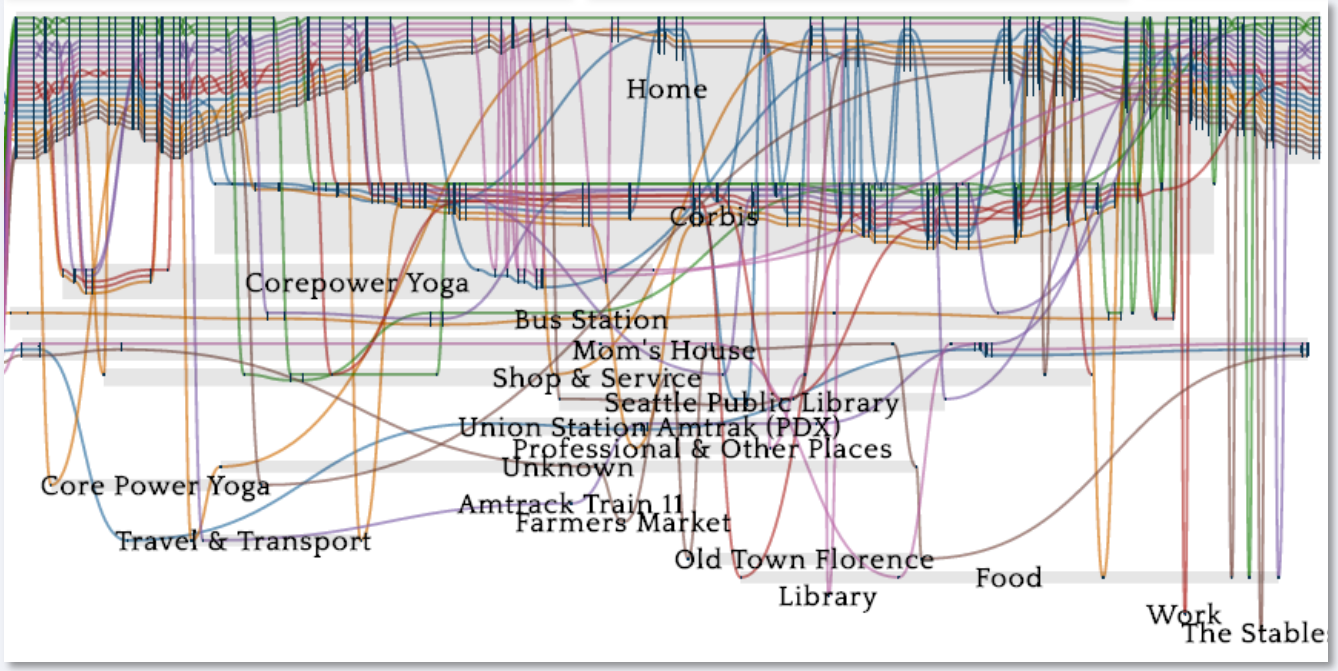






(partial) field evaluation of cuts and visualizations

Recruited 14 participants from the Pacific Northwest

- 10 F, 4 M
- Average age 36.2, variety of occupations
- 7 daily self-trackers, 5 infrequent self-trackers, 2 never tracked

Procedure:

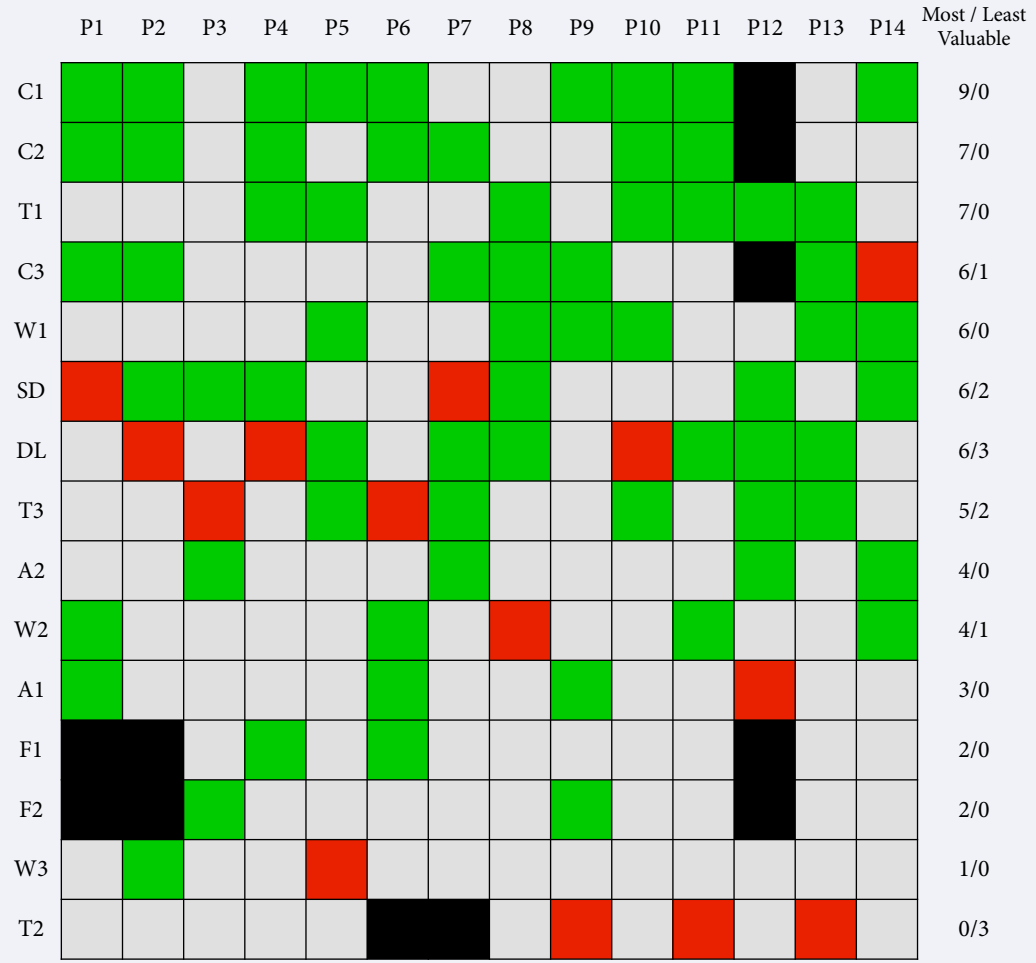
- Install and use *Moves* to record daily activity and transitions for a month, tag locations
- Three interviews: pre, two weeks weeks, after
- Review cuts and visualizations in final interview

(partial) field evaluation of cuts and visualizations

Participant average activity:

- Checking *Moves* 3.2 times/day (min: 1, max: 10, stdev: 2.8)
- Visiting 4.8 locations/day (min: 2.6, max: 6.1, stdev: 1)
- Tagging 38 district locations (min: 18, max: 63, stdev: 14.9), of which 9.6 were food places (min: 0, max: 20, stdev: 8.9)

results: feedback on cuts



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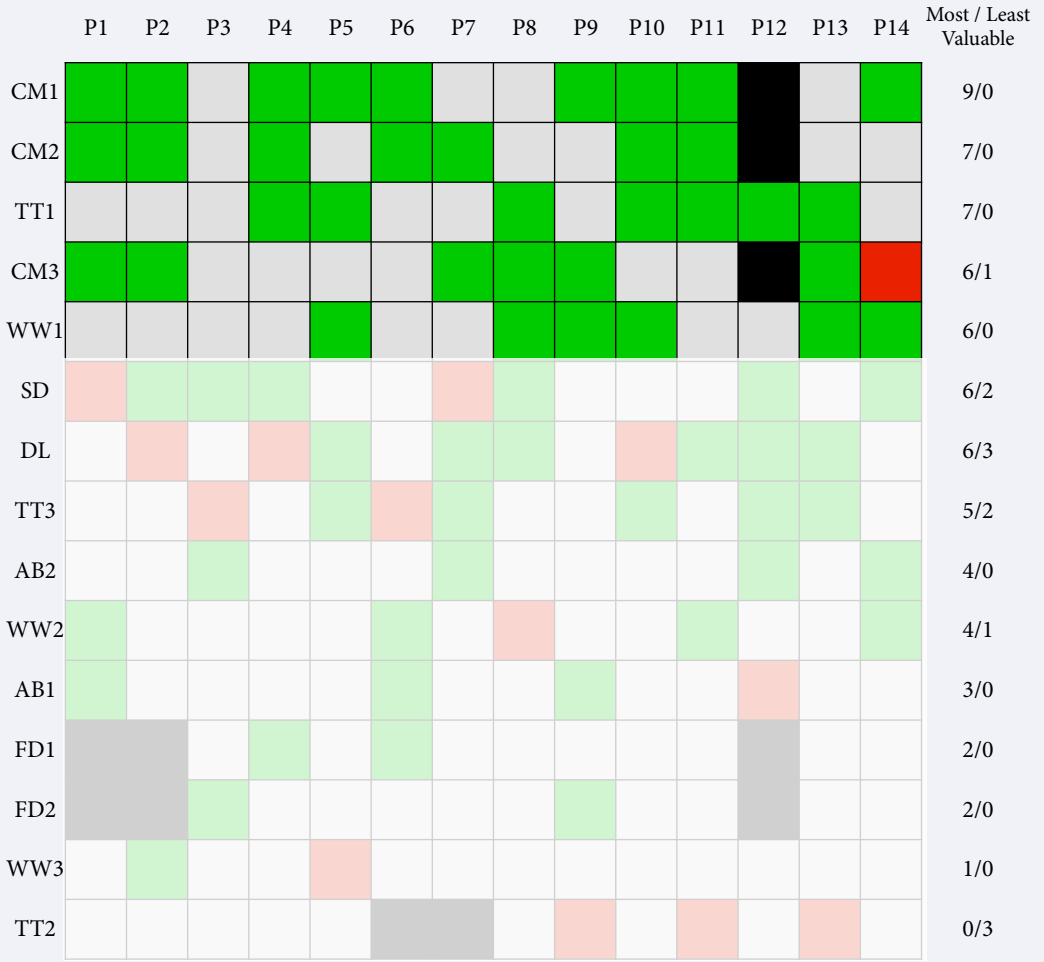

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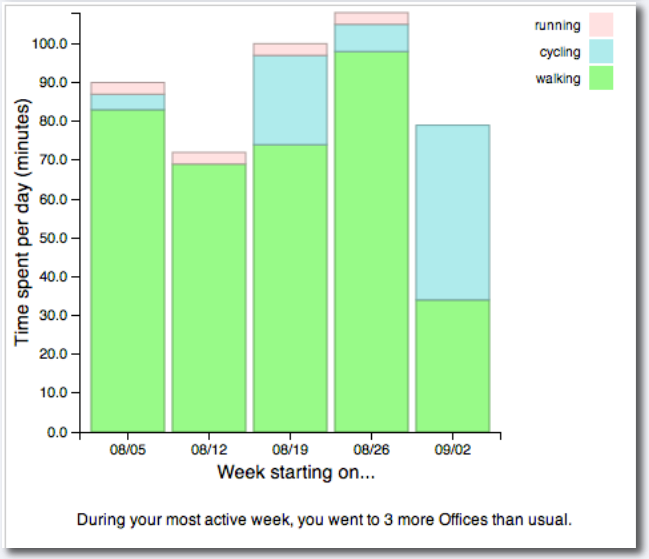
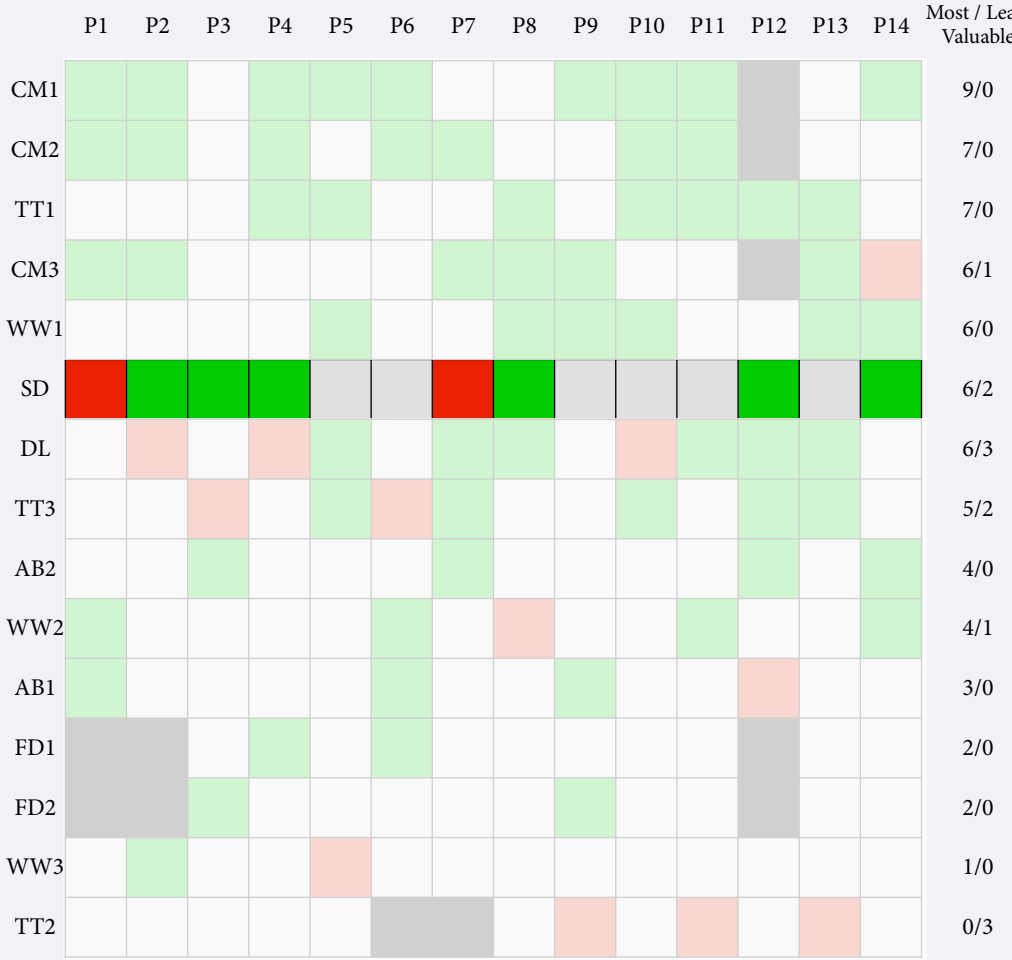
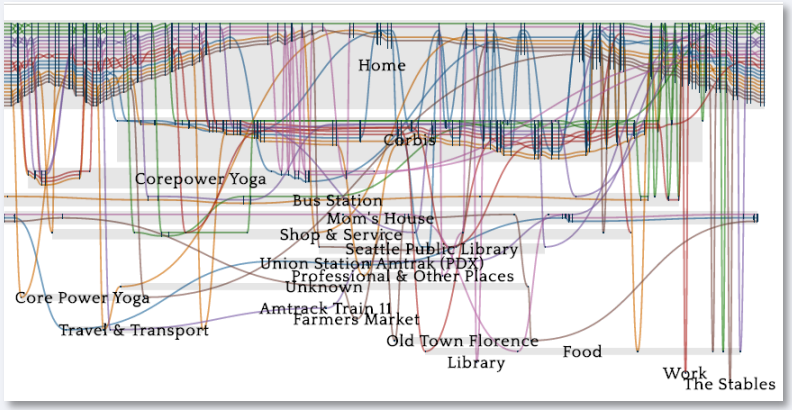


During your most active week, you went to 3 more Offices than usual.

results: feedback on cuts

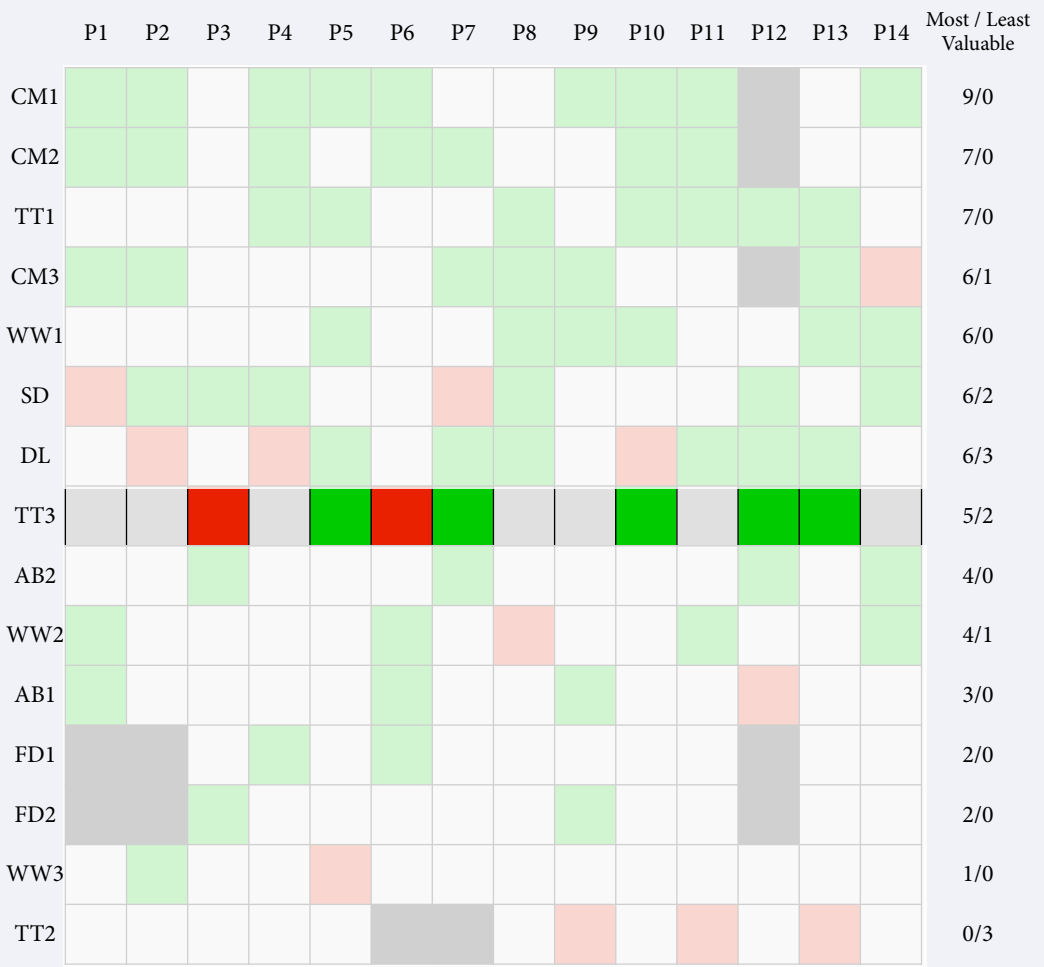


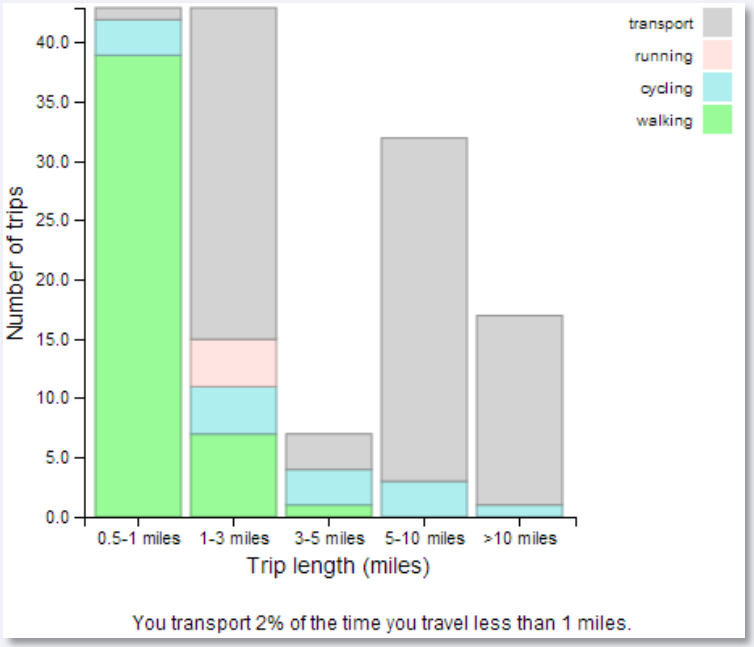


"I could quickly compare what days were different, **what Thursdays were different**."

"The Sankey had lots of potential, but was **hard to interpret**."

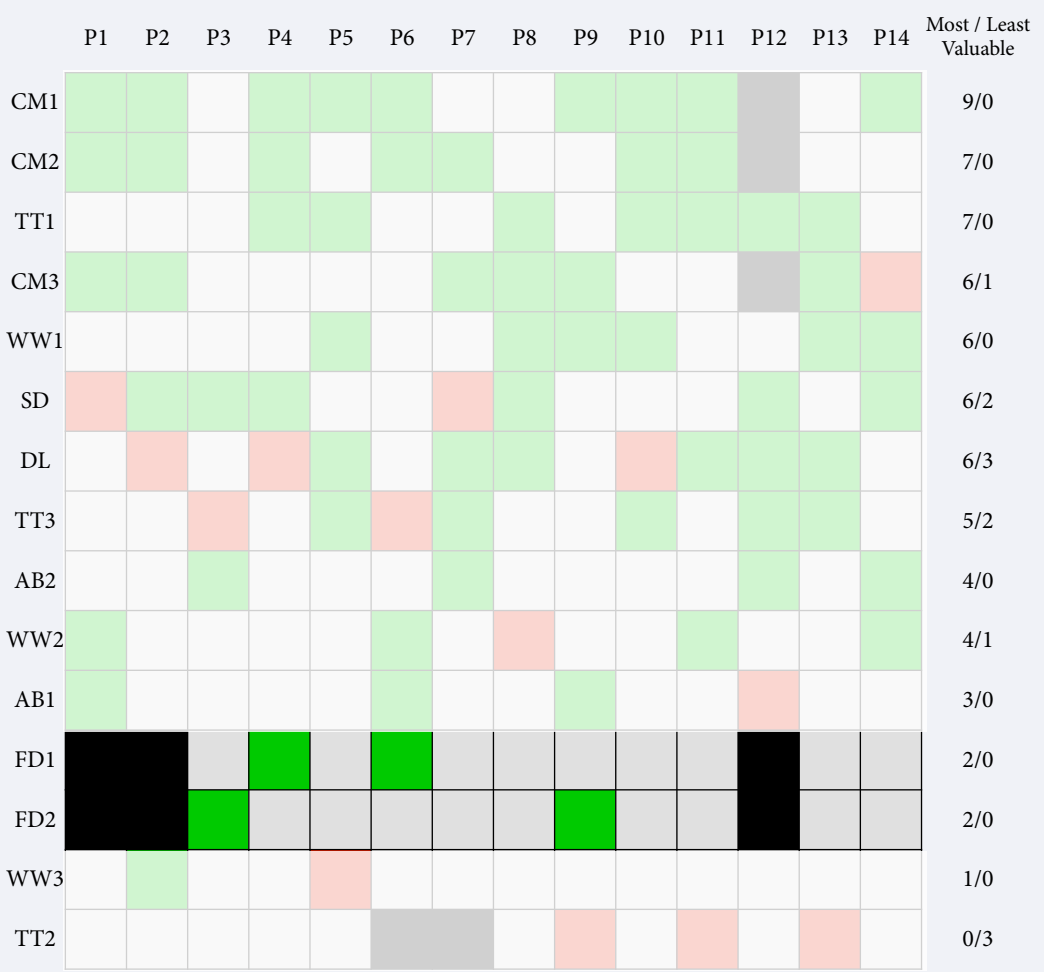
results: feedback on cuts

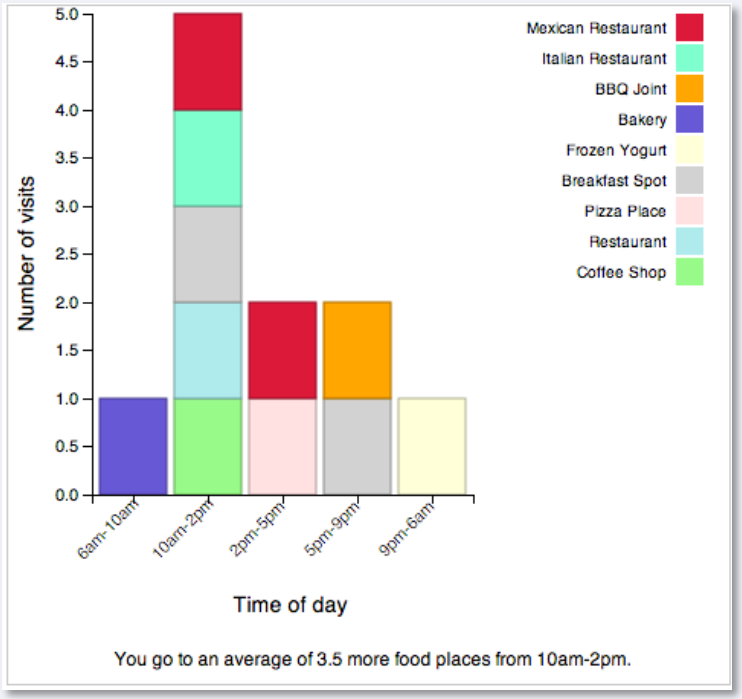




"Is this trying to say, 'look punk, **you should have been walking there?**"

results: feedback on cuts

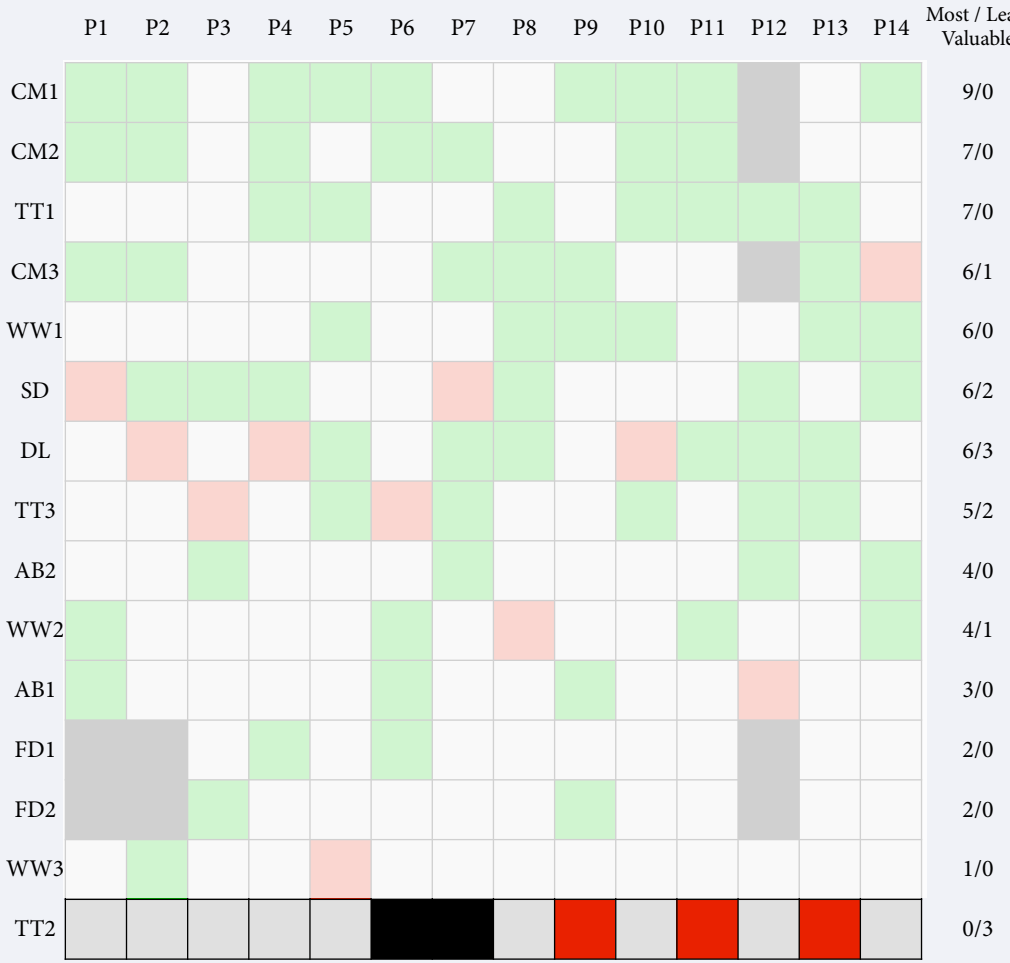


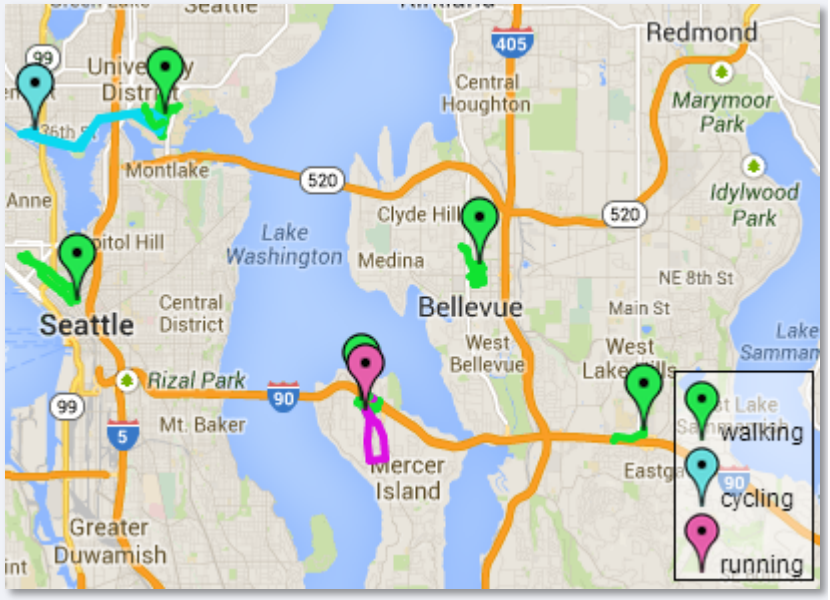


"I'm more interested in **what I'm eating** than where I'm eating."

"Some people have goals about **eating past 8pm** or things like that. Something like this could help me with that."

results: feedback on cuts





"So I guess I'm having a hard time understanding this view… **I'm not sure what I would use it for.**"

did cuts help people identify opportunities for change?

"Maybe on average on Tuesdays I don't cycle much. Maybe there was a day that I did. To be able to **think about why that was** so I could maybe think about how to change what I was doing."

"If I notice that I'm most active on Tuesdays, then obviously there's something about Tuesdays that I should start doing on other days. **That's actionable data**."

encouraging, but with limitations

- West coast of the US during the summer
  - Consistent weather
  - Lack of seasonal shifts, longer-term trends
- Location categories were not always an effective proxy for activity – may need to enable limitations
- Presented cuts and visualizations at the end of the study, so participants did not have an opportunity to work with them over time.

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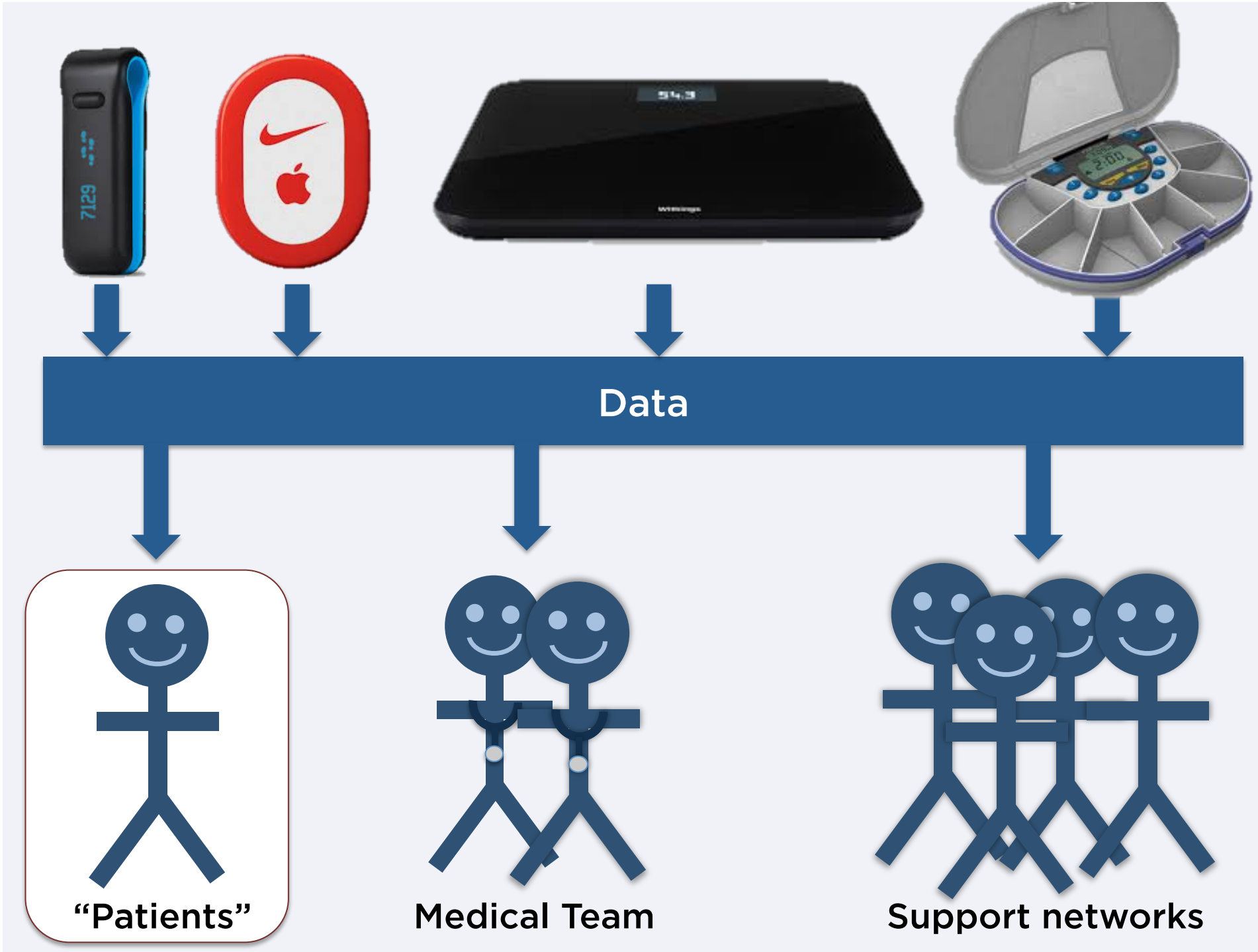
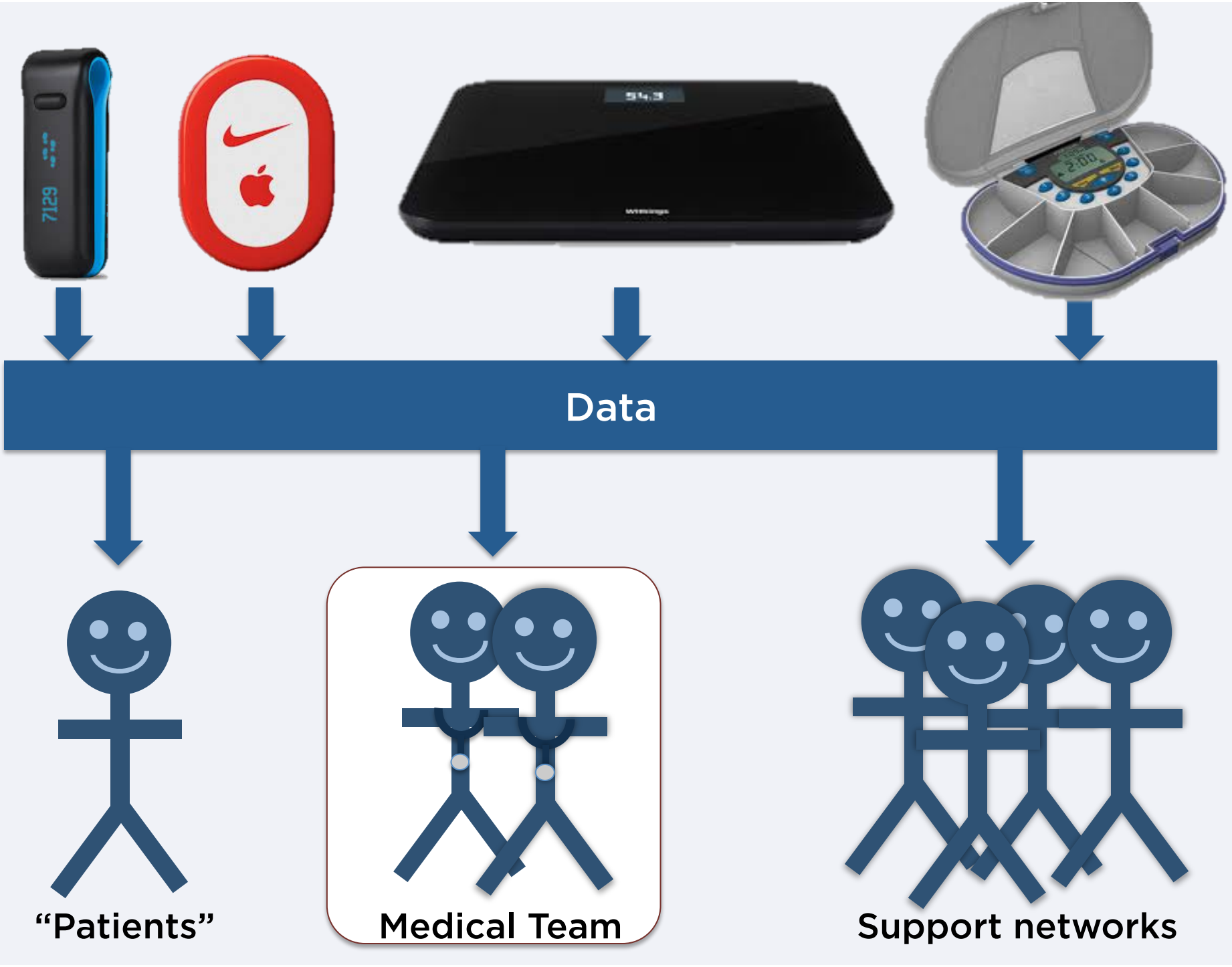
future work

- Longer term field deployment
- Developing techniques to:
  - Automatically present actionable recommendations
  - Predict progress toward goal achievement
  - Evaluate for other health concerns and other domains
- Evaluating the value of similar data to the medical team


Data
"Patients"
Medical Team
Support networks


Data
"Patients"
Medical Team
Support networks

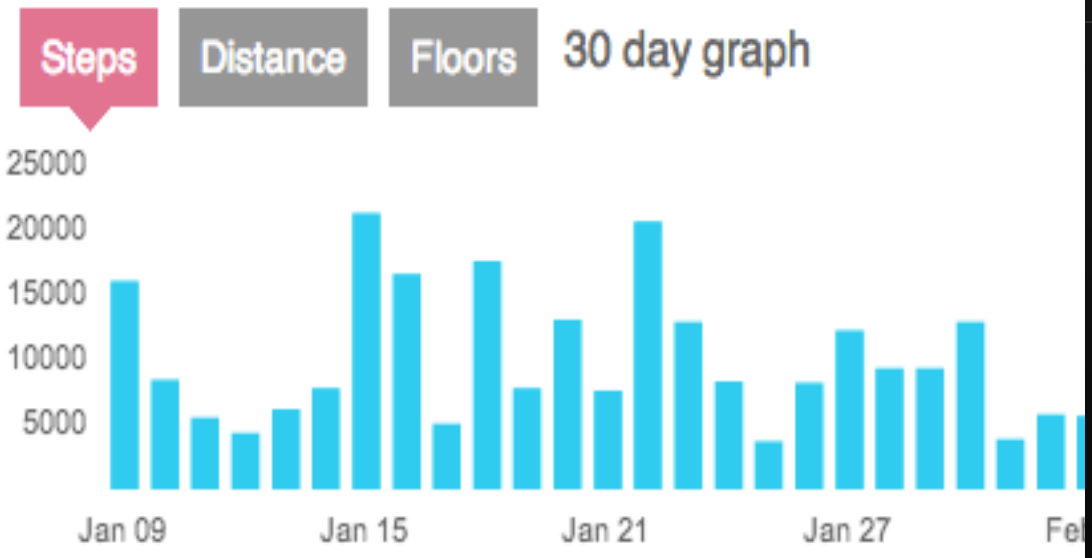
3	Run :	18:50	3miles / 18min
		287	300

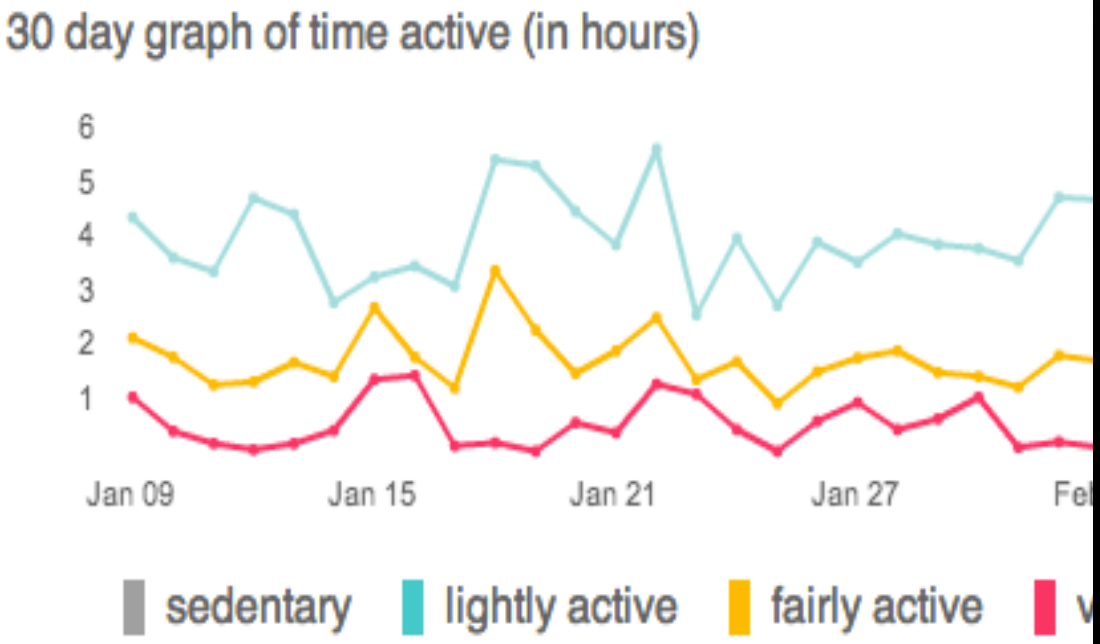
300 CFT

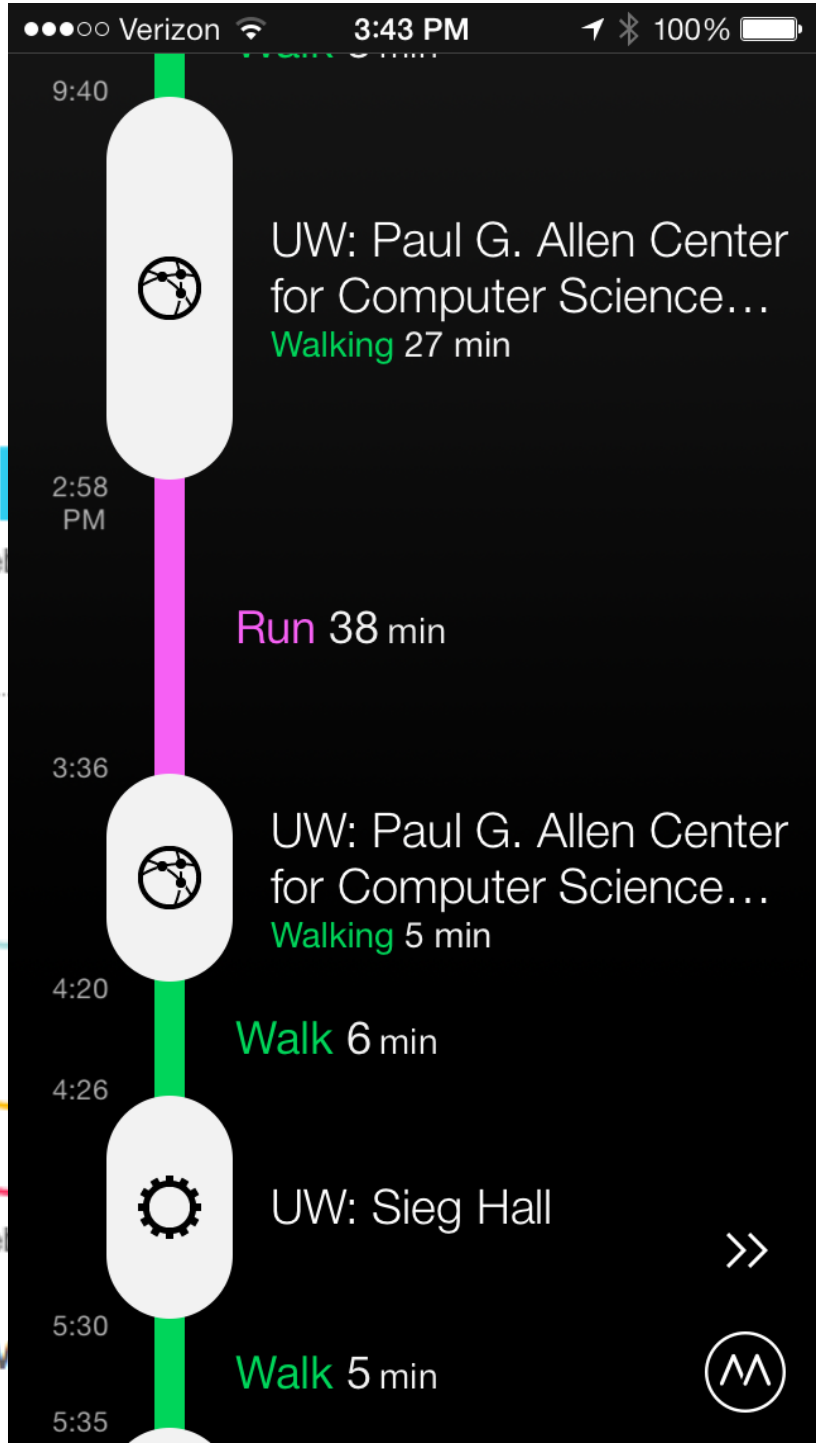
		Current	Goal
1	Movement 2 Contact	24	
2	Ammo Lift	89	
3	Maneuver Under Fire	28	
		29	
	880 yds, 30 lbs,		

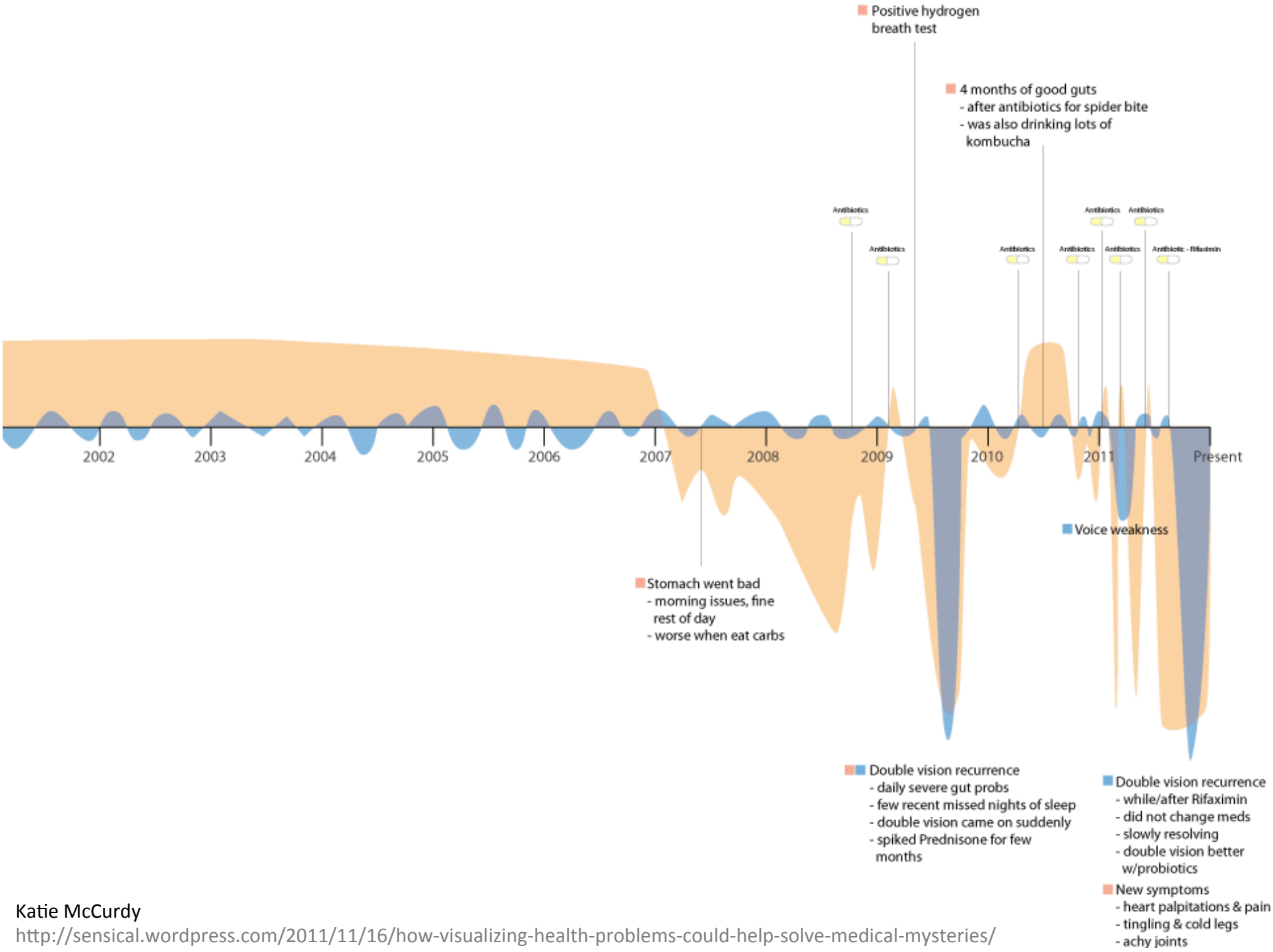
vanilla yogu
granola
banana, strawberry
+ melon

giant beer pretzel, (2/3)
with IT jalepiño
spinach dipping
sauce
turkey sandwich
on toasted italian
bread
swiss, lsl
lettuce, tomato
blueberry-pom martini
mai tai (1g)
daquiri (sm)
sav-blanc (1gl)


Steps
Distance
Floors
30 day graph
25000
20000
15000
10000
5000
Jan 09
Jan 15
Jan 21
Jan 27


30 day graph of time active (in hours)
6
5
4
3
2
1
Jan 09
Jan 15
Jan 21
Jan 27
sedentary
lightly active
fairly active


Verizon
3:43 PM
100%
9:40
UW: Paul G. Allen Center for Computer Science…
Walking 27 min
2:58 PM
Run 38 min
3:36
UW: Paul G. Allen Center for Computer Science…
Walking 5 min
4:20
Walk 6 min
4:26
UW: Sieg Hall
5:30
Walk 5 min
5:35



Katie McCurdy
http://sensical.wordpress.com/2011/11/16/how-visualizing-health-problems-could-help-solve-medical-mysteries/

pilot study questions

- What do providers want from patient-collected data?
  - what do they want patients to track?
  - how do they want to review this data?
- What are provider concerns?
- What are the constraints for providers to integrate patient-collected data into their workflow?

methods

Recruited providers for an hour-long semi-structured interview, covering:

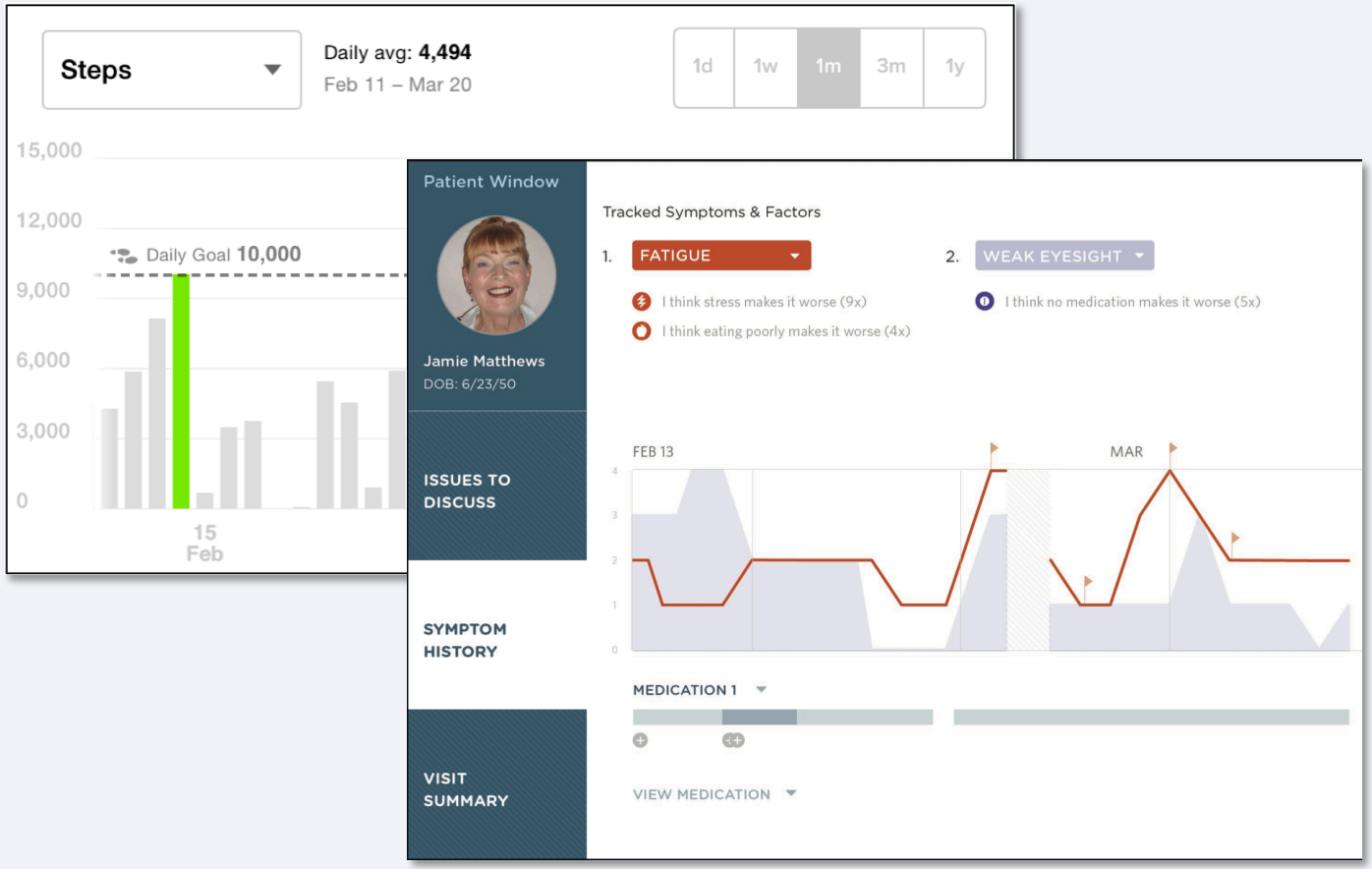
- Experiences reviewing patient-collected data, including successes and breakdowns
- Unmet needs / aspirations for patient-collected data
- Feedback on paper prototypes of interfaces for reviewing patient-collected data

Affinity Diagram Analysis (2 passes on 6 interviews)

methods

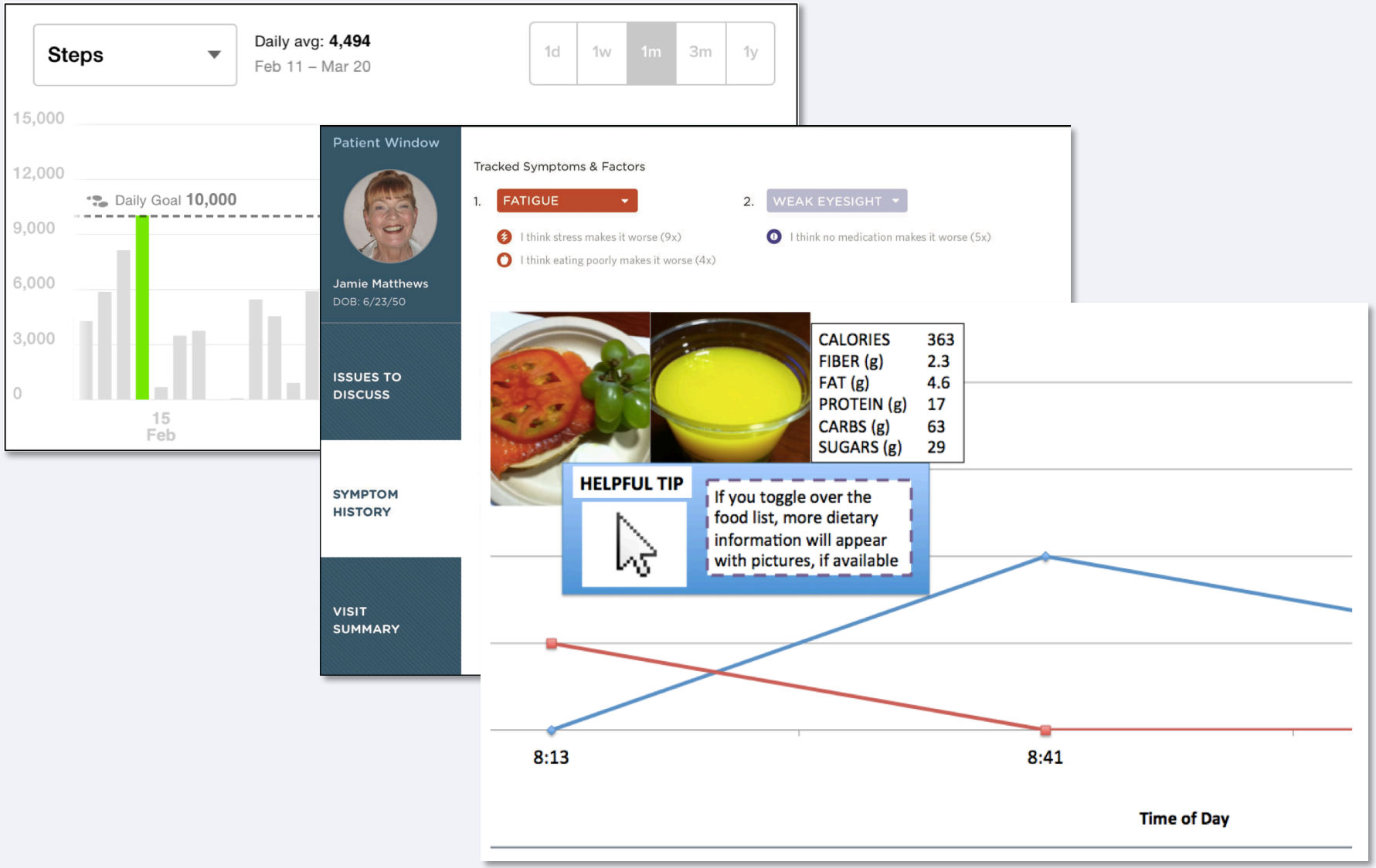
FitBit (what people bring in now)

methods



HealthReport
(masters project by Jonathan Cook, IXD)

methods



GutGuru
(IBS symptom tracker from Jasmine Zia)

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Participants

P1	MD Resident, Family Medicine	Northgate Clinic
P2	Dietitian	Northgate Clinic
P3	Behavioral Psychologist	Northgate Clinic
P4	Nurse Practitioner	Northgate Clinic
P5	MD, Family Medicine, Sports Medicine	Northgate Clinic
P6	MD, Family Medicine, Reproduction Health	Northgate Clinic
P7	MD Resident, Family Medicine	Northgate Clinic
P8	MD, Gastroenterology (interview pending)	Harborview Clinic
P9	MD, Gastroenterology (interview pending)	Harborview Clinic
P10	Dietitian (interview pending)	UWMC

preliminary results

Providers believe their review of data increases patient engagement in tracking and treatment

- Increase patient accountability

> *Even if they just know someone is gonna look at it, I think they have a little bit more honesty. If they are doing it, they want someone to help them and cross-check.*

P2

- Increase patient motivation

> *I think it's a lot more helpful if you have someone to review it with. Because otherwise it might look like "Why am I doing this to myself?"*

P2

supports provider-patient relationship

Helps providers learn about patients

It can help me make more informed decision about their medicine and when I need to involve other members in my peer team.

P1

It tells me more about the patient. It tells me what the patient cares about or they wouldn't bother trying to use it.

P3

Supports provider-patient relationship

Viewing data together helps with discussion

> *[If we have this data] they'll understand next time this (symptom) might happen and they'll be asking about that information to the doctor.*
>
> P6

> *If they don't know what the problem is, I at least have something to look at. I can identify where to ask questions around rather than having a million things but now knowing if any of them is relevant.*
>
> P2

Supports patient sense of control and creates opportunities for coaching

Having that data feedback (from the app) can be therapeutic to treat them. Especially for chronic pain, depression, anxiety, poor sleep.

P1

Some data you collected for the purpose of teaching the patients. It's part of the interaction, not the data just recorded.

P3

... but

it's not clear who should review the data or when

- Physicians think someone else should review data

  I feel that (food record) is probably not something I'll do anything with. I'm referring them to nutritionists already. So I guess it's nutritionists' job… sort of.

  P2

- *In primary medicine, the average of things people want to talk about is 3 to 6, and right now there is only 15 minutes per visit.*

- *So the incentive sometimes has a perverse, mixed message "Collect the data but you don't have time to review it." It's complicated.*

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- Physicians don't have time during patient visits

  In primary medicine, the average of things people want to talk about is 3 to 6, and right now there is only 15 minutes per visit.

  P3

- Physicians don't get paid for reviewing patient data

  So the incentive sometimes has a perverse, mixed message "Collect the data but you don't have time to review it." It's complicated.

  P3

Presentation needs to offer interpretable summaries & show correlations

Providers want some automatic synthesis of data

> *I want to know what's most important, something actionable.*
>
> P1

> *You need to have a way to sort the data, to transfer it to something else, so the meaningfulness can be accessible.*
>
> P6

Correlations between factors and trends are important

> *As a dietitian, I like to have this information overlapping with stress and gut symptoms.*

> *If you present a specific trend of data, sometimes it's a more organized way to present the data, and easier to comprehend.*

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P5

interface points unclear (to EMR or not to EMR?)

(If it's linked with the EMR), it could (increase my preference to review the data).I could look at it before or in-between visits.

P2

It would be fine if they use their own app. But if it could be somehow incorporated into EMR, it would be helpful between visits.

P4

Concerns about patient burden or reliability

Tracking can be too much work for patients

> *I think the limitation is when patients don't comply with it. It may be they forgot, it's too time-consuming, or maybe they don't have a good means of doing it or reminders for them to do that.*
>
> P5

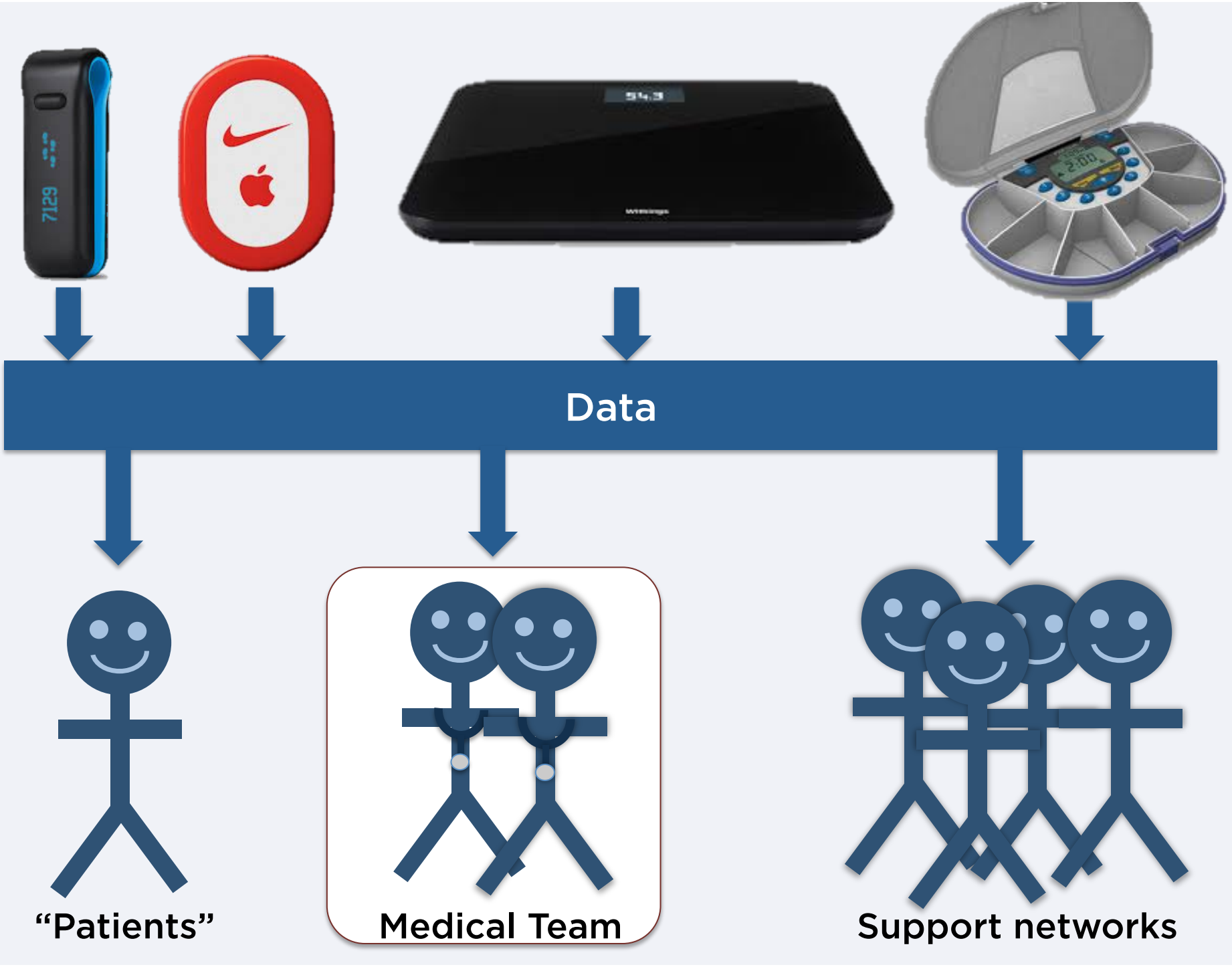
Patients don't track correctly, making the data less valuable

> *They might also do it at the end of day, rather then just by meal or by time. They don't remember anything.*
>
> P2

where we're going with this

Specific investigations around overweight/obesity, IBS, and (possibly) medication adherence, including:

- Observations of current interactions
- Designing tools for sharing data with the medical team and interfaces for review of data, in and out of patient visits
- (eventually) field evaluations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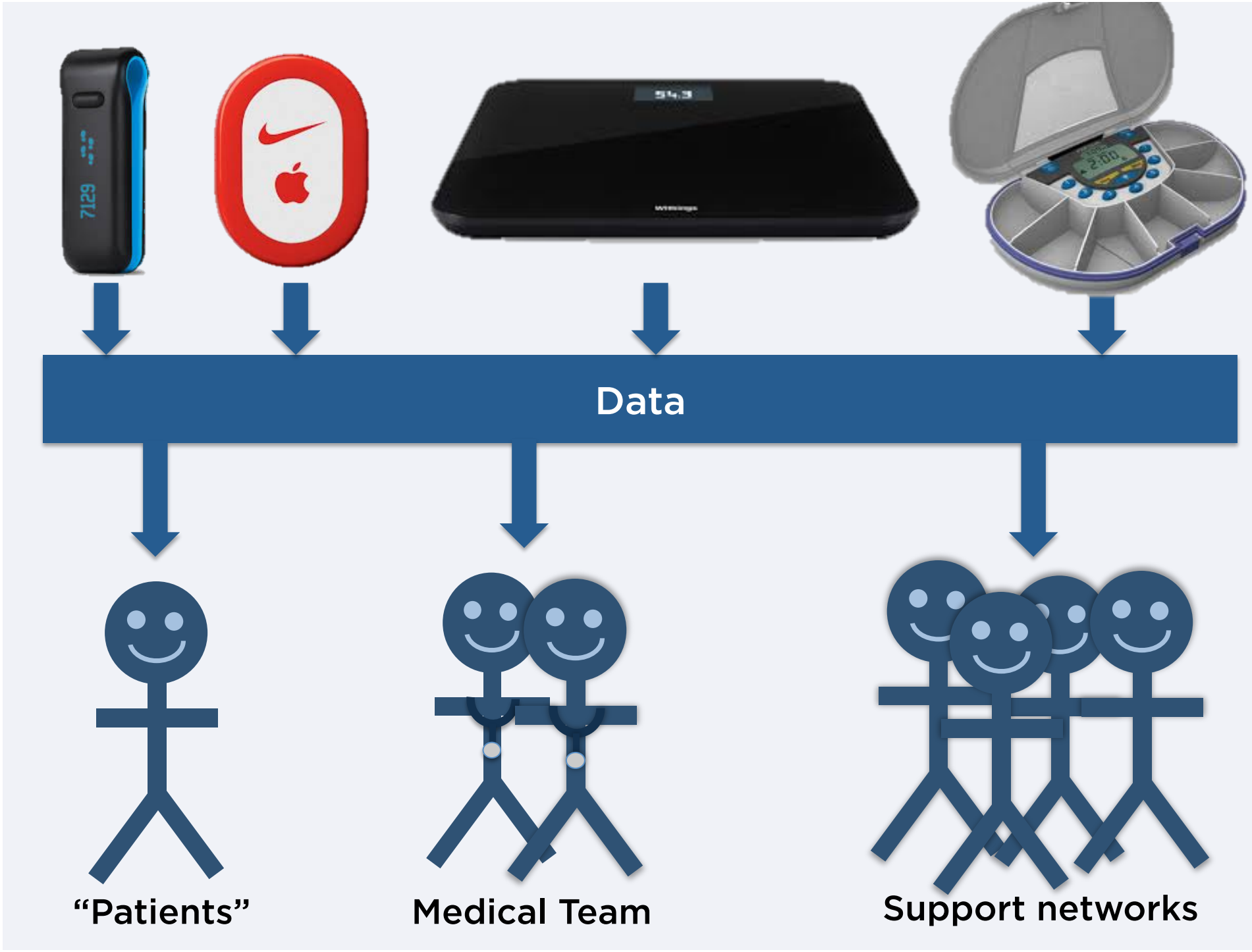
Data
"Patients"
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- We've had incredible progress in tracking patient data – more types of data, with greater accuracy and precision, and less user burden.

- Progress in tools for *getting value* from this data has not kept pace.
  - Cuts may help people interrogate their data for actionable information.
  - There's likely value in connecting this data to the medical team, but we don't really know how (yet).

"Patients"

Medical Team

Support networks

thanks!

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