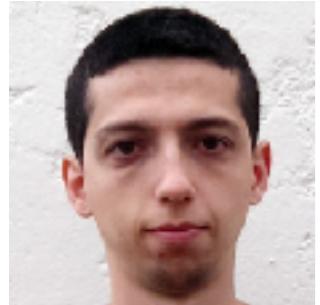


# The Smart Hospital Living Lab

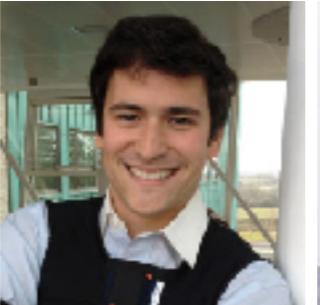
---

Prof.Vassilis Kostakos  
School of Computing and Information Systems  
University of Melbourne

Presented as part of COMP90018 - Mobile Computing Systems Programming  
University of Melbourne, 24 September 2019



Jorge  
Goncalves



Eduardo  
Velloso



Gabriele  
Marini



Niels  
van Berkel



Chu  
Luo



Zhanna  
Sarsenbayeva



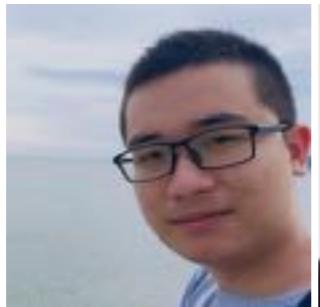
Yitong  
Chen



Chaofan  
Wang



Tilman  
Dingler



Weiwei  
Jiang



Danula  
Hettiachchi  
Wijenayake



Senuri  
Wijenayake



Xiuge  
Chen



Simo  
Hosio



Simon  
Klakegg

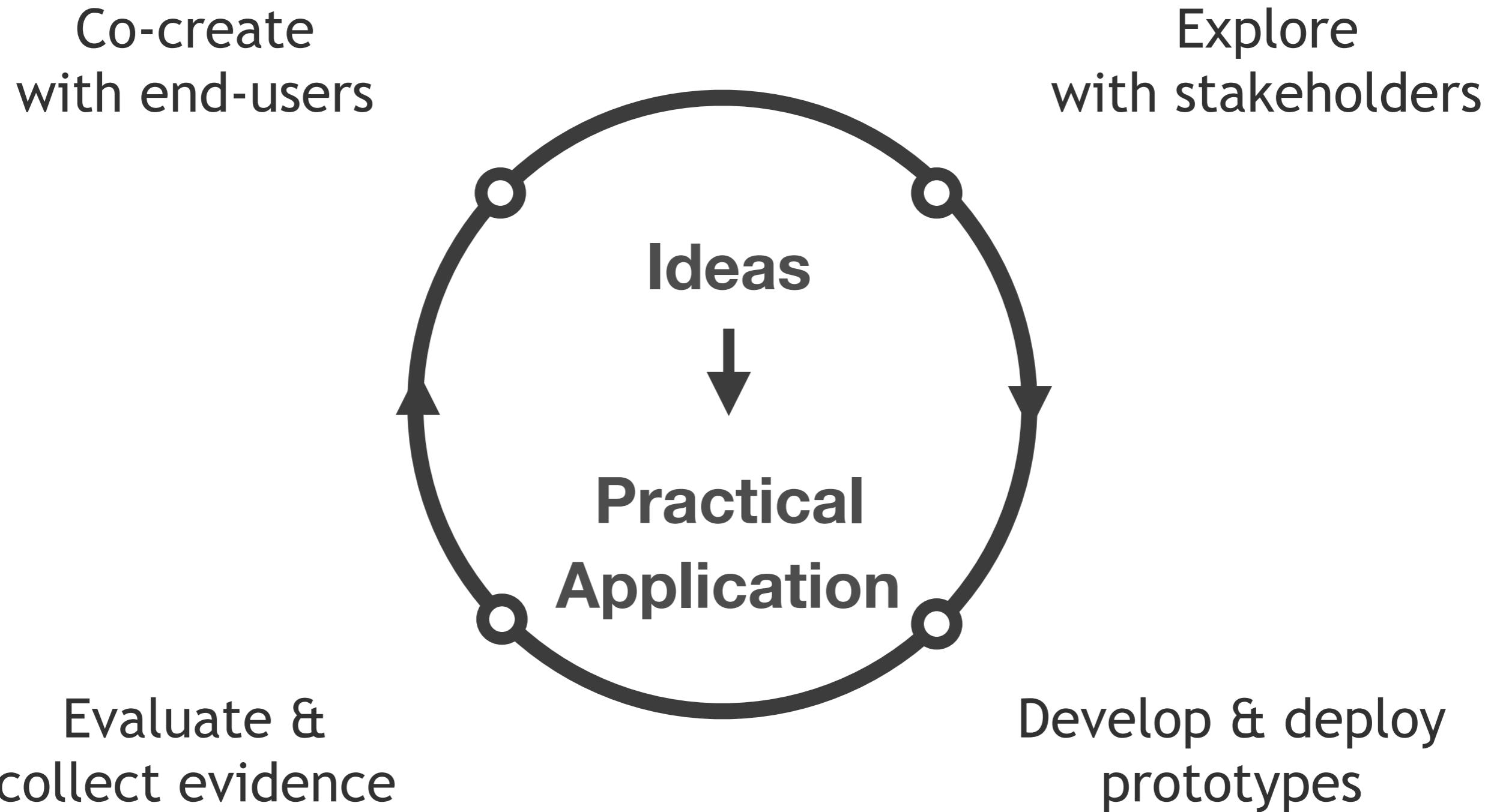


Aku  
Visuri



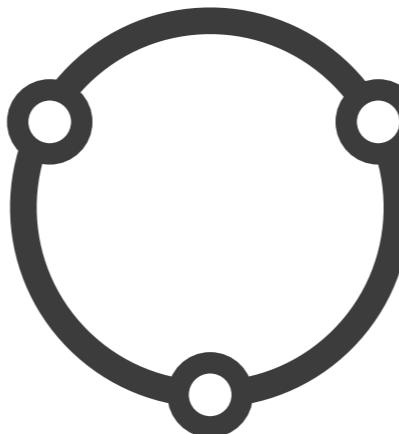






# Smart Hospital Living Lab

Northern Health  
Royal Children's  
Royal Melbourne



University of Melbourne  
Computing  
Population Health



Department of Health and Human Services  
Government of Victoria

# Expertise on Ubiquitous Computing & User-Centered Design



University

Interactive  
systems:  
hardware &  
software

Creating new  
technologies

Sensors,  
actuators,  
machine  
learning, user  
modelling,  
analytics

Real-world  
deployments

# Smart Hospital Living Lab

## Improve hospital operations

Safety: reduce errors  
Efficiency: generate insights

# Ongoing projects



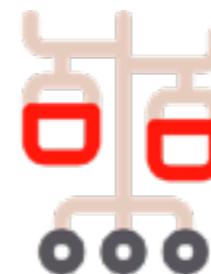
Smart pill box  
Identify pills using  
chemical signatures



Operating theatre tracking  
Track patients/staff in & out  
of operating theatres



Hand washing detection  
Detect (and quantify) hand  
washing in the hospital

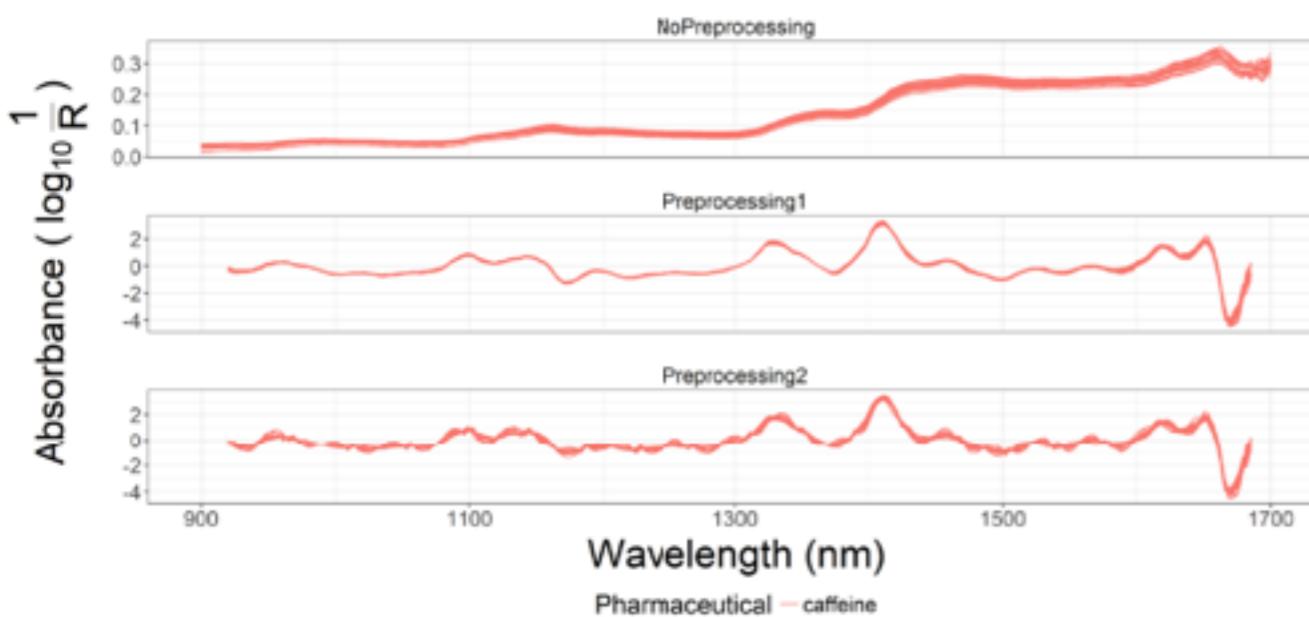
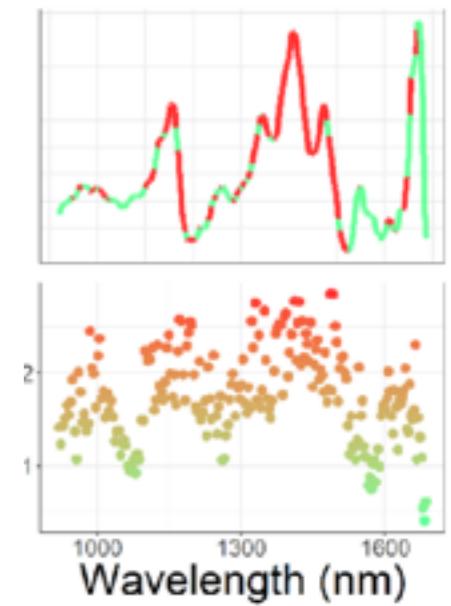
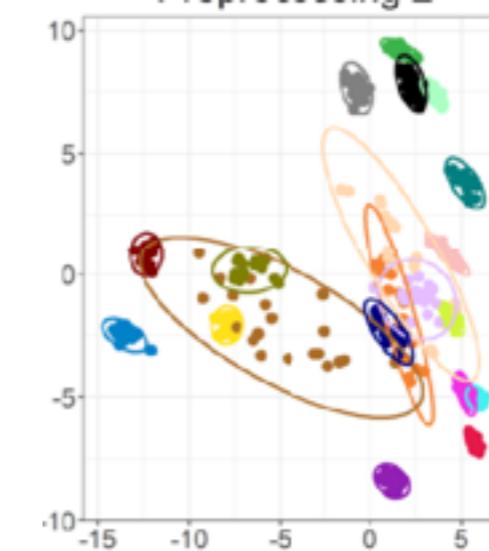
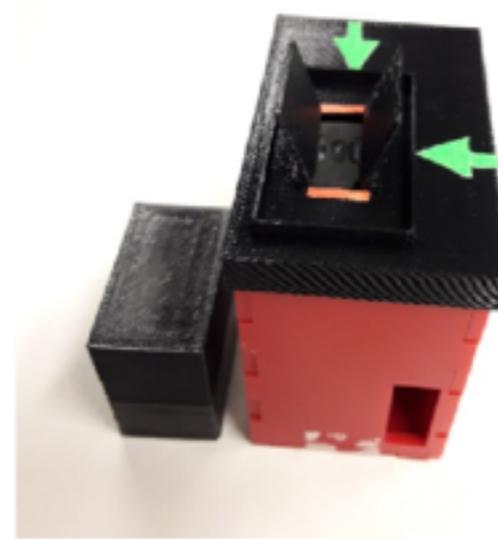
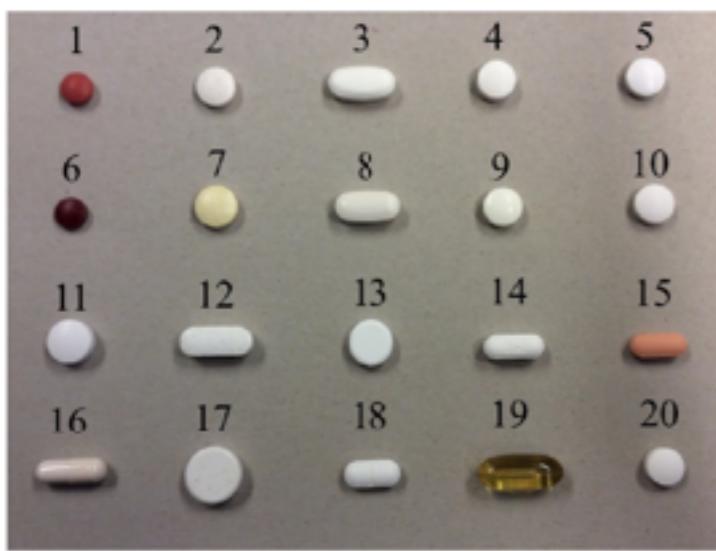


IV line monitoring  
Continuous identification of  
liquids/concentrations in IV line

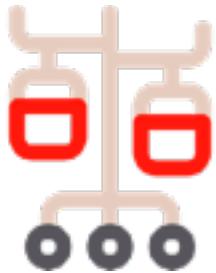


## Smart pill box

### Identify pills using chemical signatures

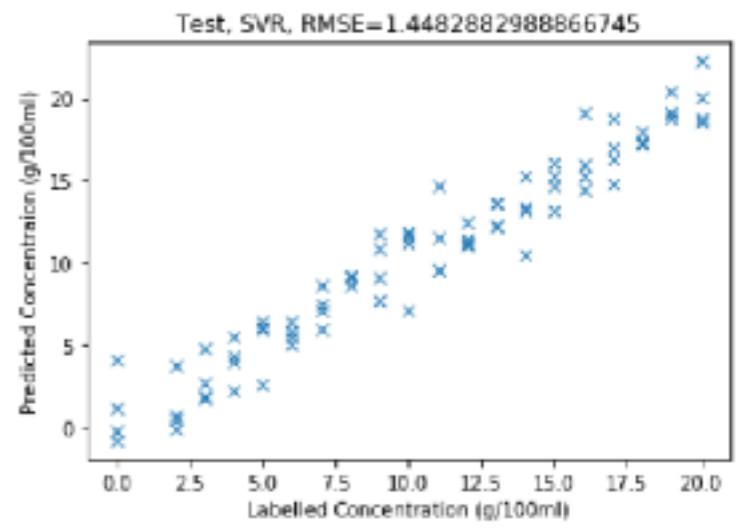
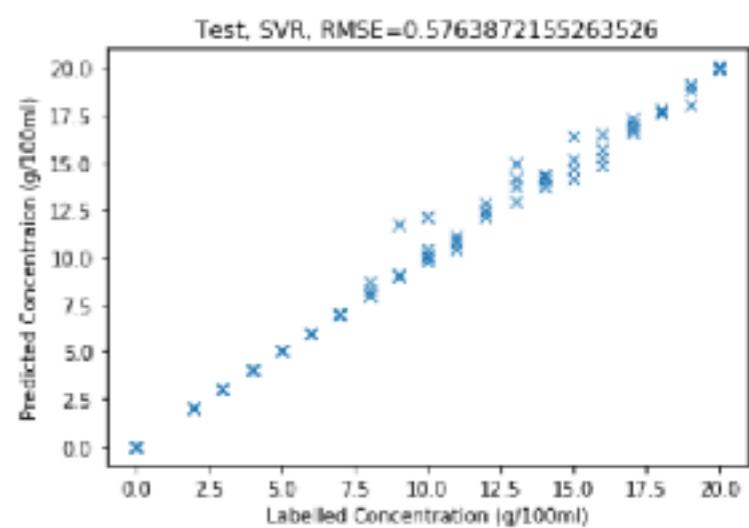
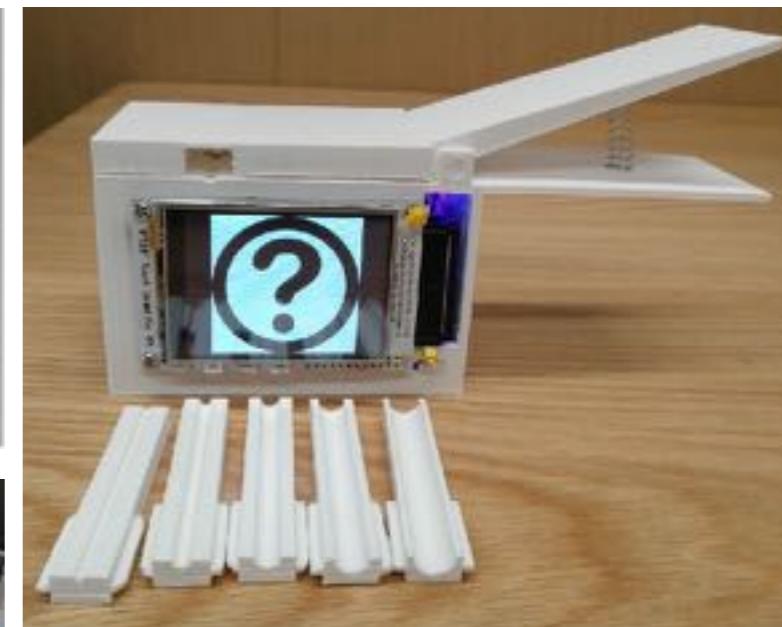
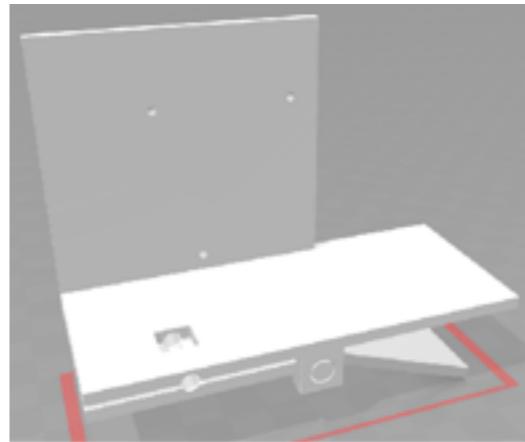
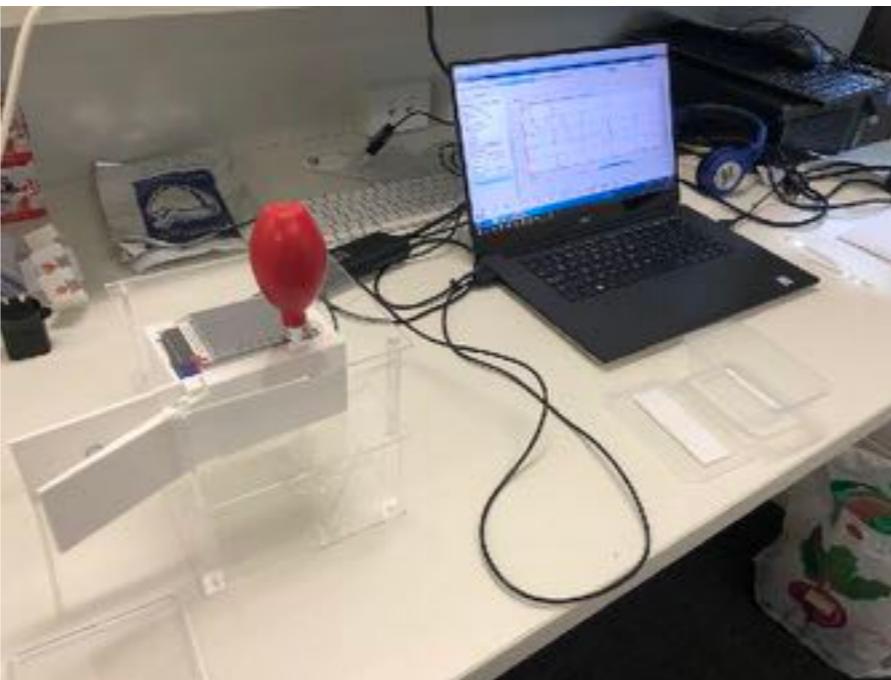






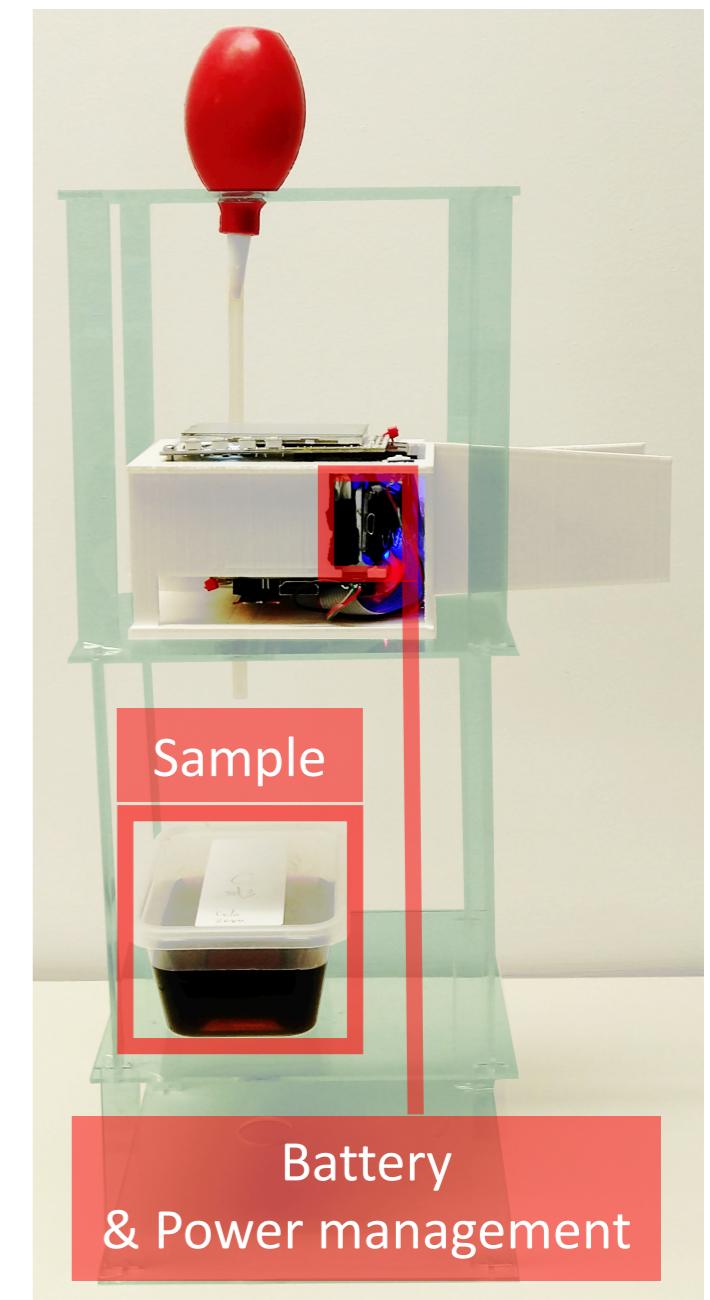
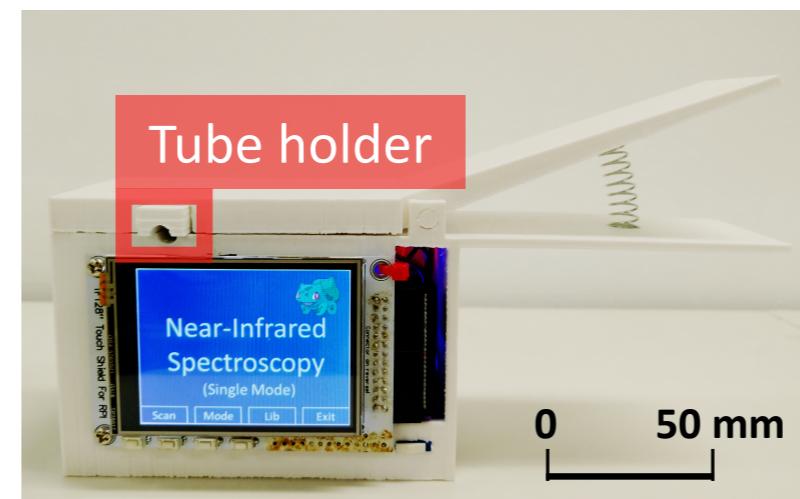
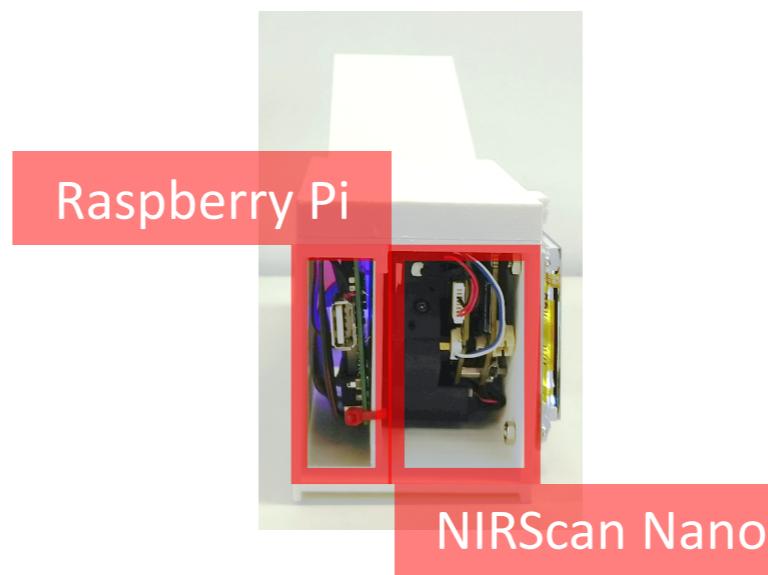
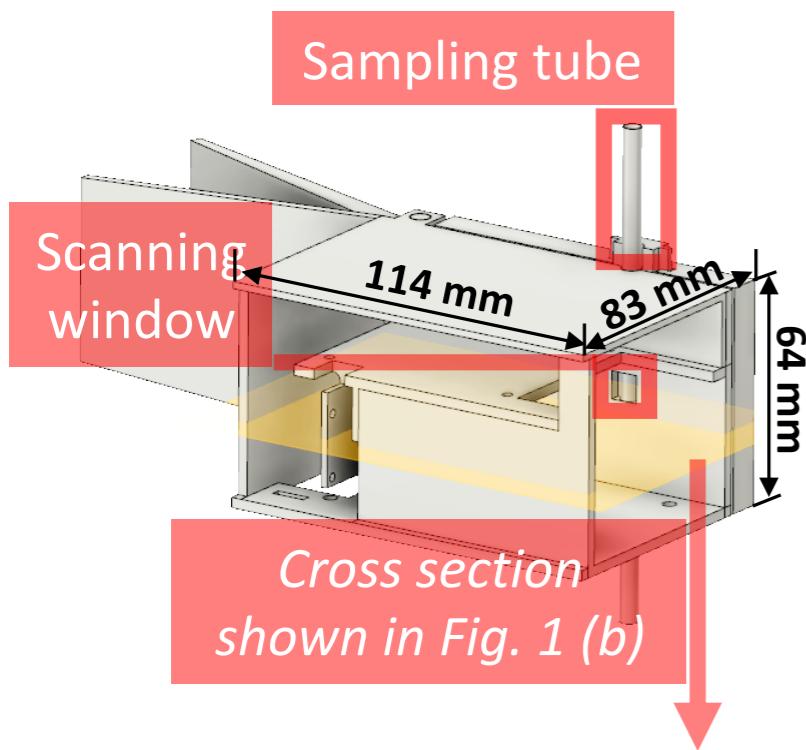
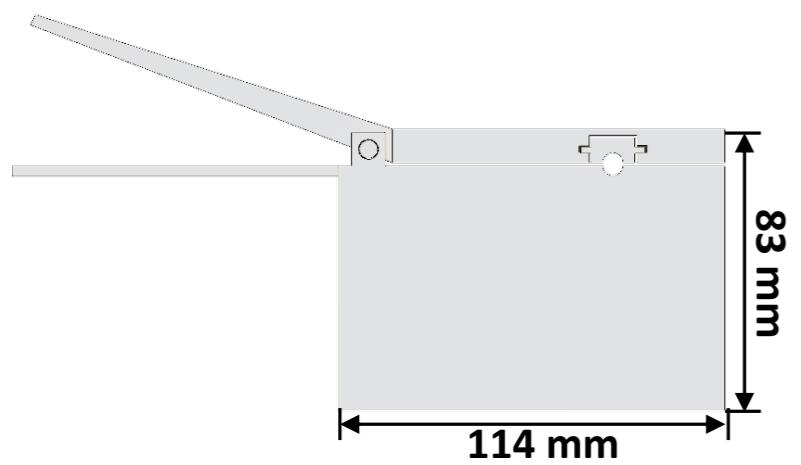
## IV line monitoring

### Continuous identification of liquids/concentrations in IV line



114 mm

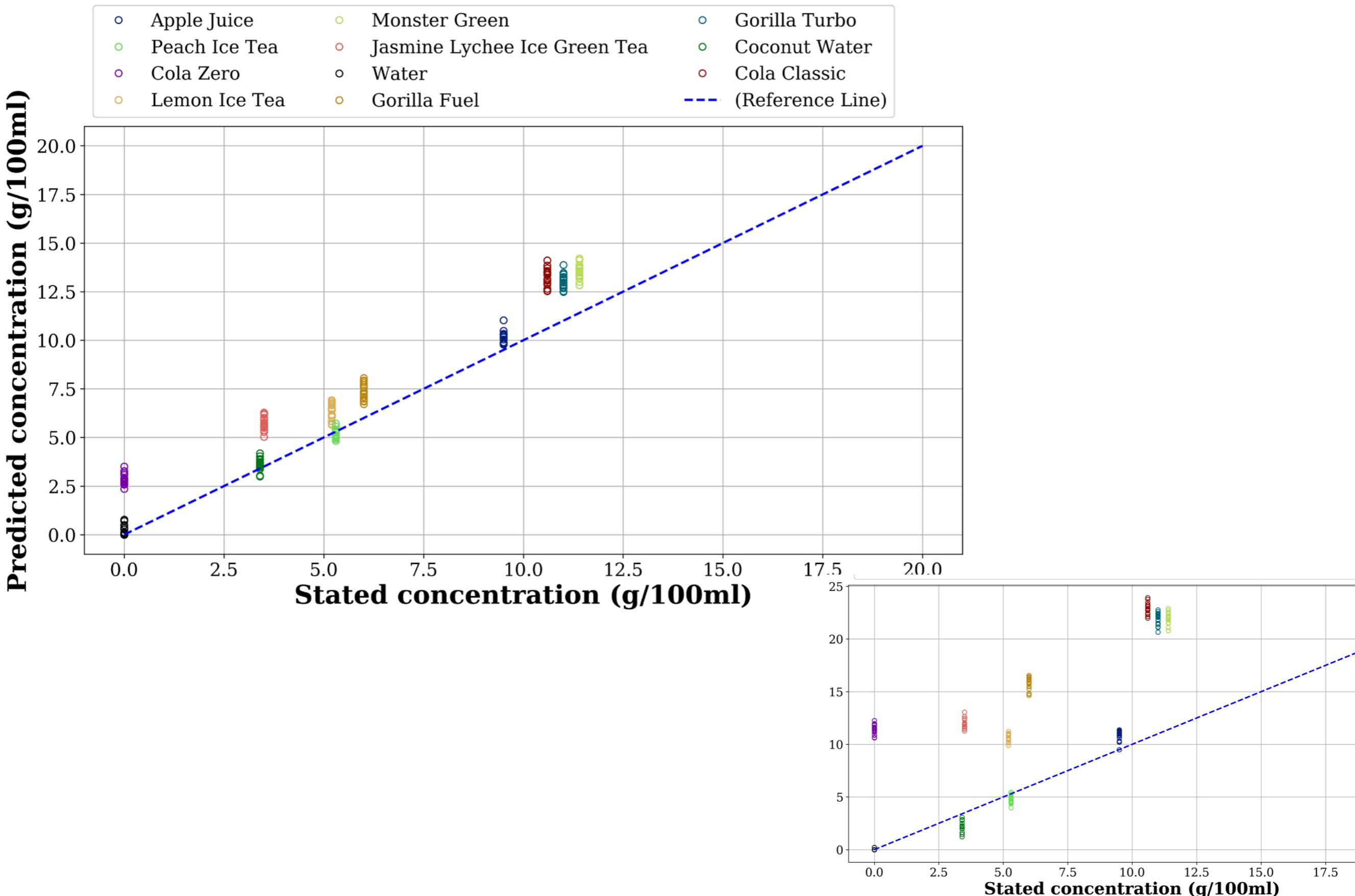


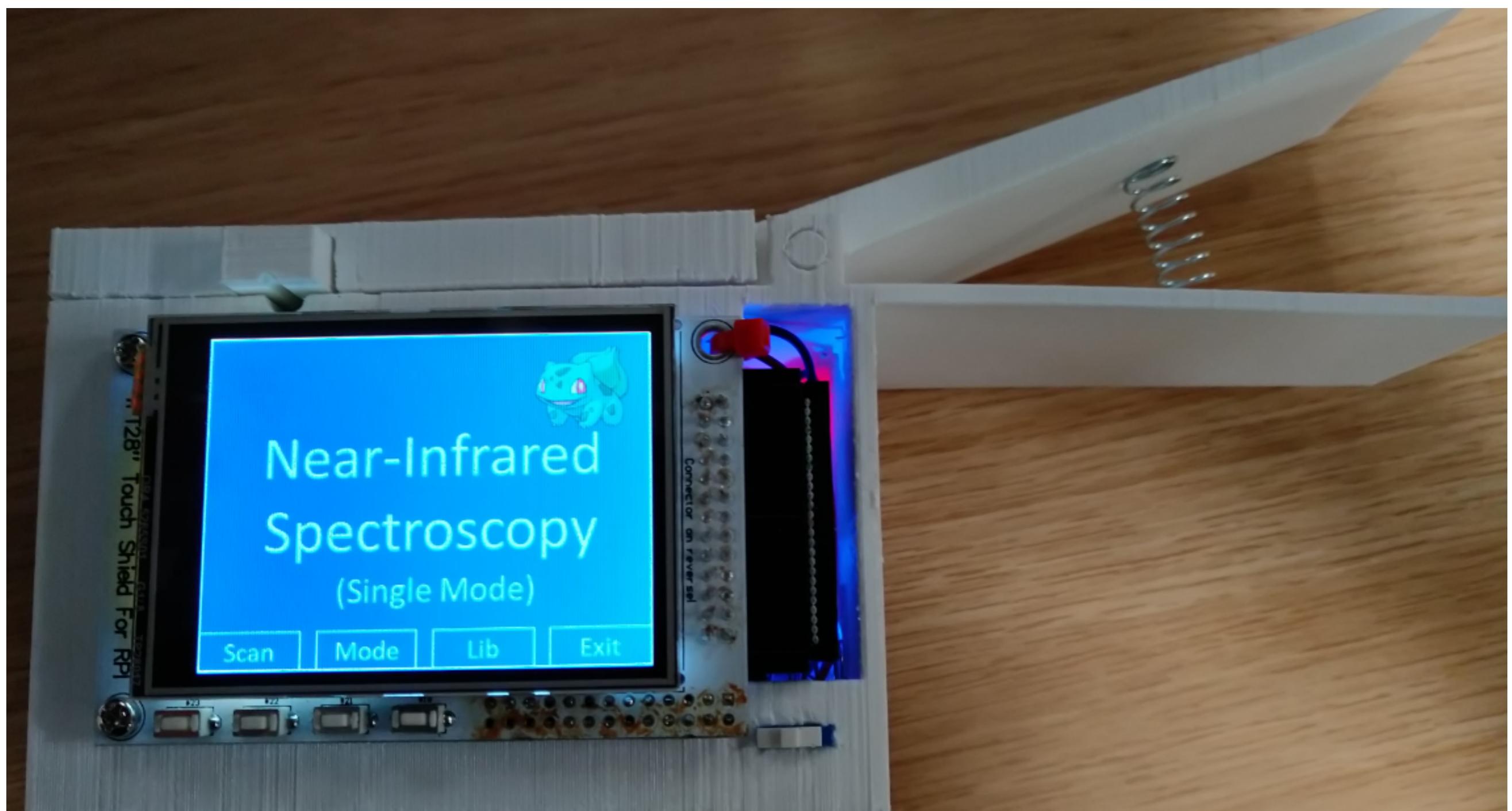


# Tube holder



0      50 mm

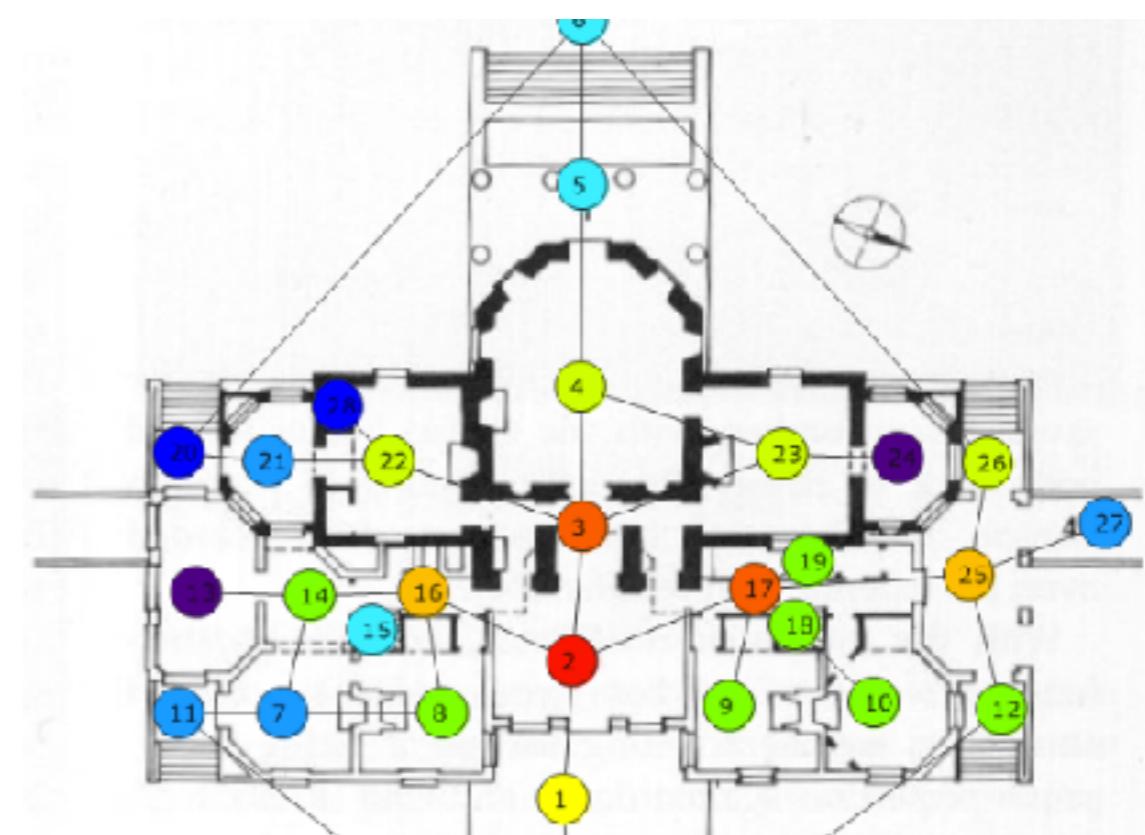
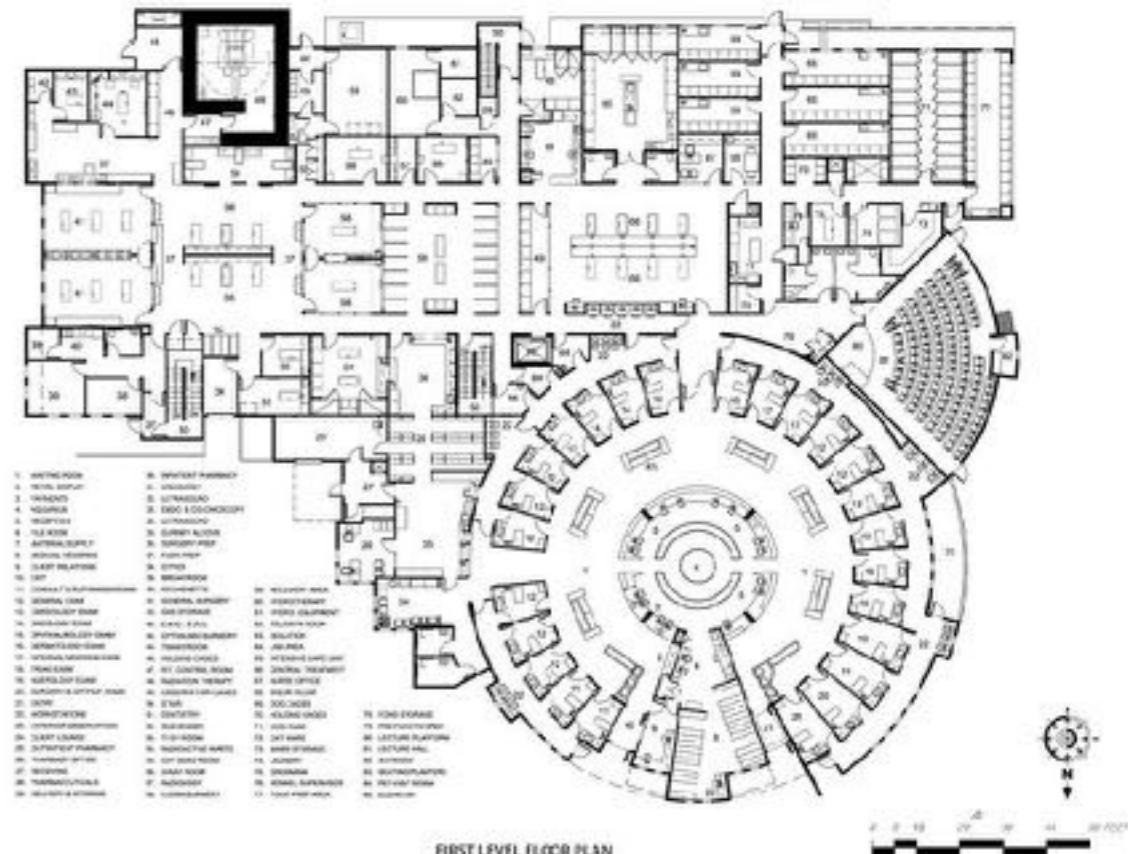
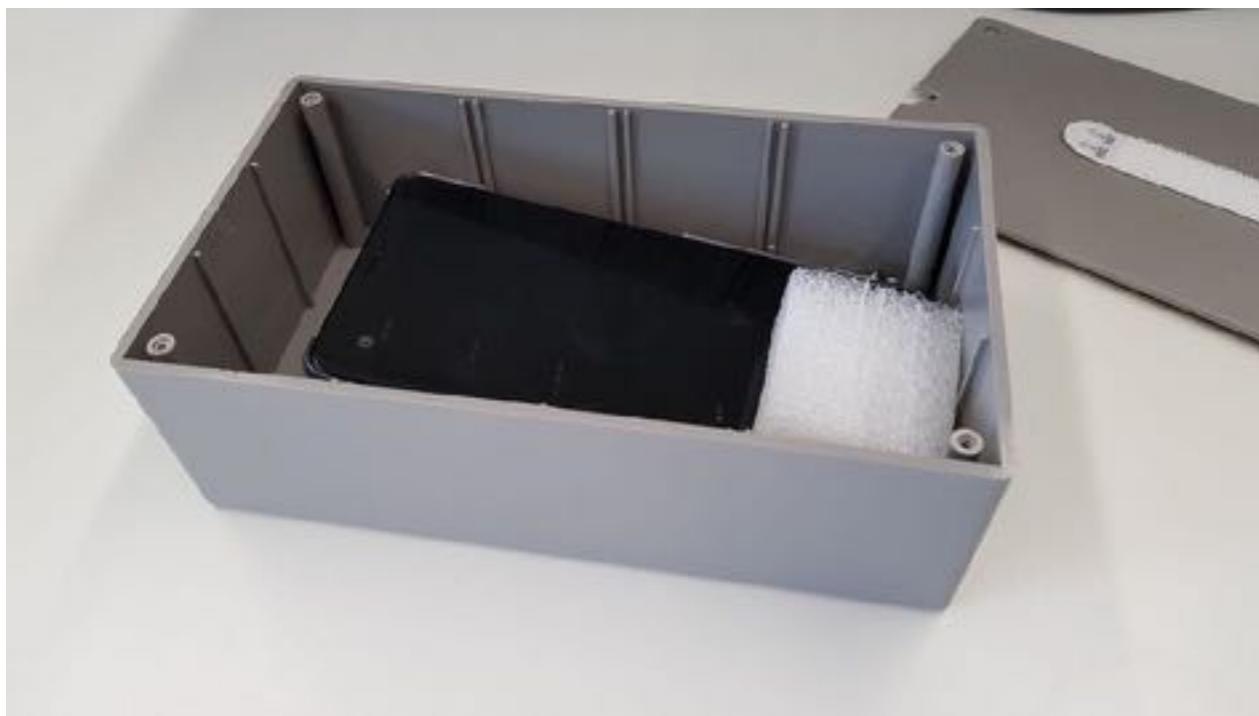






## Operating theatre tracking

Track patients/staff in & out  
of operating theatres







302  
University of  
Melbourne  
Rheoacar

303  
University of  
Melbourne  
Rheoacar

301  
University of  
Melbourne  
Rheoacar

305  
University of  
Melbourne  
Rheoacar

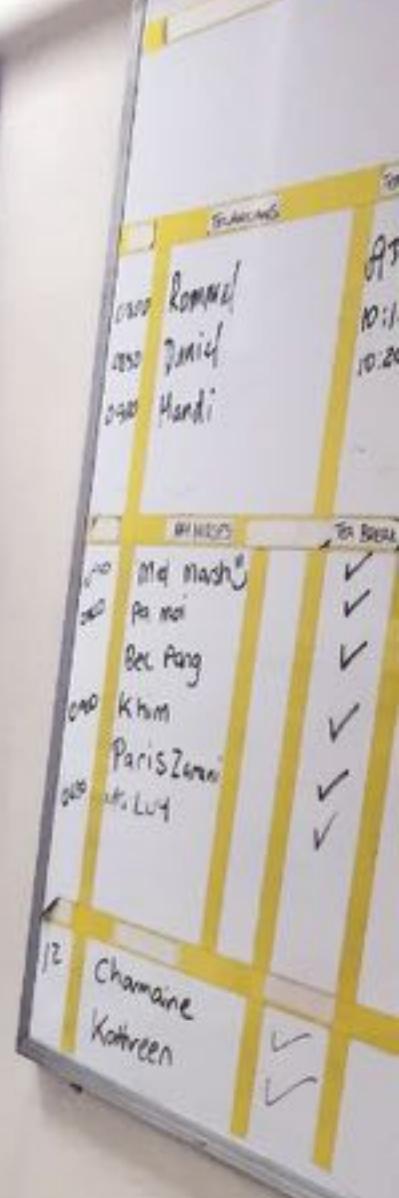
304  
University of  
Melbourne  
Rheoacar















**OR  
1**



**DO NOT UNPLUG!**

Project: Reliable Operating Rooms (ROR)  
In collaboration with The University of Melbourne

For more information contact:  
Prof. Vassilis Kostakos  
[vassilis.kostakos@unimelb.edu.au](mailto:vassilis.kostakos@unimelb.edu.au)

**23**

**OR  
3**



**DO NOT UNPLUG!**

Project: Reliable Operating Rooms (ROR)  
In collaboration with The University of Melbourne

For more information contact:  
Prof. Vassilis Kostakos  
[vassilis.kostakos@unimelb.edu.au](mailto:vassilis.kostakos@unimelb.edu.au)

**16**

Office Envelope

Office

Show Deployed Only:  5 / 16

## Devices

355166080343718

Watchdog: **offline**

None

Device Number: 11

Last contact: 17 Oct 2018 9:06:57

87%  

Settings: v0.003



355166080347230

Watchdog: **offline**

None

Device Number: 12

Room: OR 2

Last contact: 5 Nov 2018 18:47:54

1%  

Settings: v0.003



355166080347370

Watchdog: **online**

516	-79
573	-80
324	-94
399	-78

Device Number: 13

Room: OR 4

Last contact: 12 Nov 2018 17:01:54

100%  

Settings: v0.003



355166080347362

Watchdog: **online**

399	-77
324	-87
573	-86
516	-87

Device Number: 16

Room: OR 3

Last contact: 12 Nov 2018 17:01:54

100%  

Settings: v0.003



355166080346505

Watchdog: **offline**

None

Device Number: 17

Last contact: 17 Oct 2018 19:55:19

46%  

Settings: v0.003



355166080347560

Watchdog: **offline**

None

Device Number: 18

Room: Anes 1

Last contact: 4 Nov 2018 16:04:03

100%  

Settings: v0.003



## Devices

Show Avail. Only:  5 / 21

355166080347370

Watchdog: **online**

516	-79
573	-80
324	-94
399	-78

Device Number: 13

Room: OR 4

Last contact: 12 Nov 2018 17:01:54

100%

Settings: v0.003



355166080344831

Watchdog: **online**

None

Device Number: 14

Room: DPU Recovery (Bay 5)

Last contact: 12 Nov 2018 17:01:54

100%

Settings: v0.003



355166080344724

Watchdog: **online**

None

Device Number: 15

Room: Recovery (Corner)

Last contact: 12 Nov 2018 17:01:54

100%

Settings: v0.003



355166080347560

Watchdog: **offline**

None

Device Number: 18

Room: Anes 1

Last contact: 4 Nov 2018 16:04:03

100%

Settings: v0.003



355166080345101

Watchdog: **offline**

None

Device Number: 19

Last contact: No last contact date

Settings: v-



355166080345184

Watchdog: **offline**

None

Device Number: 20

Room: Hallway

Last contact: 4 Nov 2018 16:04:17

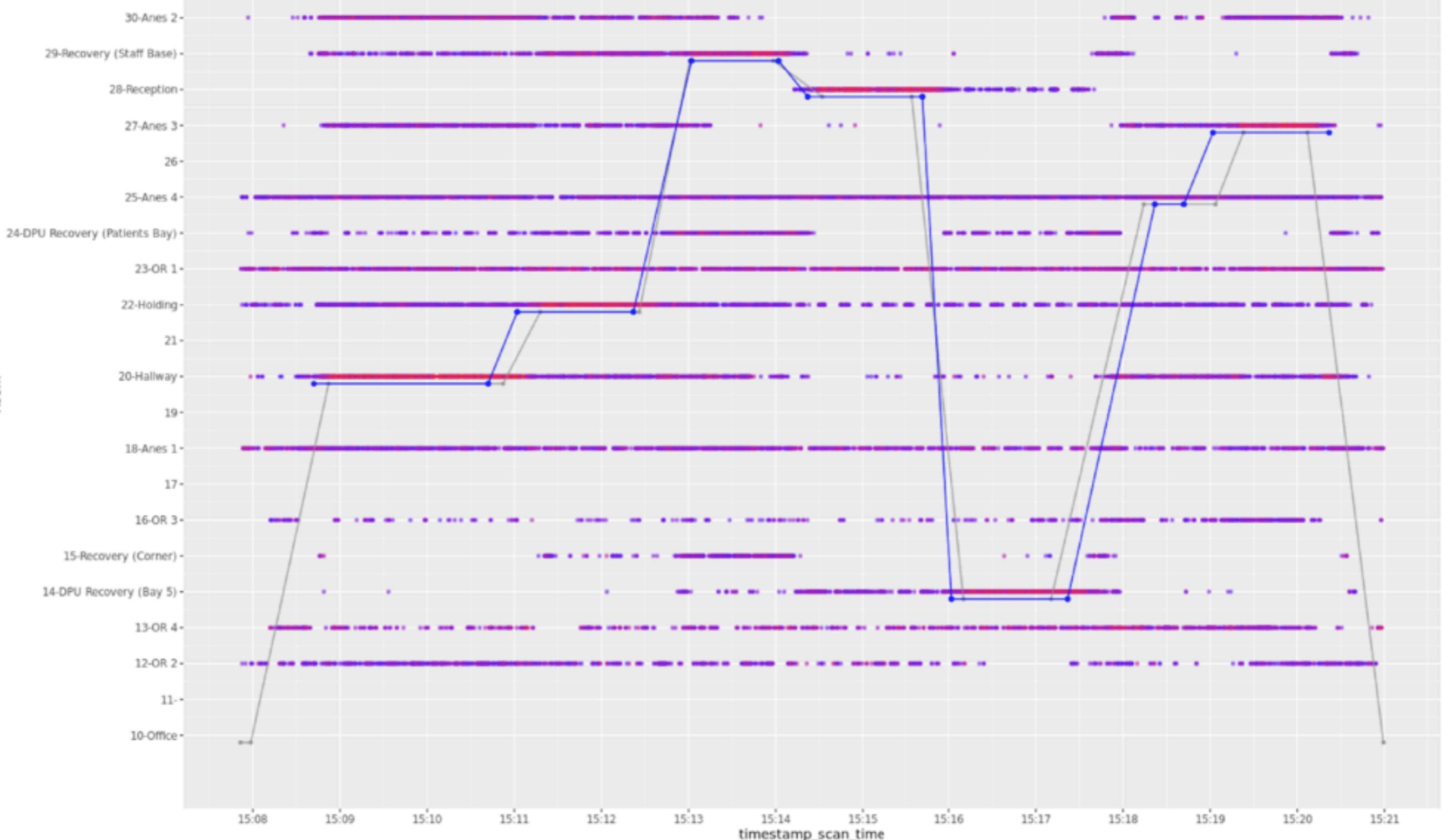
100%

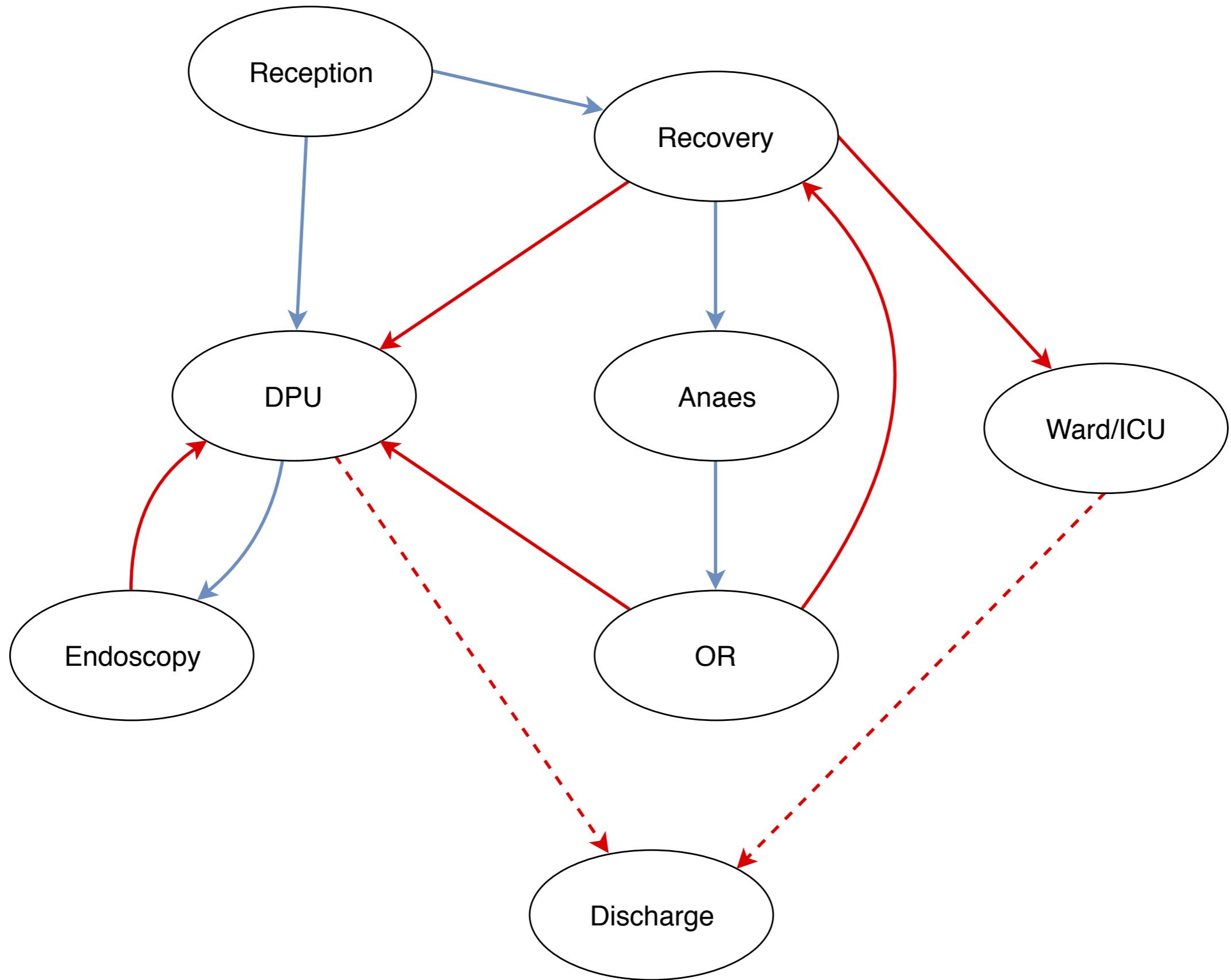
Settings: v0.003



## Beacon

Click to go back, hold to see history

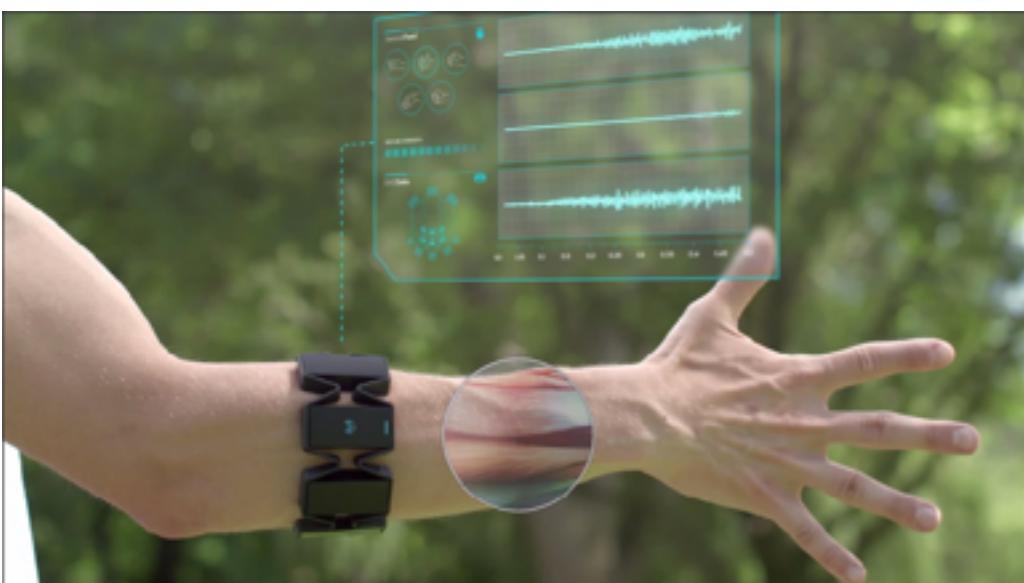
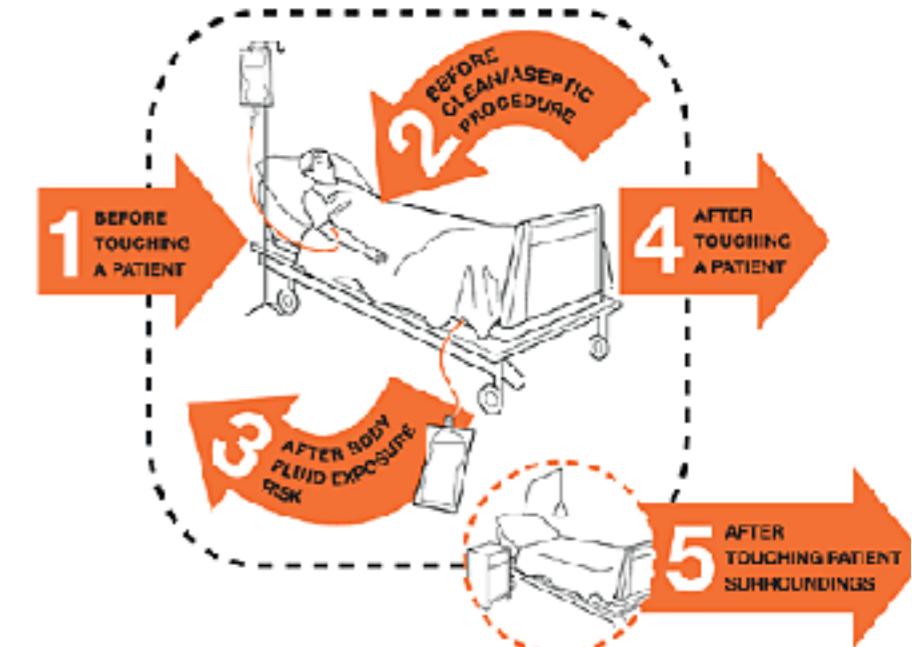






## Hand washing detection

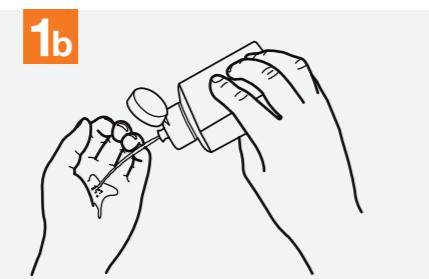
### Detect (and quantify) hand washing in the hospital



# How to Handrub? How to Handwash?

RUB HANDS FOR HAND HYGIENE! WASH HANDS WHEN VISIBLY SOILED!

Duration of the entire procedure: 20-30 seconds



Apply a palmful of the product in a cupped hand, covering all surfaces;



Rub hands palm to palm;

WASH HANDS WHEN VISIBLY SOILED! OTHERWISE, USE HANDRUB

Duration of the handwash (steps 2-7): 15-20 seconds

Duration of the entire procedure: 40-60 seconds



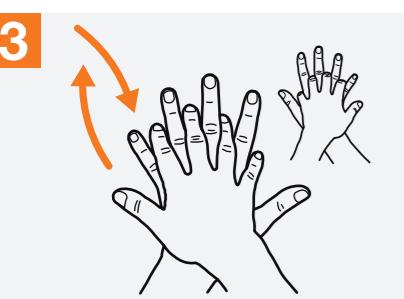
Wet hands with water;



Apply enough soap to cover all hand surfaces;



Rub hands palm to palm;



Right palm over left dorsum with interlaced fingers and vice versa;



Palm to palm with fingers interlaced;



Backs of fingers to opposing palms with fingers interlocked;



Right palm over left dorsum with interlaced fingers and vice versa;



Palm to palm with fingers interlaced;



Backs of fingers to opposing palms with fingers interlocked;



Rotational rubbing of left thumb clasped in right palm and vice versa;



Rotational rubbing, backwards and forwards with clasped fingers of right hand in left palm and vice versa;



Once dry, your hands are safe.



Rotational rubbing of left thumb clasped in right palm and vice versa;



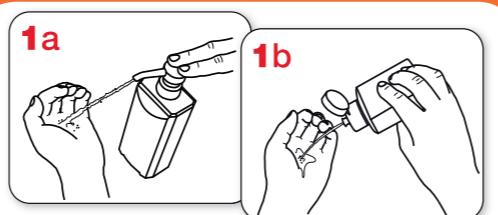
Use towel to turn off faucet;



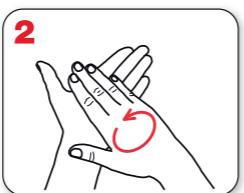
Your hands are now safe.

# How to handrub?

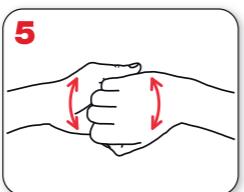
WITH ALCOHOL-BASED FORMULATION



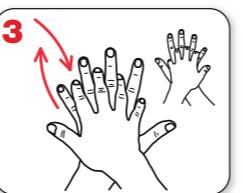
Apply a palmful of the product in a cupped hand and cover all surfaces.



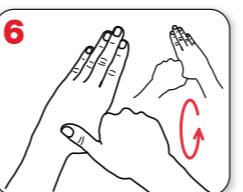
Rub hands palm to palm



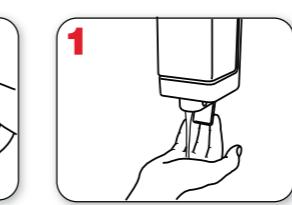
backs of fingers to opposing palms with fingers interlocked



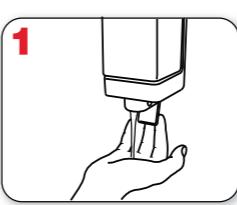
right palm over left dorsum with interlaced fingers and vice versa



rotational rubbing of left thumb clasped in right palm and vice versa



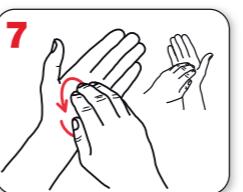
Wet hands with water



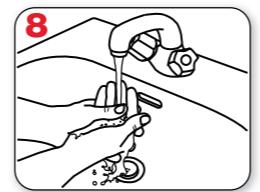
apply enough soap to cover all hand surfaces.



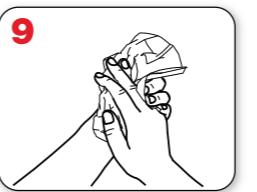
palm to palm with fingers interlaced



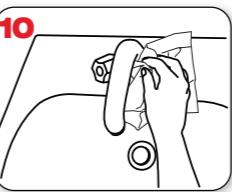
rotational rubbing, backwards and forwards with clasped fingers of right hand in left palm and vice versa



rinse hands with water



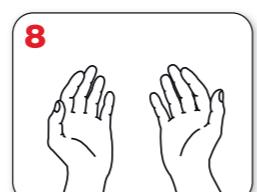
dry thoroughly with a single use towel



use towel to turn off faucet



20-30 sec



...once dry, your hands are safe.



40-60 sec



...and your hands are safe.

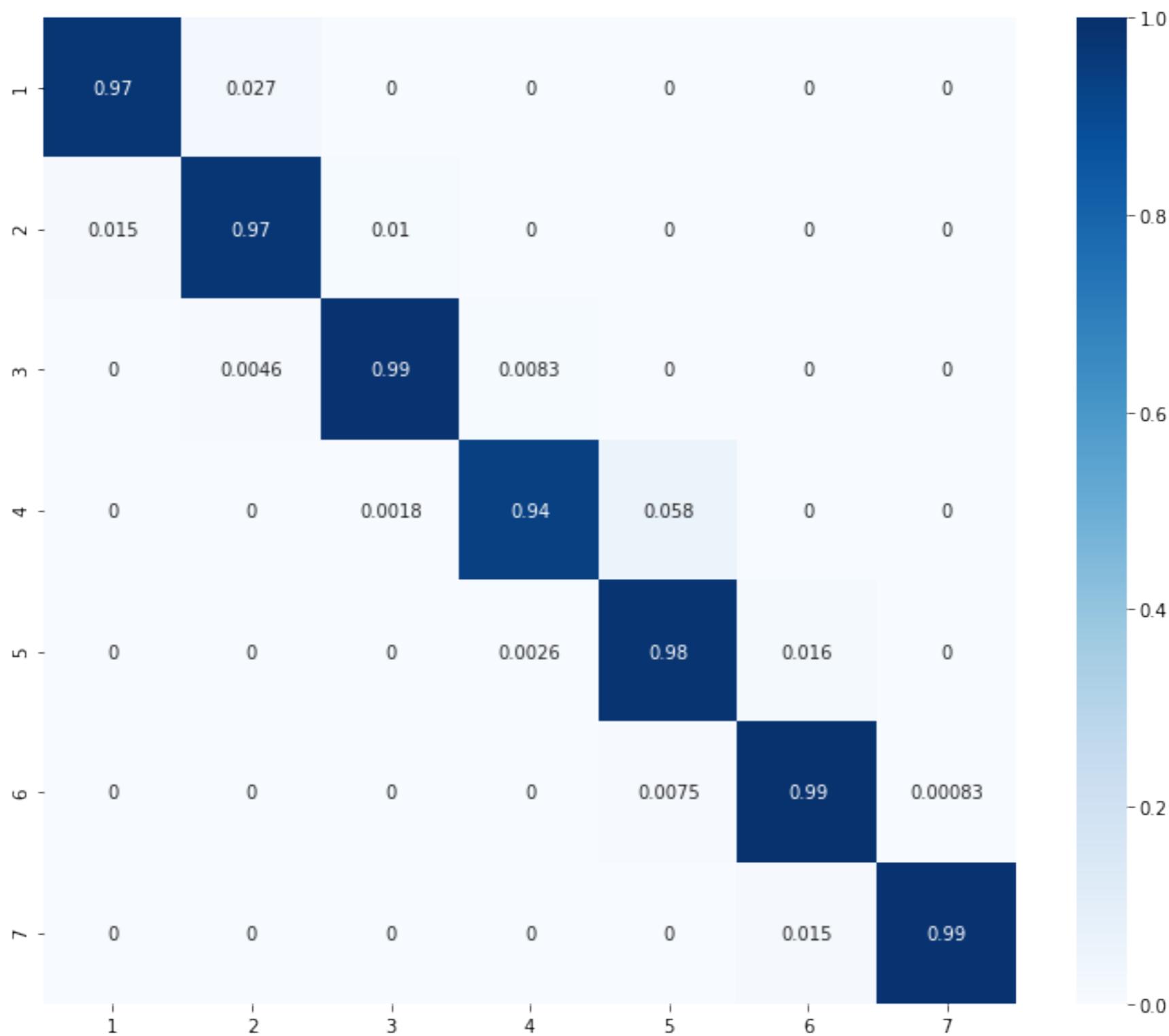
Design: mondoragliis network







## Upper Arm with Both Hands(smoothed with ecp)



9:41



9:41



9:41



## ≡ Home



### Hand Hygiene History

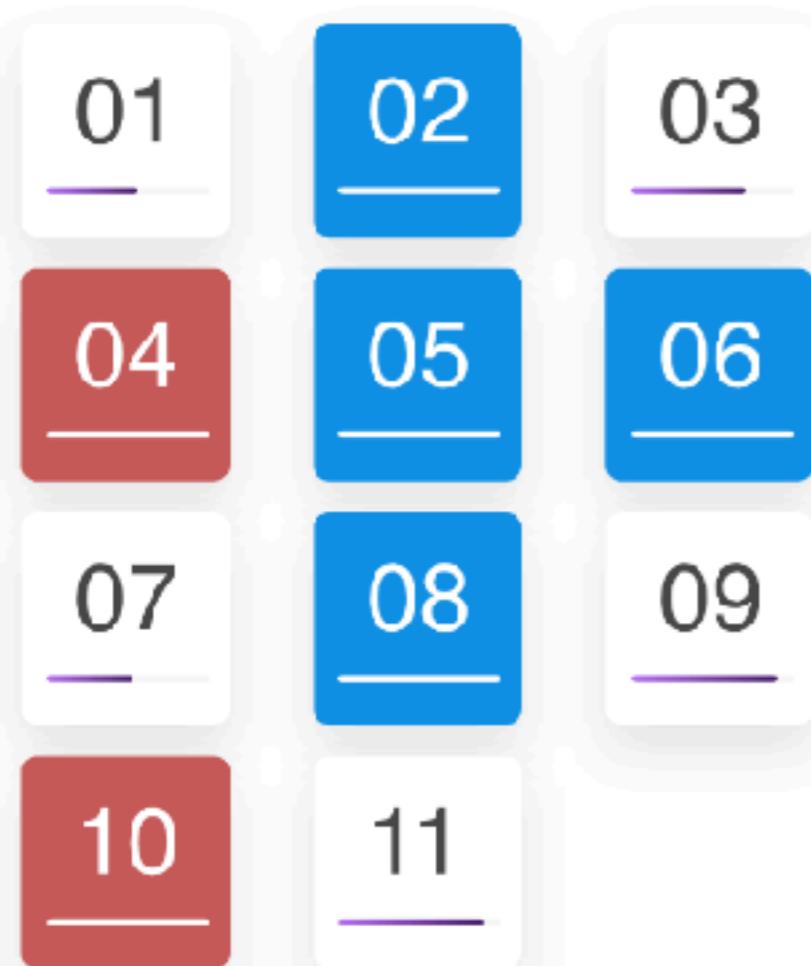
**Record - 21** Active Now  
Good completeness of hand washin...

**Record - 20** 5 mns ago  
You missed some steps when last h ...

**Record - 19** 5 hours ago  
There are some steps you need to i...

[Read More](#)

### Summary



## ≡ Home

**01**

Wet your hands w th water

Completeness: 50%

**02**

Apply Soap to cover all hand surfa

Completeness: 100%

**03**

Rub hands palm to palm

Completeness: 70%

**04**Right palm over left dorsum with  
Interlaced finger and vice versa

Completeness: Missed

**06**Backs o' fingers to opposing pa n  
with finger's interlocked

Completeness: 100%

**05**

Palm to palm with fingers interlac

Completeness: Wrong Order

**07**

Rotational rubbing left thumb clas

in the right palm and vice versa

Completeness: 50%

**08**Rotational rubbing, backwards and  
forwards with clasped fingers of right  
hand in left palm and vice versa

## ≡ Home

**01**

Wet your hands with water

Completeness: 50%

### Description

This is the first step from the standard hand washing process from WHO; however, it seems like you may need to prolong the curation of hand washing.

### Standard Procedure





Co-create



Explore



Prototype



Evaluate



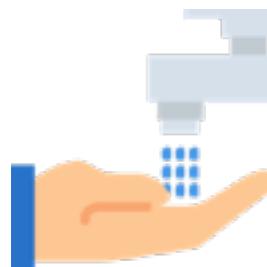
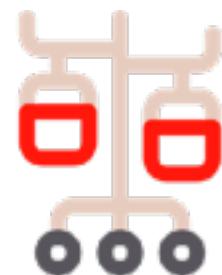
Publish



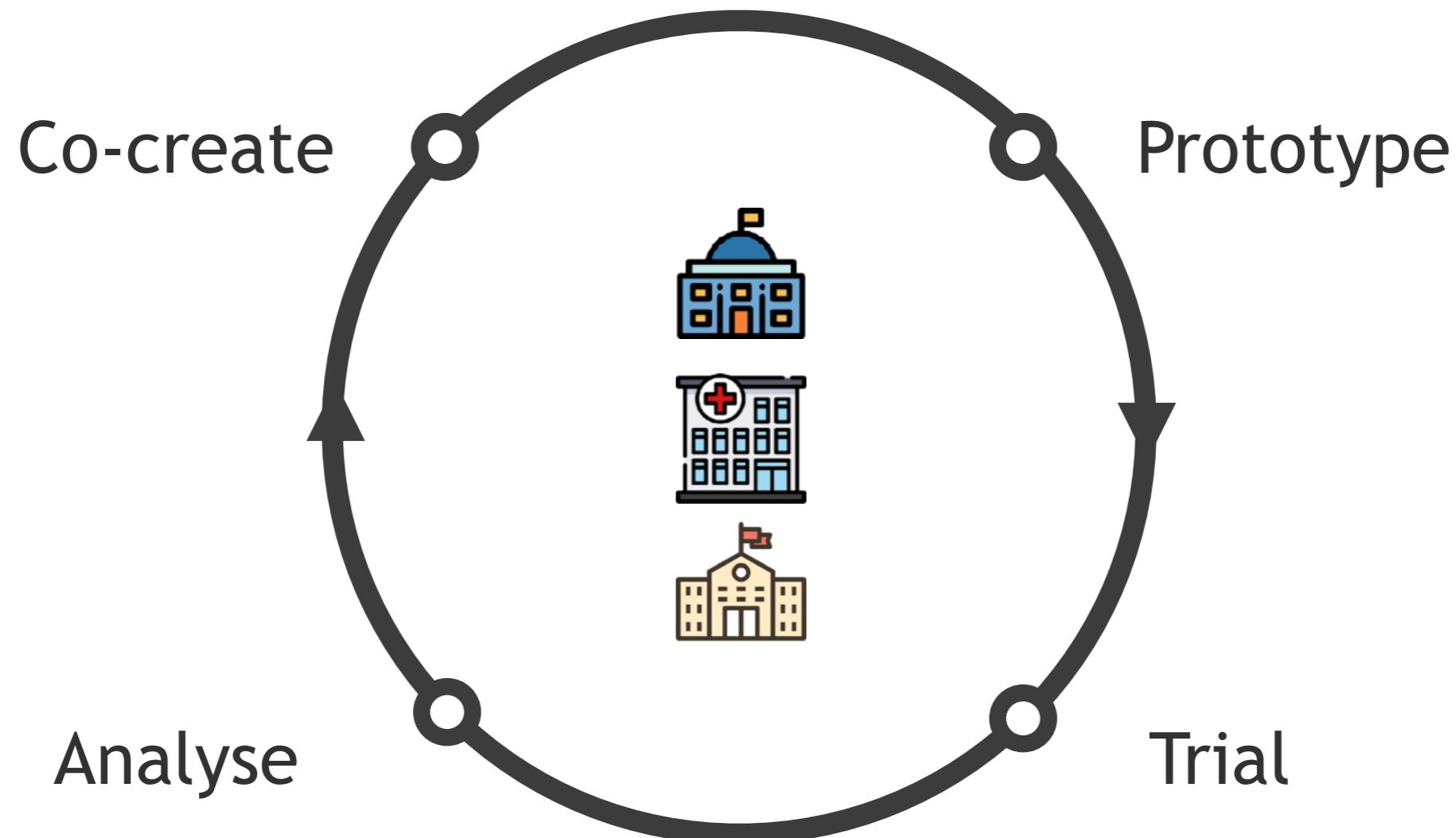
Funding



Trials



# Living Lab: Continuous Innovation



# Outcomes and benefits



Improved operations



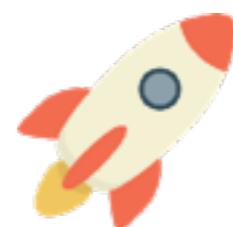
Generalisable solutions



Pathway to funding



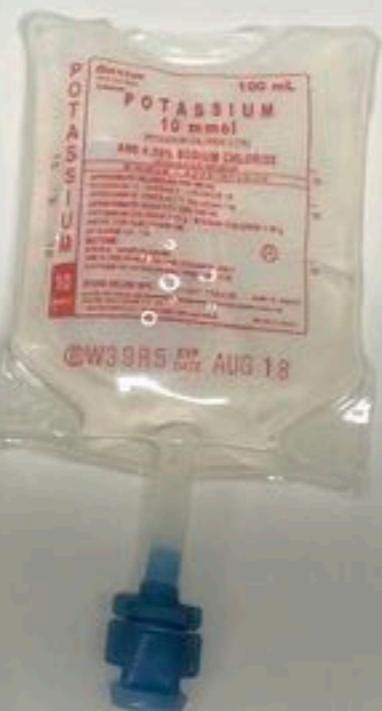
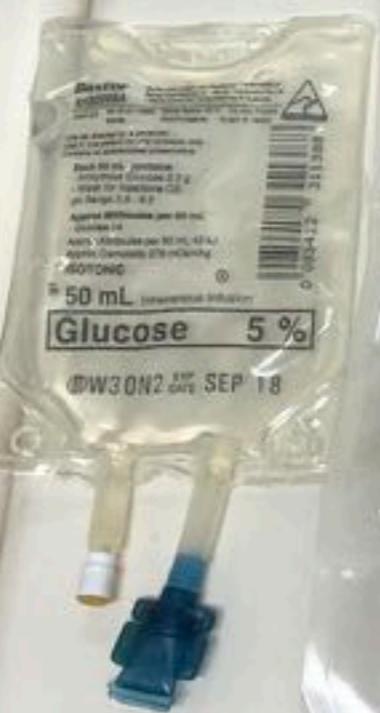
Establish critical mass



Innovation beyond hospitals

# Lessons learned

- The focus of our work is not “owned” by medical experts
  - Good: we do not become “programers”
  - Bad: who drives this? Need support from higher management.
- This is a highly regulated space
  - Linking our work to a regulation makes it highly attractive
- Health funding can be very different from “science”
  - Attending dinner balls to attract donations
- Path to commercialisation?
  - After funding & trials
- Small seed funding is CRUCIAL to enable this work
  - You don’t need millions to get things done
- How to make a contribution when solving others’ problems?
  - Be selective about which problems you solve!
  - Strong grounding of work, compelling motivation.







The ~~end~~ *beginning!*

Prof. Vassilis Kostakos

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School of Computing and Information Systems  
University of Melbourne