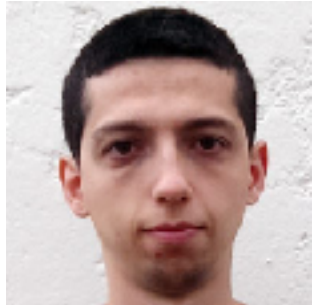


# The Smart Hospital Living Lab

---

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

Presented at  
University of Boston, 26 March 2021



Jorge  
Goncalves



Eduardo  
Velloso



Gabriele  
Marini



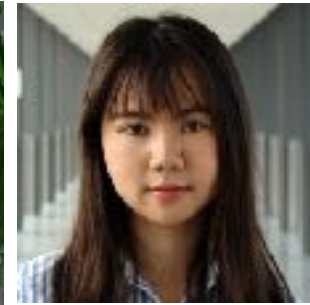
Niels  
van Berkel



Chu  
Luo



Zhanna  
Sarsenbayeva



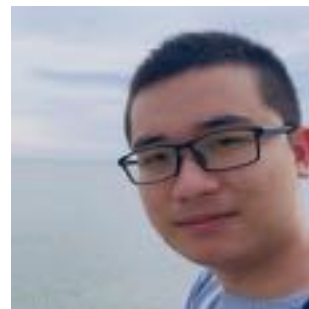
Jing  
Wei



Chaofan  
Wang



Tilman  
Dingler



Weiwei  
Jiang



Danula  
Hettiachchi Wijenayake



Senuri



Xiuge  
Chen



Simo  
Hosio



Simon  
Klakegg



Aku  
Visuri















Co-create  
with end-users

Explore  
with stakeholders

**Ideas**



**Practical  
Application**

Evaluate &  
collect evidence

Develop & deploy  
prototypes

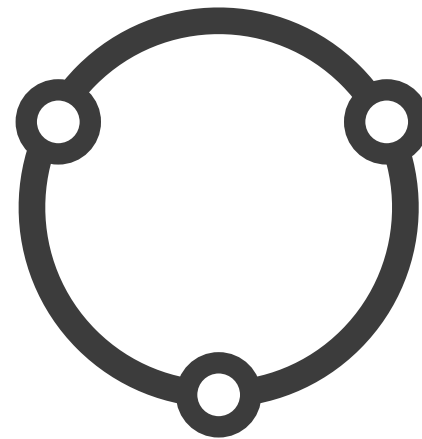


# Smart Hospital Living Lab

Northern Health  
Royal Children's  
Royal Melbourne



Hospital



University

University of Melbourne  
Computing  
Population Health



Government

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



# Some 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

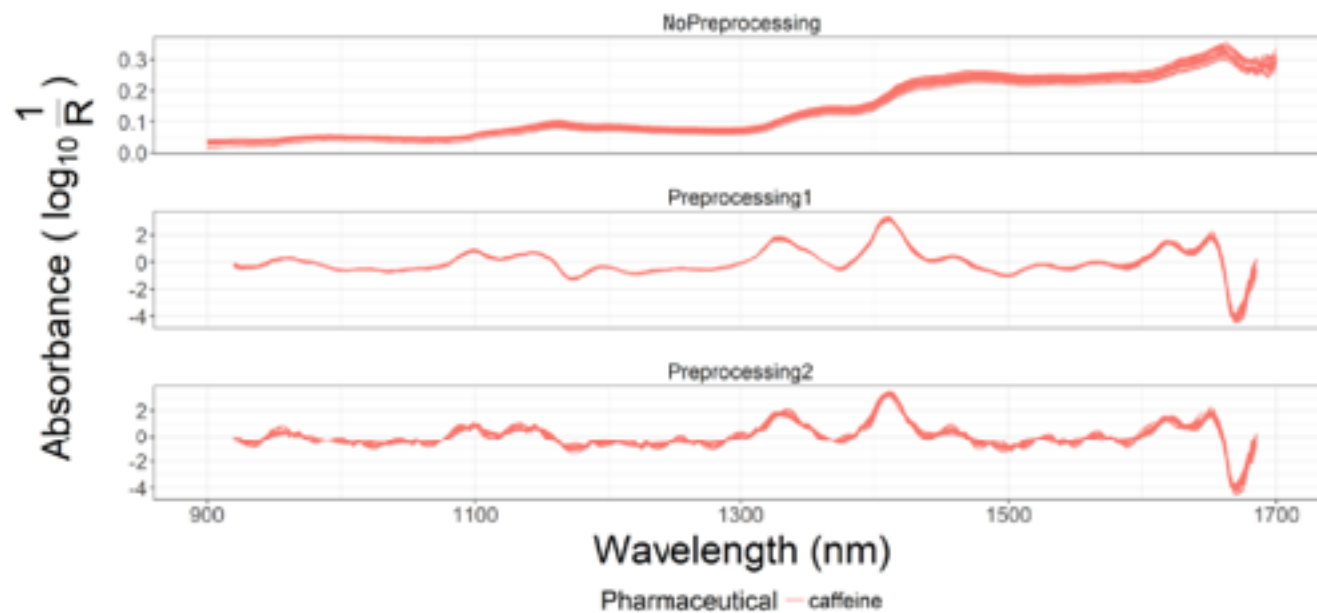
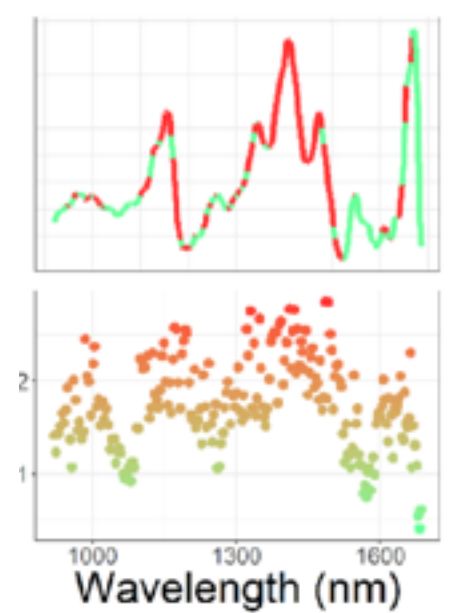
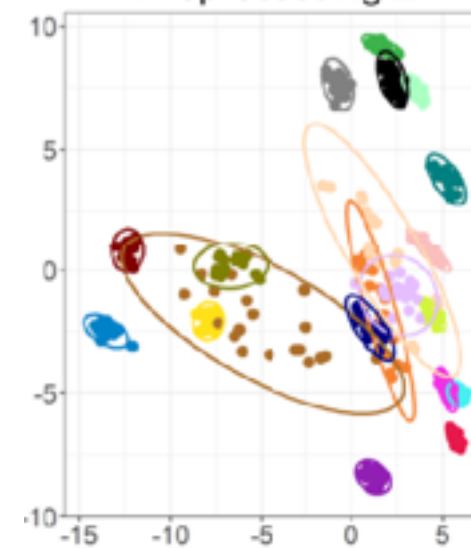
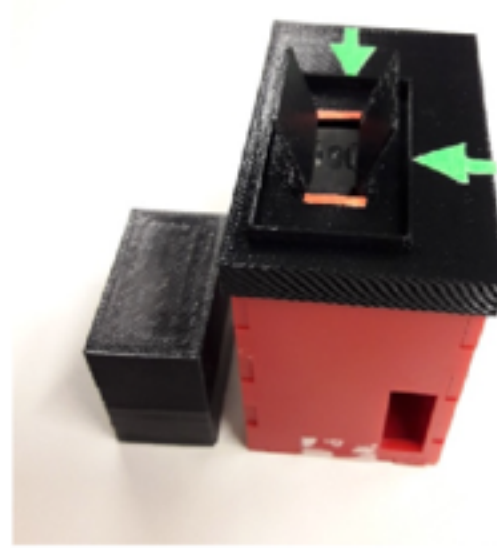
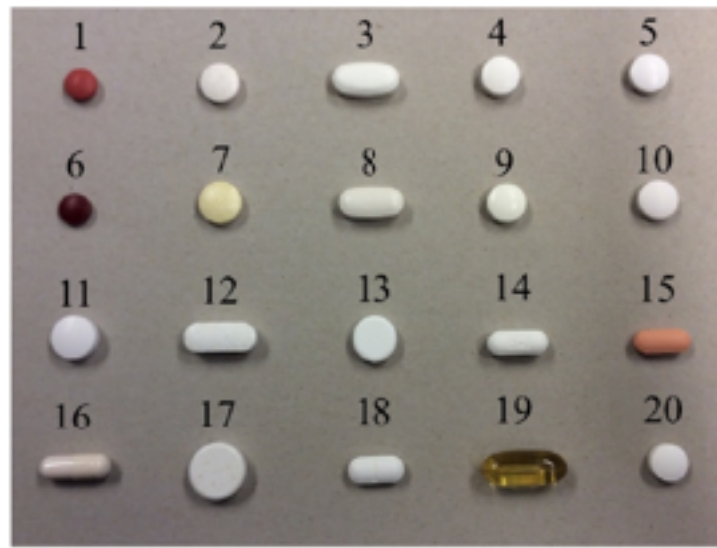


IV line monitoring  
Continuous identification of  
liquids/concentrations in IV line



## Smart pill box

### Identify pills using chemical signatures



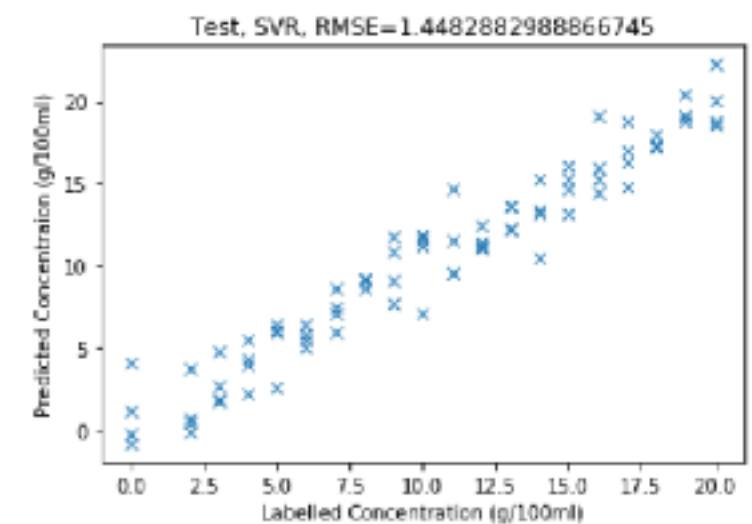
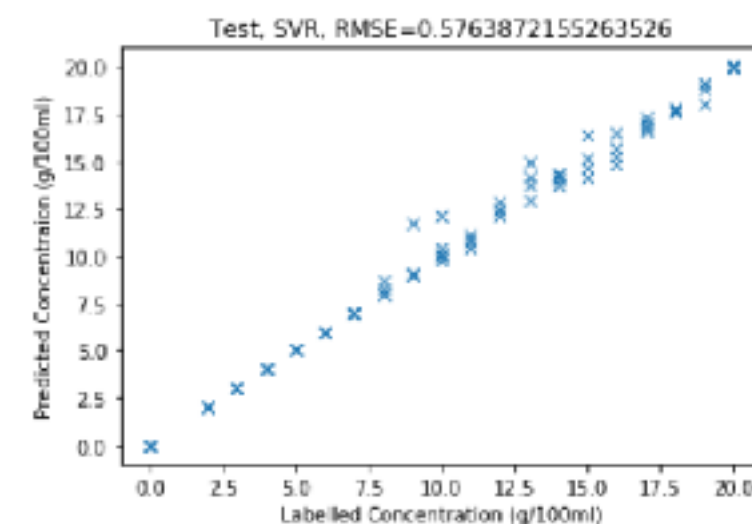
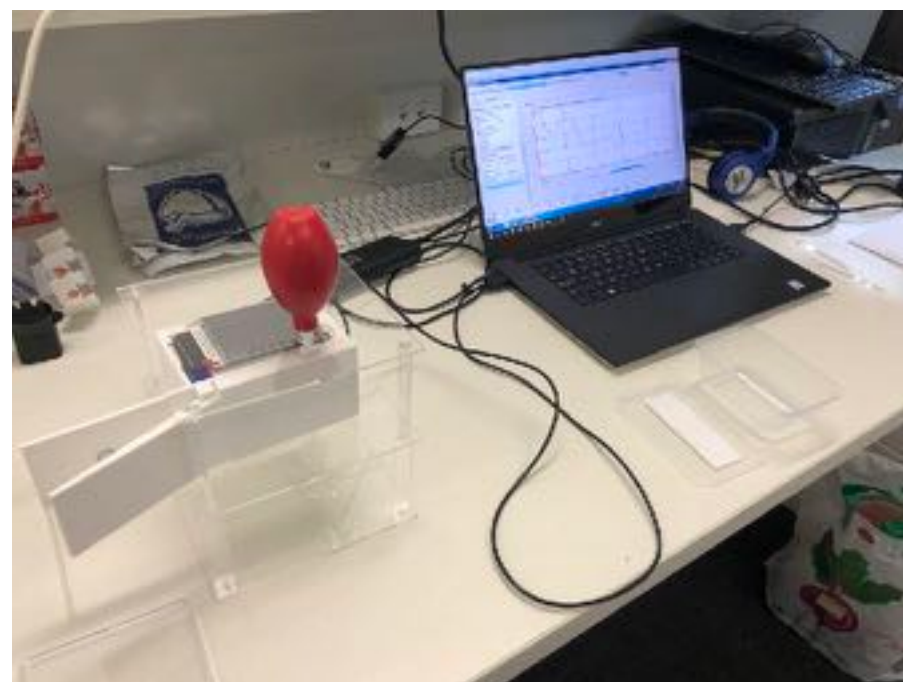
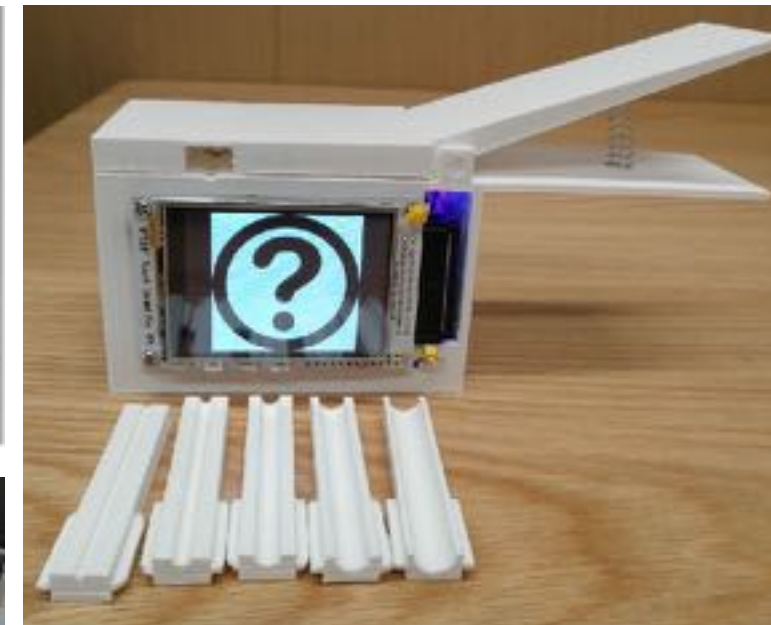
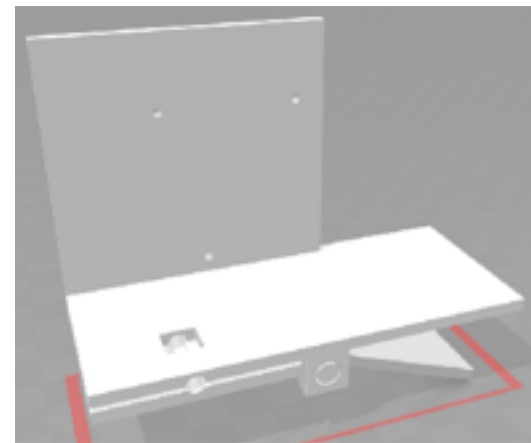








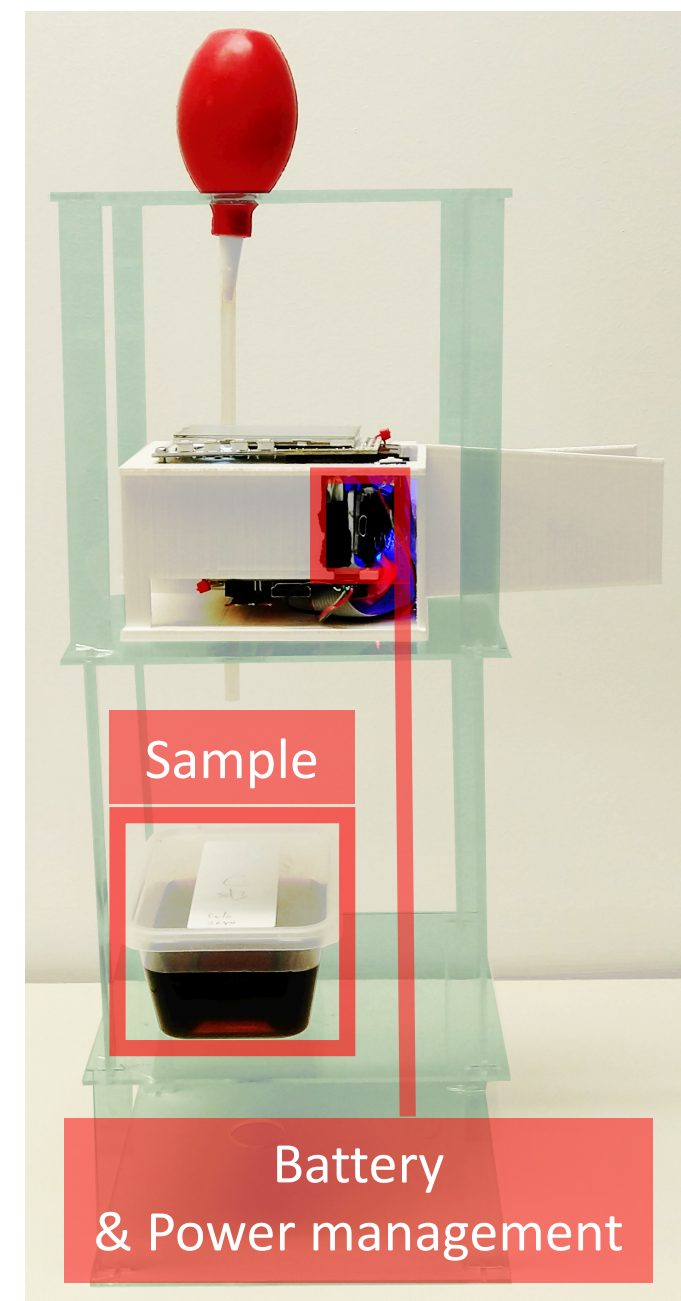
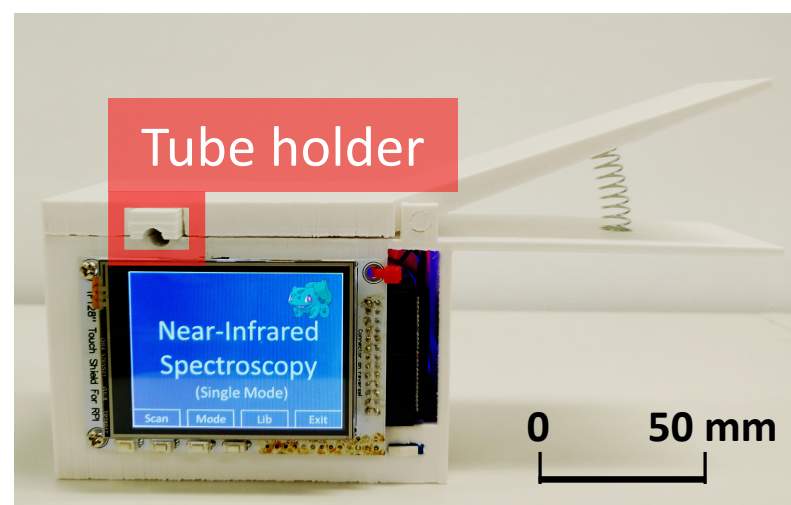
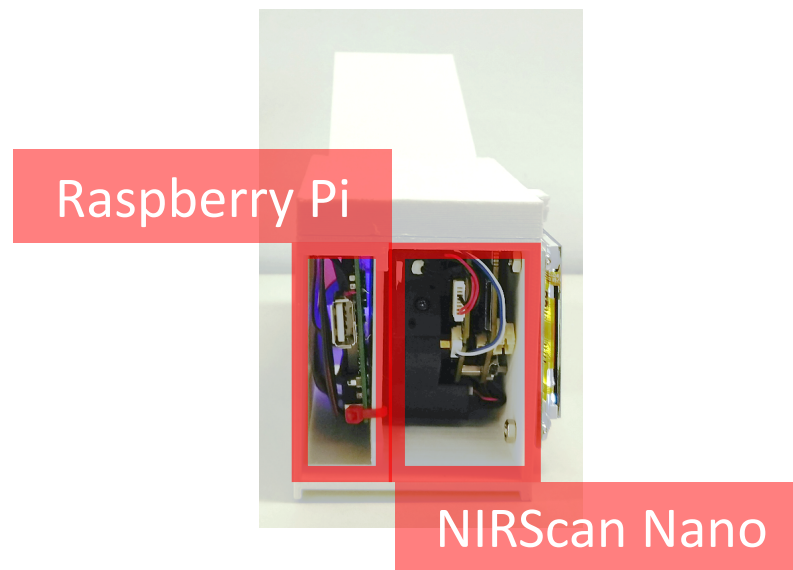
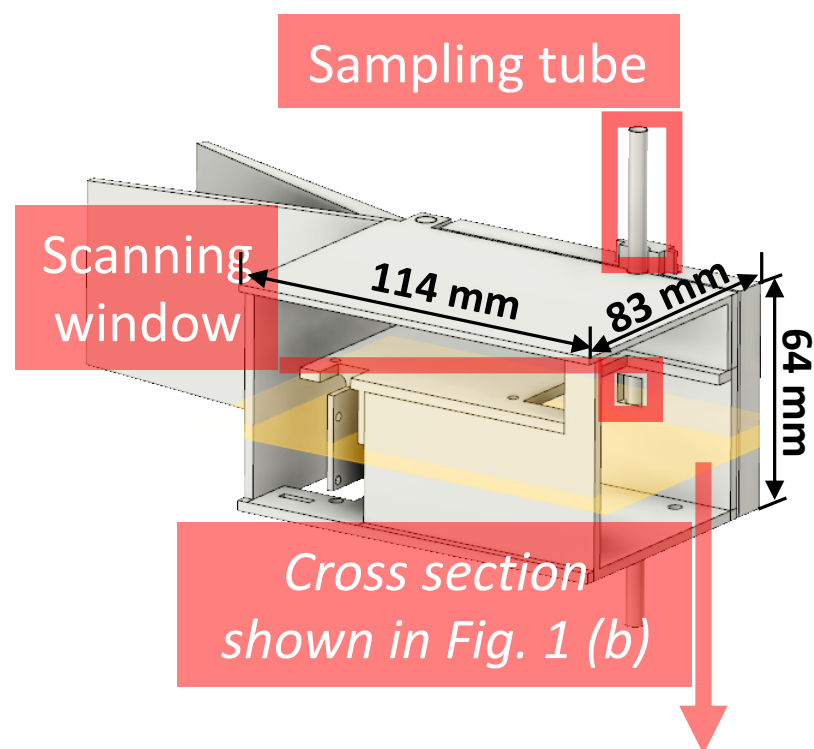
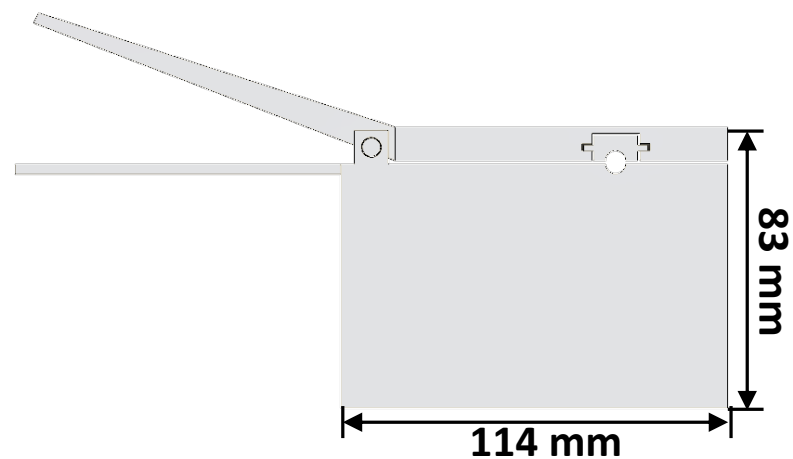
# IV line monitoring Continuous identification of liquids/concentrations in IV line



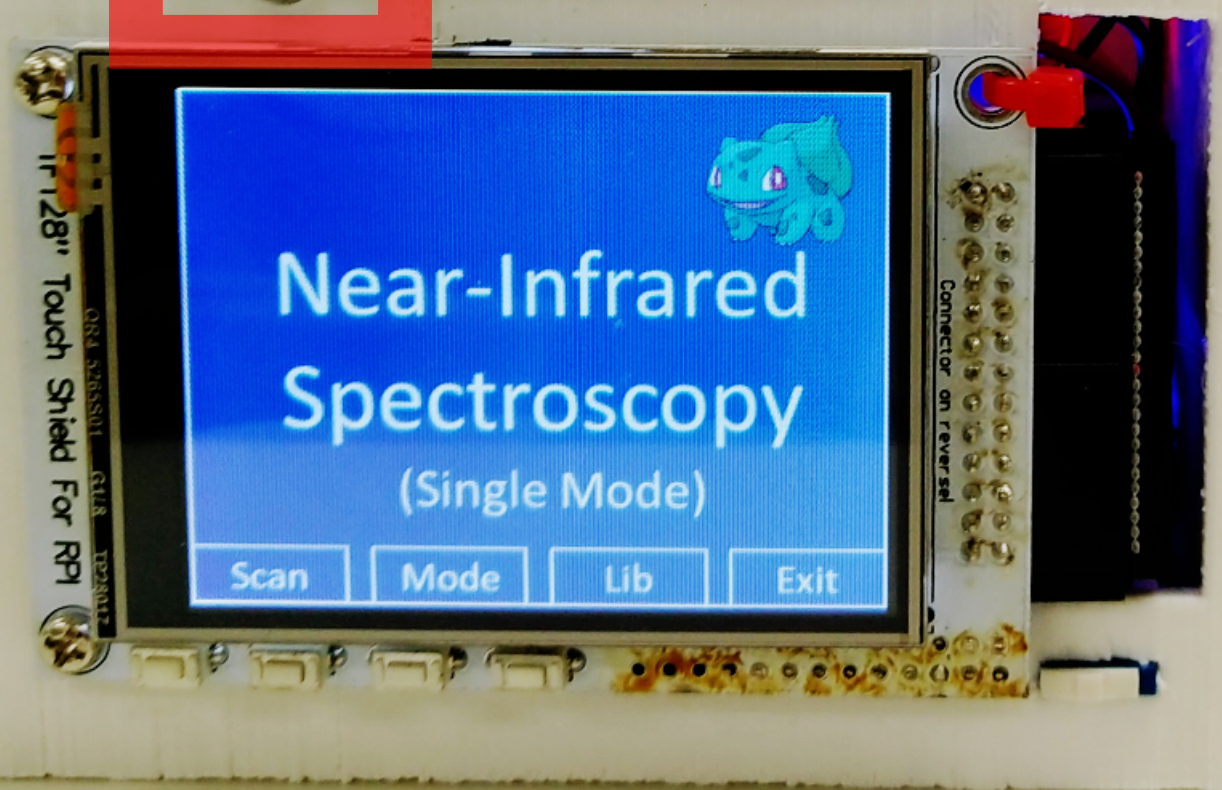
114 mm





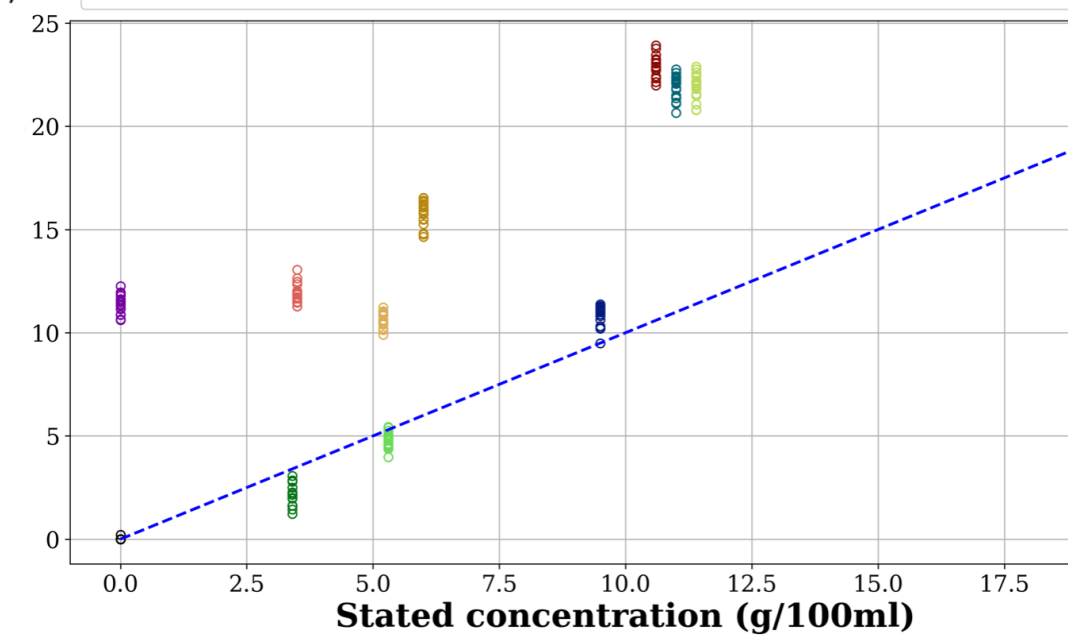
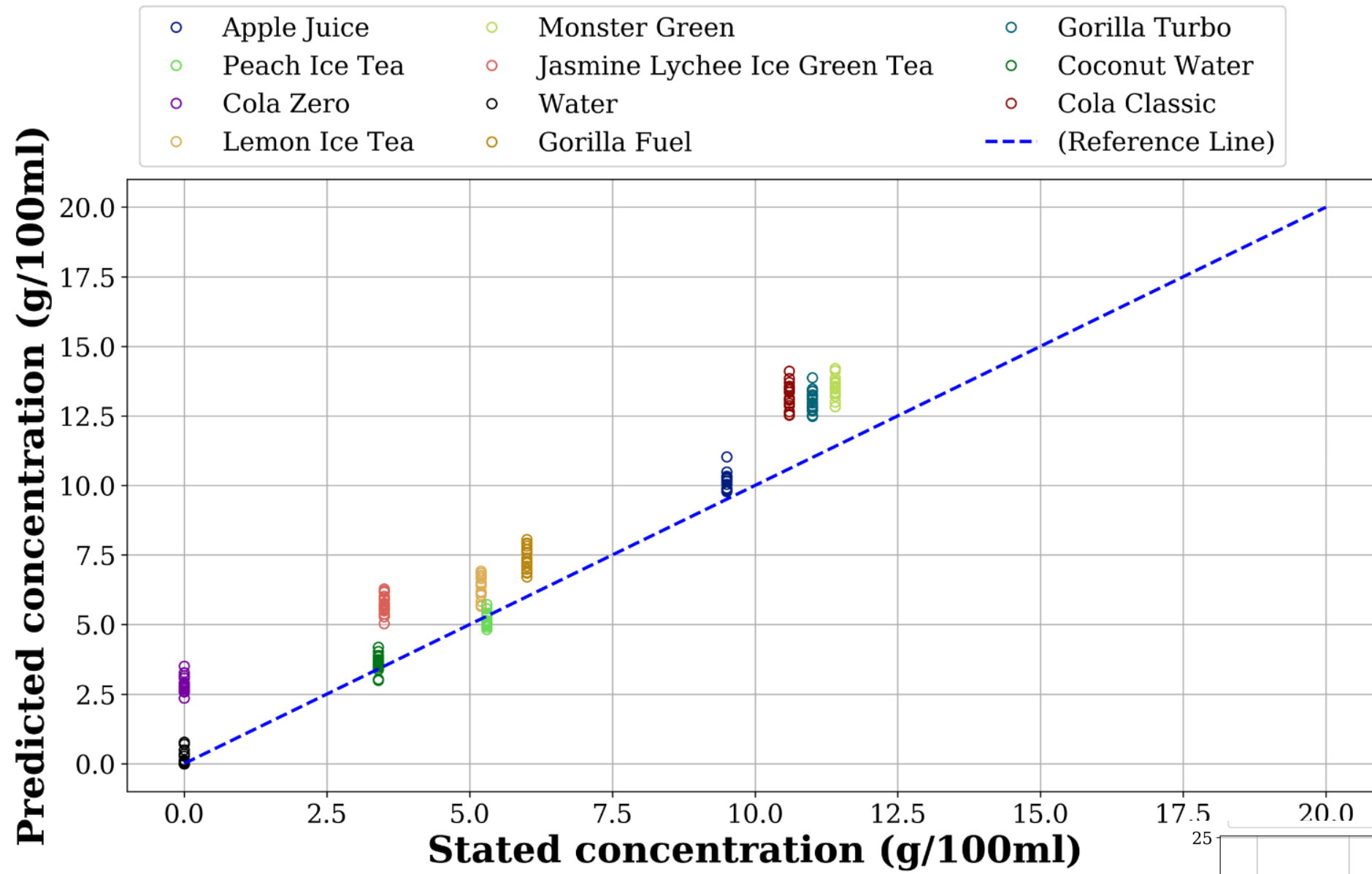


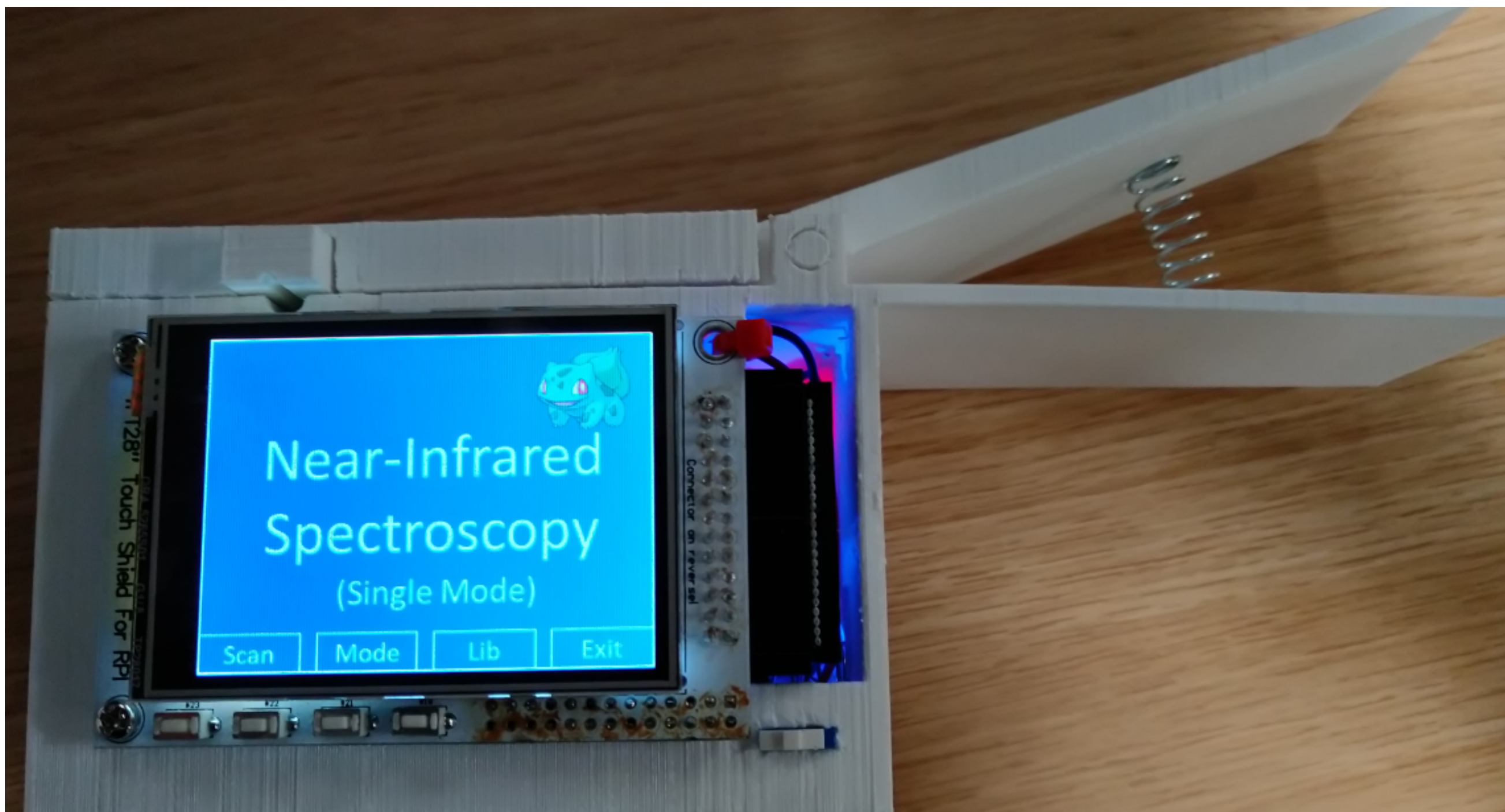
# Tube holder



0 50 mm





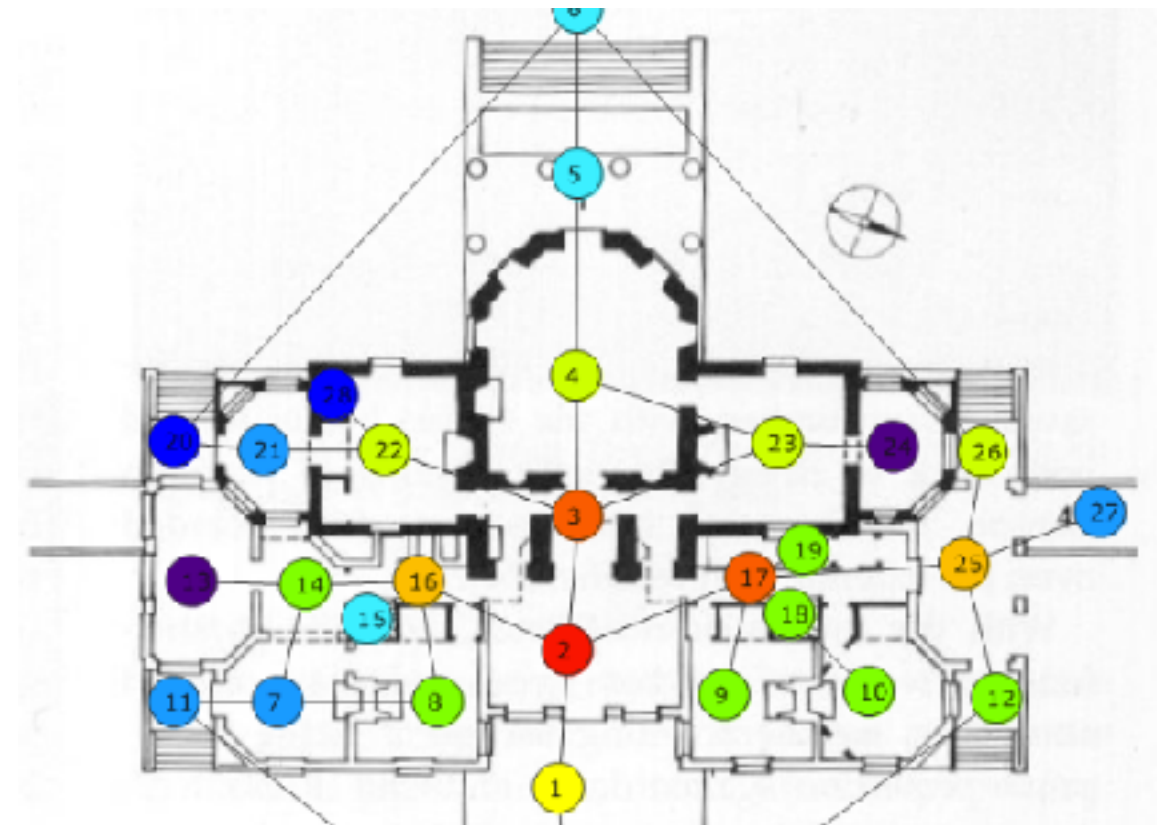
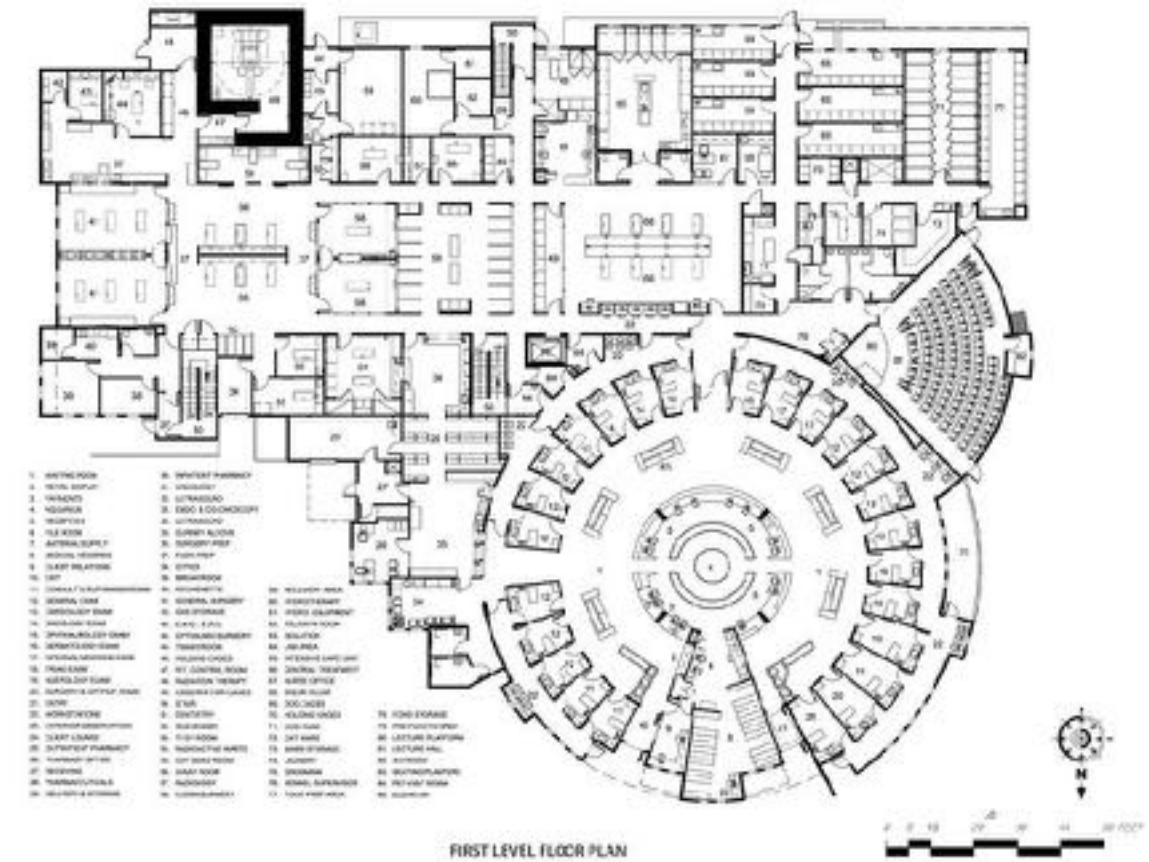






## Operating theatre tracking

Track patients/staff in & out of operating theatres







23

University of Melbourne  
Prof Vassilis Kostakos

24

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Prof Vassilis Kostakos

18

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19

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20

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302  
University of Melbourne  
Replus Networks

303  
University of Melbourne  
Replus Networks

301  
University of Melbourne  
Replus Networks

305  
University of Melbourne  
Replus Networks

304  
University of Melbourne  
Replus Networks



















3

26.7.17  
No Smoking  
No Smoking

TUESDAY		AT
09:00	Rommel	10.1
10:00	Janet	10.20
11:00	Handi	
WEDNESDAY		TH. BERRY
09:00	Mal Mash	✓
10:00	Pa Mei	✓
11:00	Bec Pang	✓
12:00	Khm	✓
13:00	Paris Zenni	✓
14:00	Lu	✓
15:00	Charmaine	✓
16:00	Katreen	✓





Human Dermatomes

clinell

IV Stuff

OP Airway  
NP Airway T Bag

Combine Large &  
Small  
Gauze







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

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

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
	398	-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

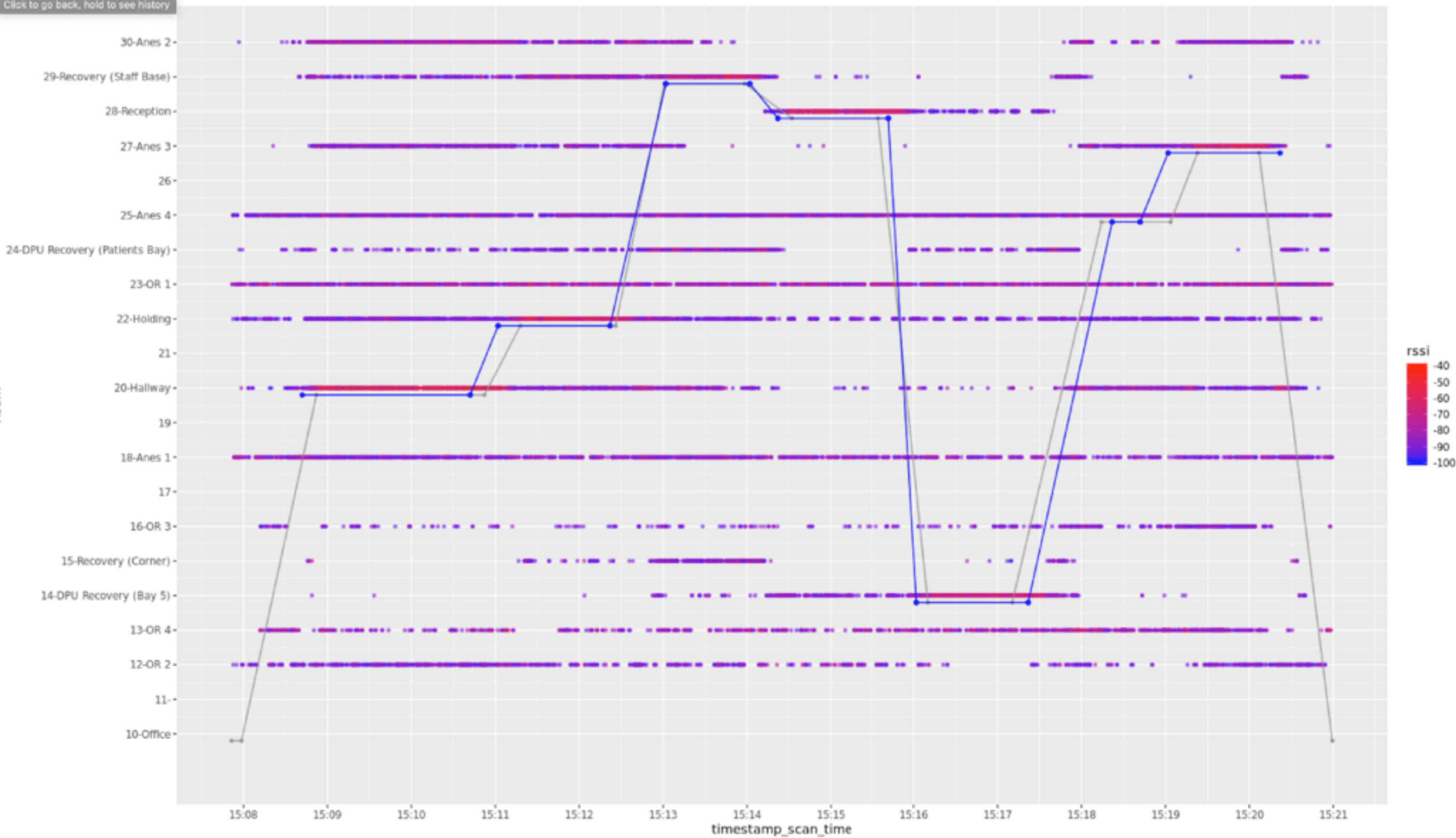
100%  

Settings: v0.003

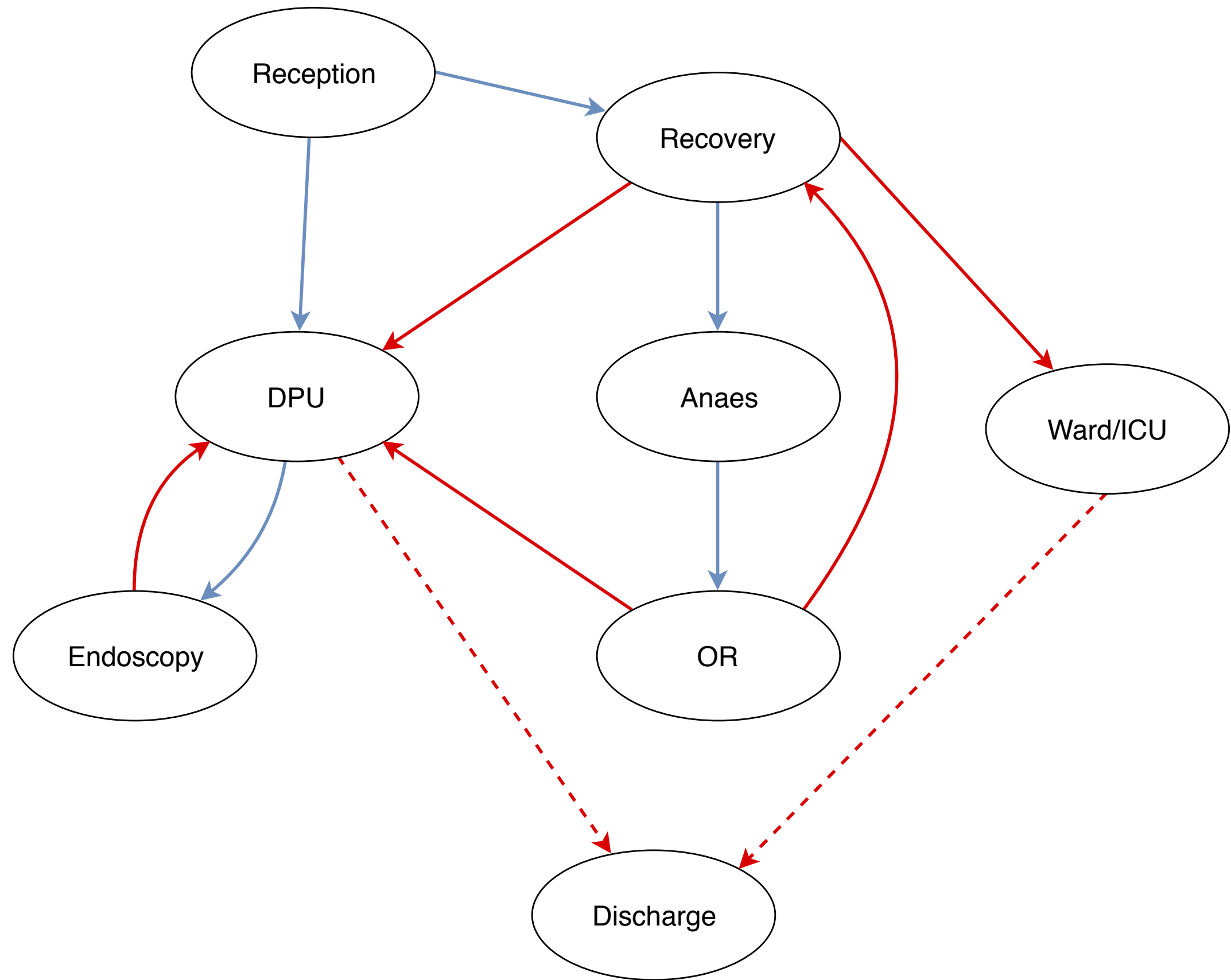


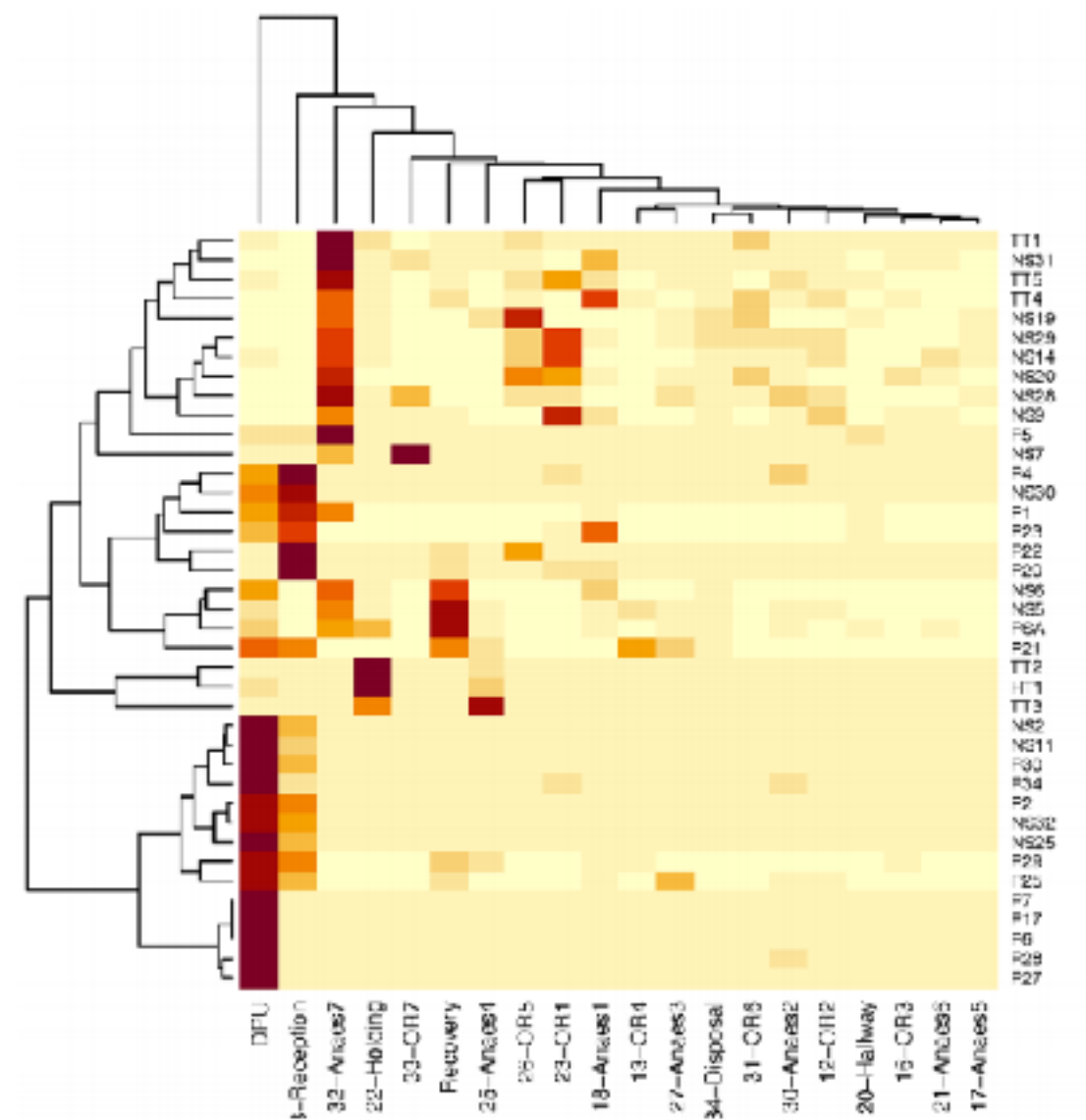
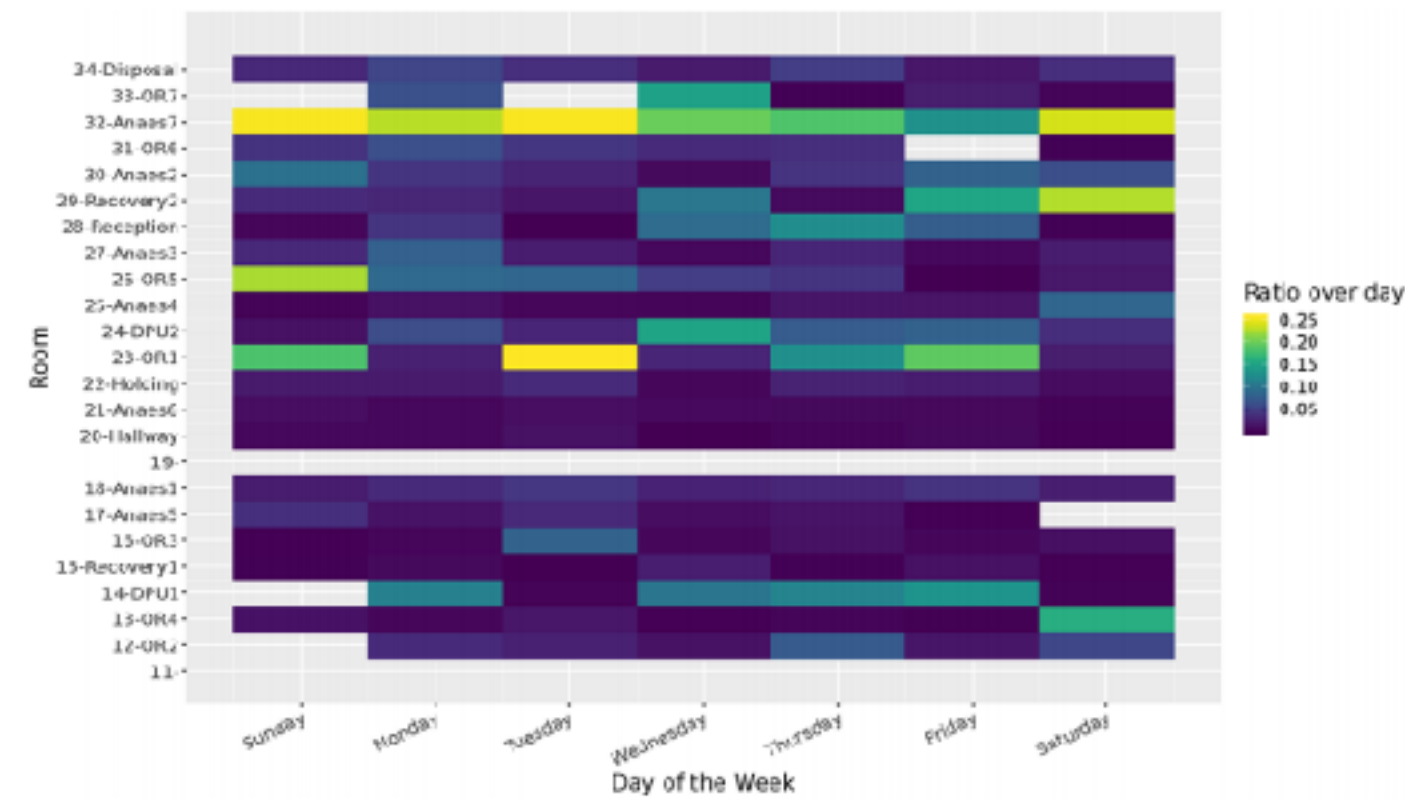
## Beacon

Click to go back, hold to see history





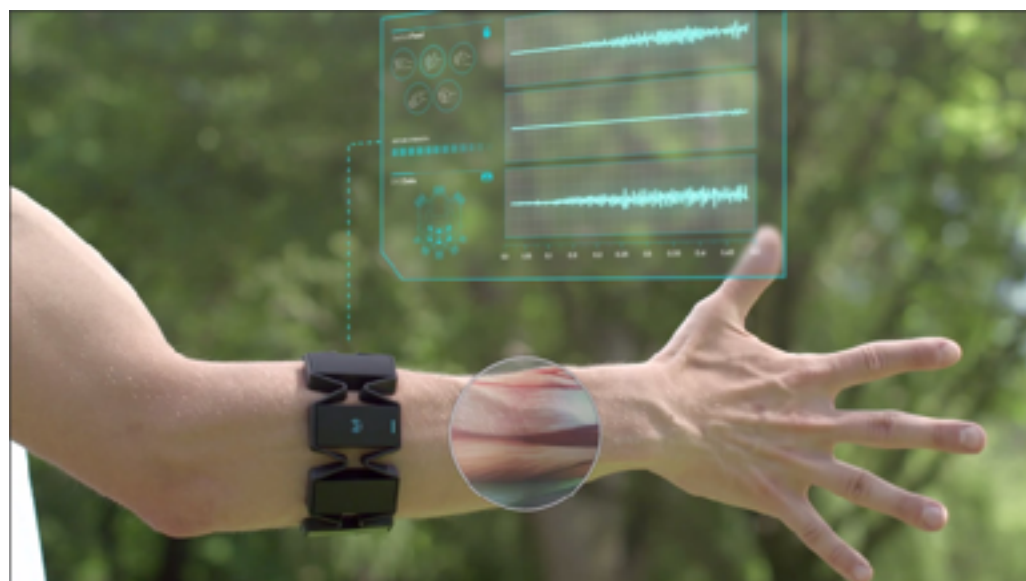
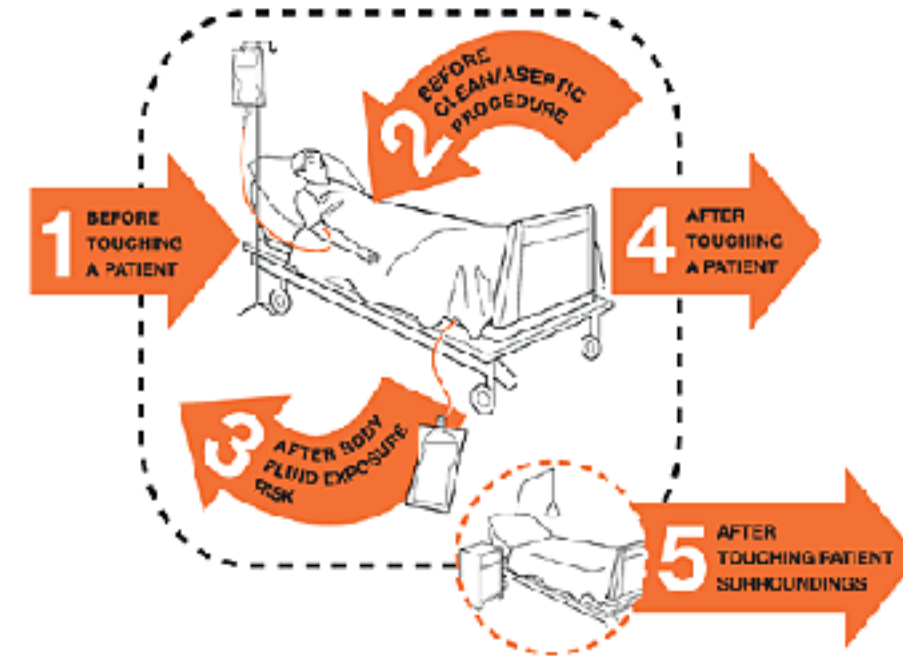








## Hand washing detection Detect (and quantify) hand washing in the hospital

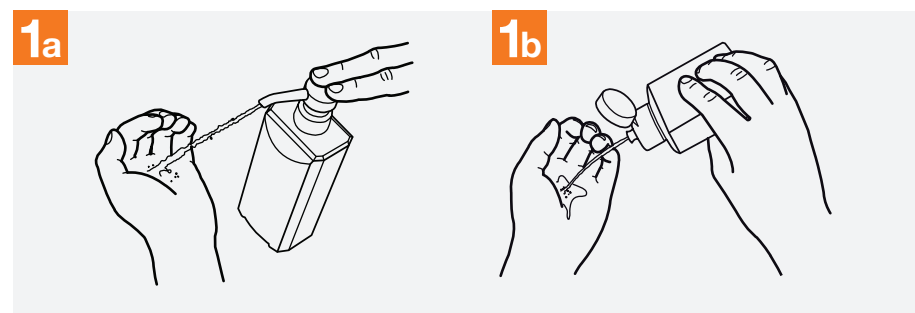




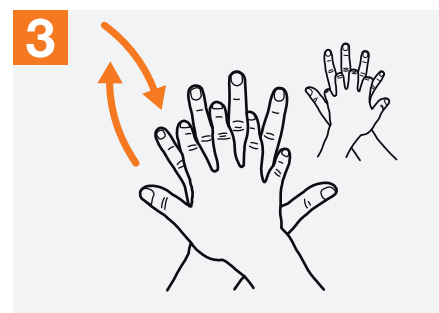
# How to Handrub

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;



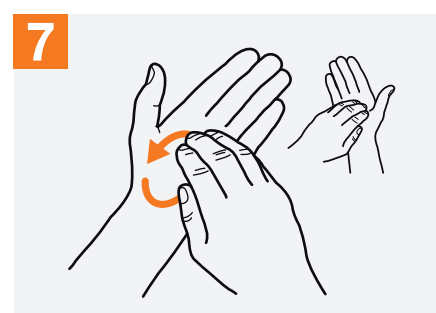
Right palm over left dorsum with interlaced fingers and vice versa;



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



Palm to palm with fingers interlaced;



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



Rub hands palm to palm;




Backs of fingers to opposing palms with fingers interlocked;




Once dry, your hands are safe.

# How to Handwash?

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;



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;



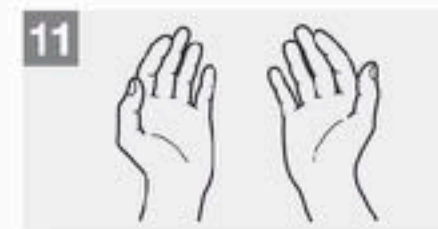
Rinse hands with water;



Dry hands thoroughly with a single use towel;



Use towel to turn off faucet;

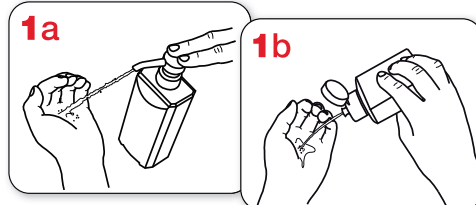


Your hands are now safe.

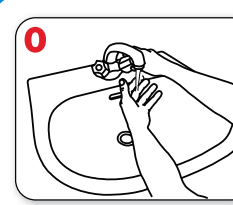


# How to handrub? WITH ALCOHOL-BASED FORMULATION

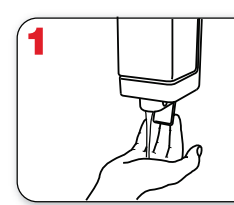
# How to handwash? WITH SOAP AND WATER



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



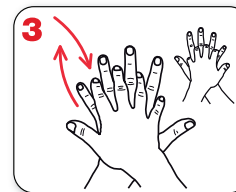
Wet hands with water



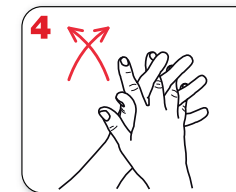
apply enough soap to cover all hand surfaces.



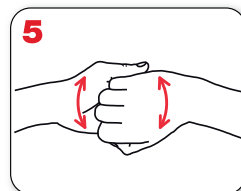
Rub hands palm to palm



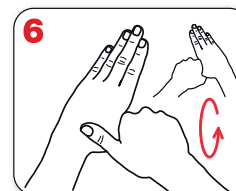
right palm over left dorsum with interlaced fingers and vice versa



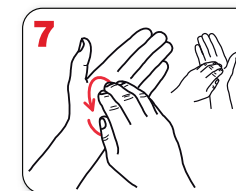
palm to palm with fingers interlaced



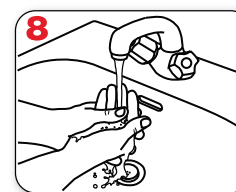
backs of fingers to opposing palms with fingers interlocked



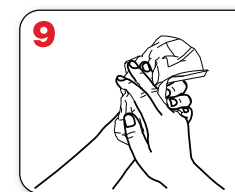
rotational rubbing of left thumb clasped in right palm and vice versa



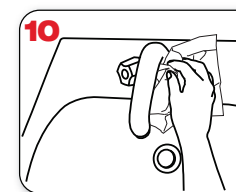
rotational rubbing, backwards and forwards with clasped fingers of right hand in left palm and vice versa



rinse hands with water



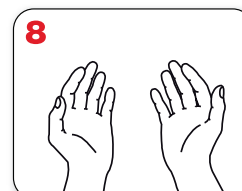
dry thoroughly with a single use towel



use towel to turn off faucet



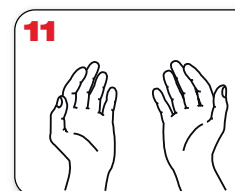
20-30 sec



...once dry, your hands are safe.



40-60 sec



...and your hands are safe.

Design: monofragilis network



THE UNIVERSITY OF  
MELBOURNE



WHO acknowledges the Hôpitaux Universitaires de Genève (HUG), in particular the members of the Infection Control Programme, for their active participation in developing this material.



World Health  
Organization

October 2006, version 1.







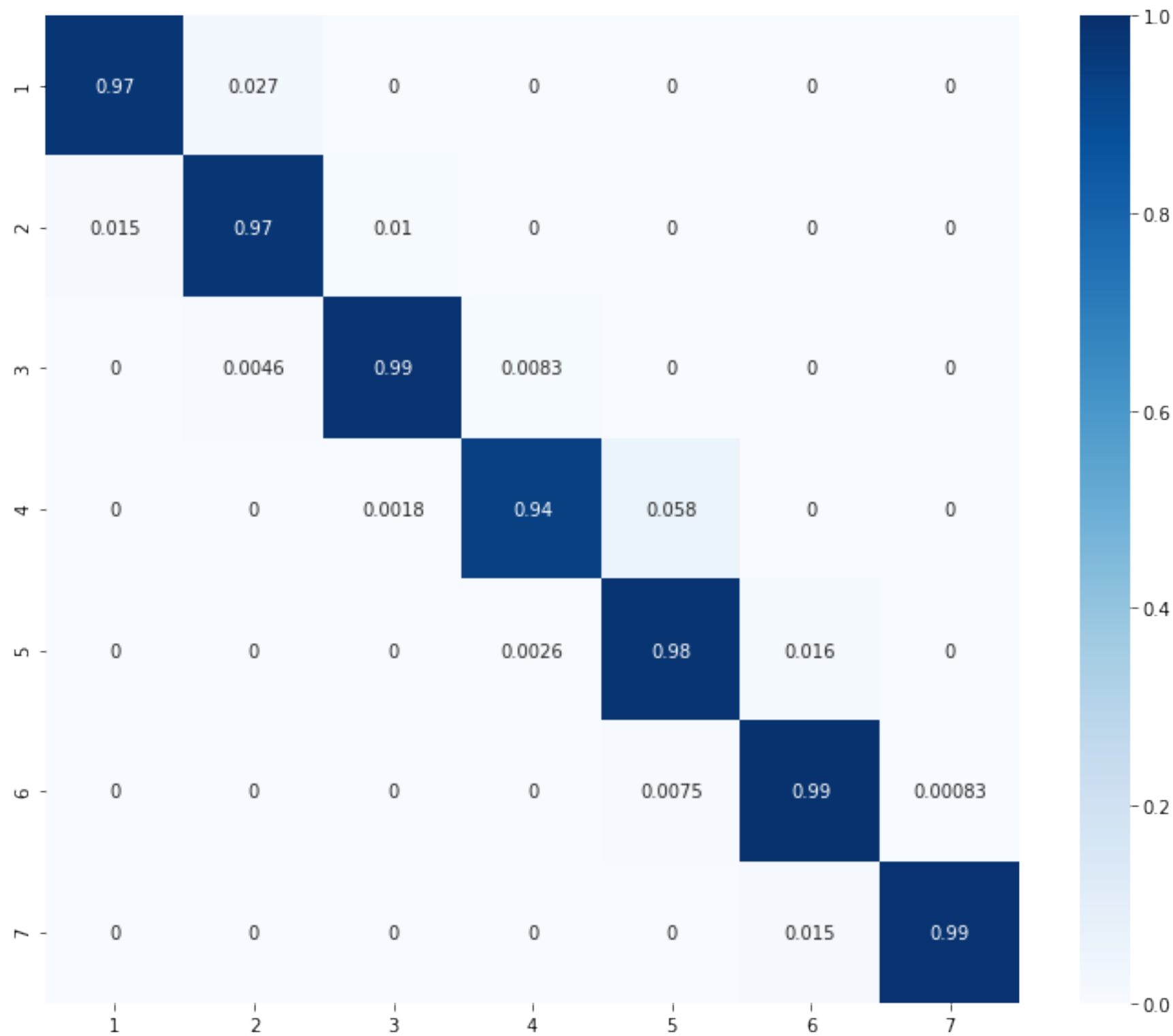








## Upper Arm with Both Hands(smoothed with ecp)





## Hand Hygiene History



Record - 21

Active Now

Good completeness of hand washin...



Record - 20

5 mins ago

You missed some steps when last h...



Record - 19

5 hours ago

There are some steps you need to i...

[Read More](#)

## Summary

01

02

03

04

05

06

07

08

09

10

11

01

Wet your hands with water

Completeness: 50%

02

Apply Soap to cover all hand surf

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 of fingers to opposing palm  
with fingers 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

01

Wet your hands with water

Completeness: 50%

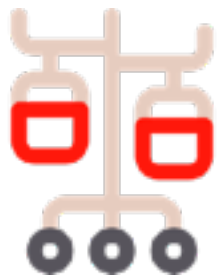
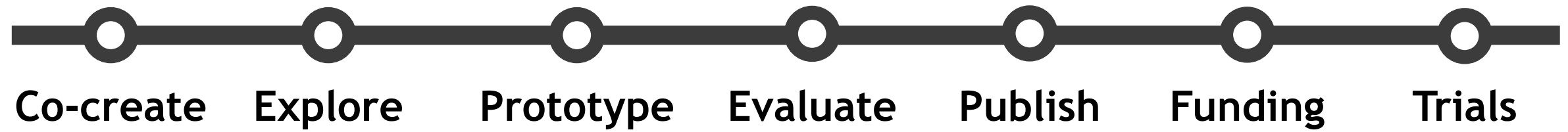
## Description

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

## Standard Procedure











# How to Handrub?

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

 **Duration of the entire procedure: 20-30 seconds**



**1a** Apply a palmful of the product in a cupped hand, covering all surfaces;



**1b**



**2** Rub hands palm to palm;



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



**4** Palm to palm with fingers interlaced;



**5** Backs of fingers to opposing palms with fingers interlocked;



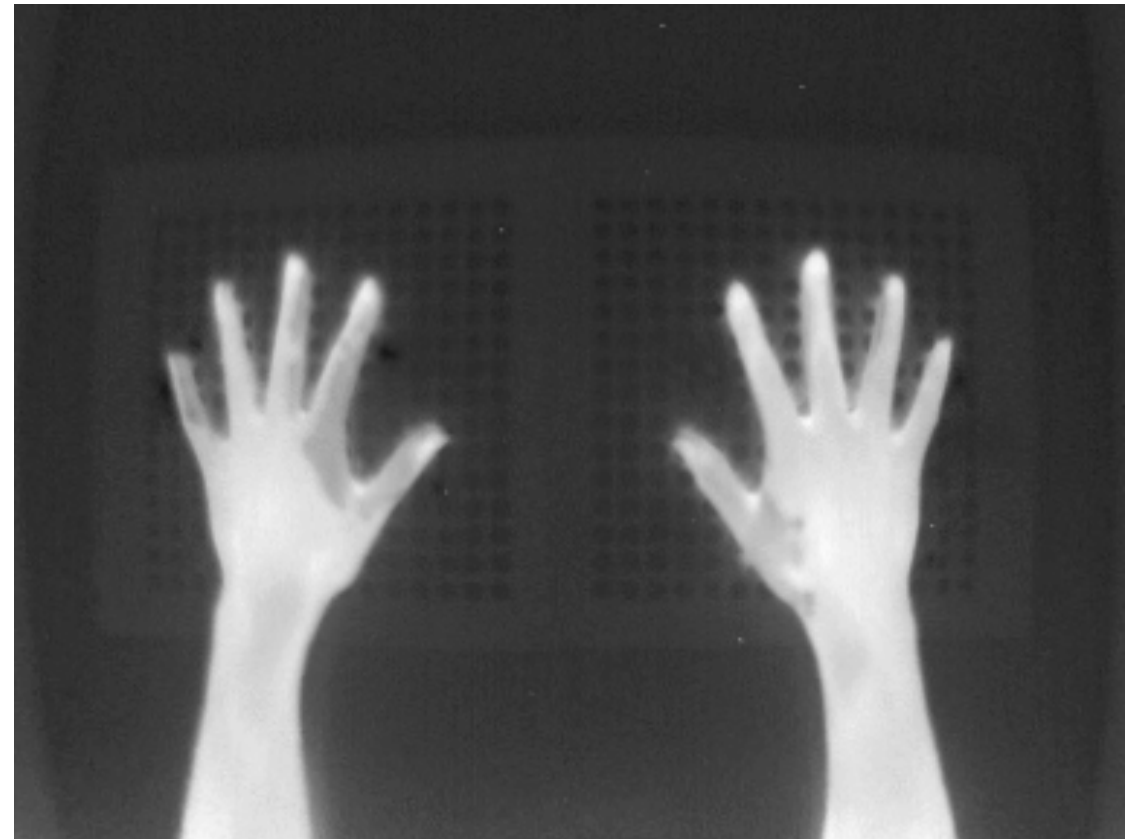
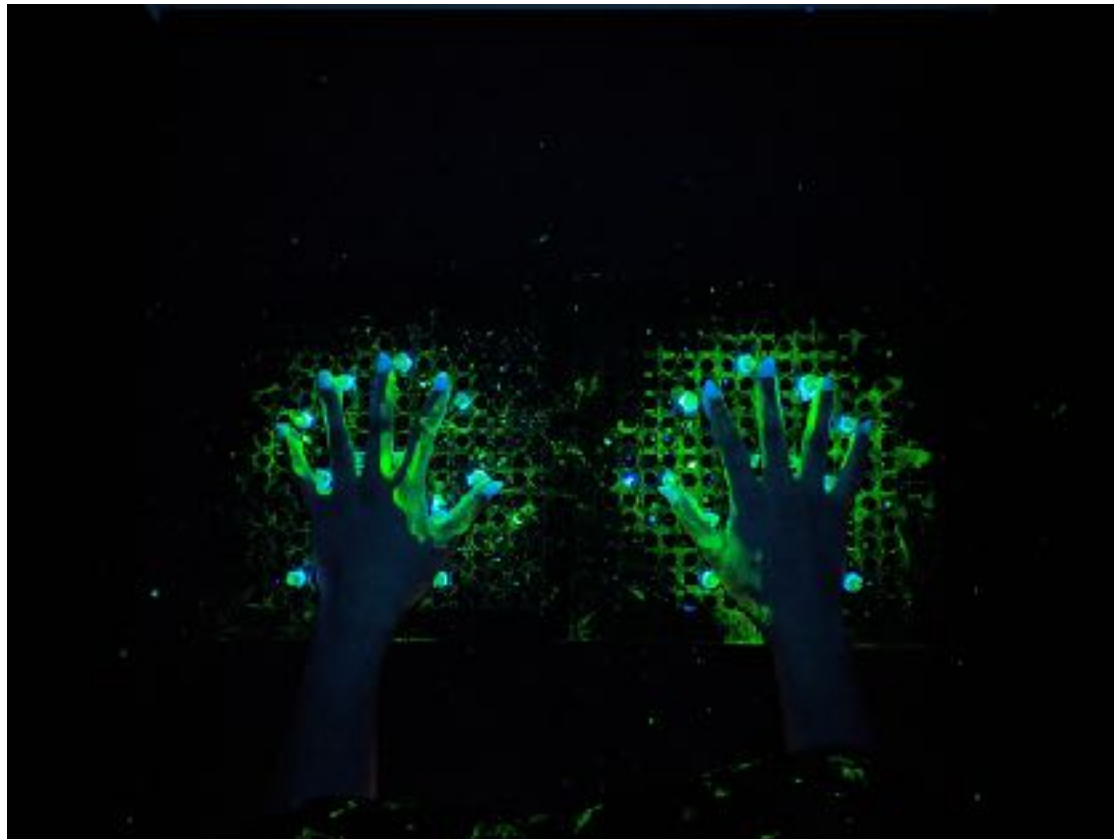
**6** Rotational rubbing of left thumb clasped in right palm and vice versa;



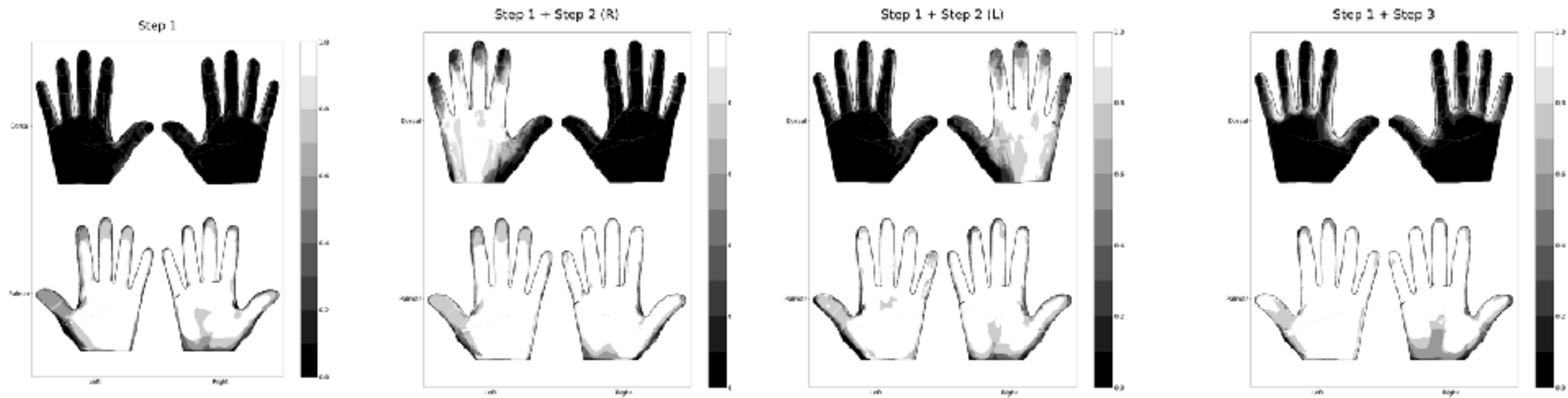
**7** Rotational rubbing, backwards and forwards with clasped fingers of right hand in left palm and vice versa;



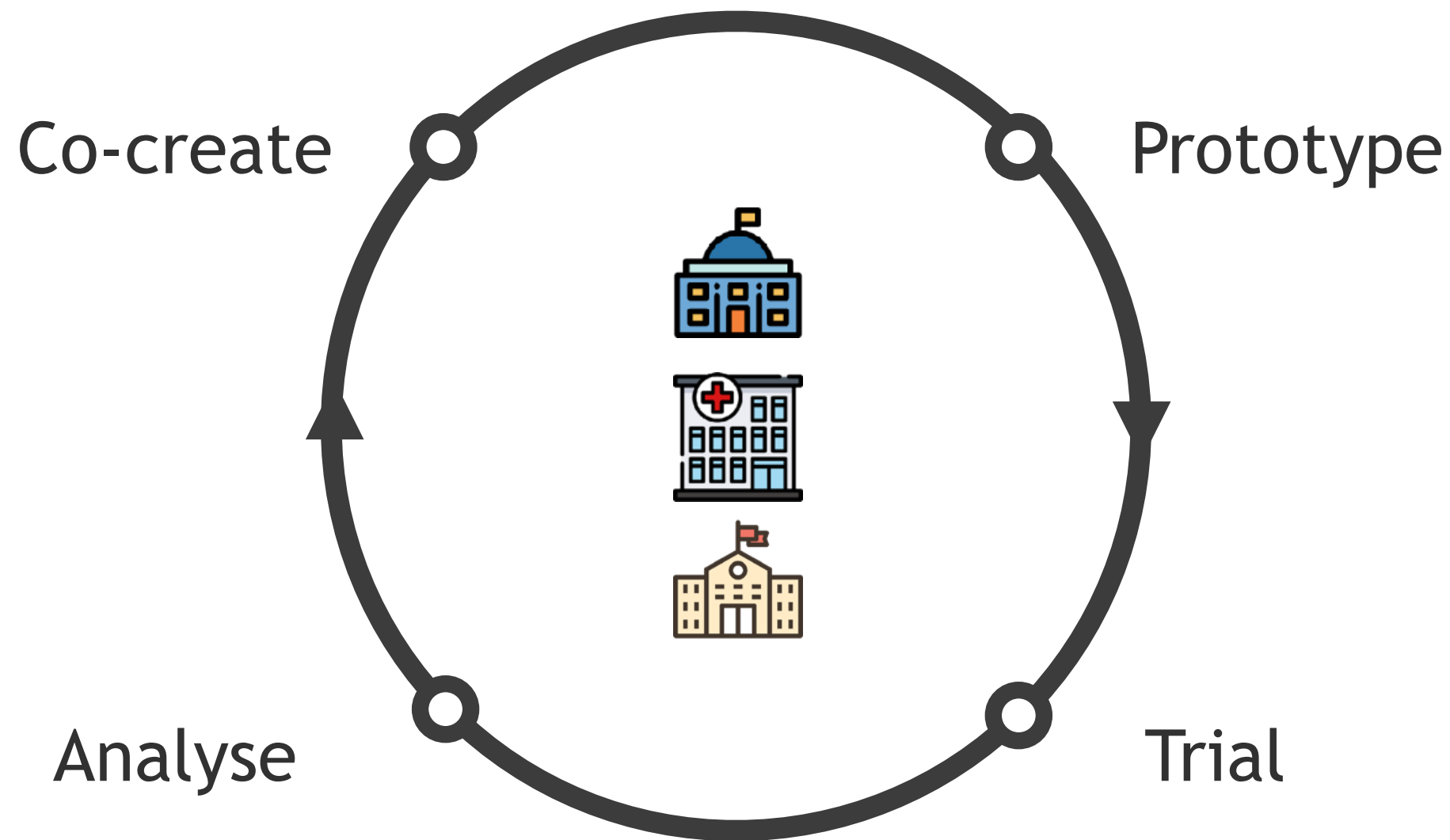
**8** Once dry, your hands are safe.







# Living Lab: Continuous Innovation





# Outcomes and benefits



Improved operations



Generalisable solutions



Pathway to funding



Establish critical mass

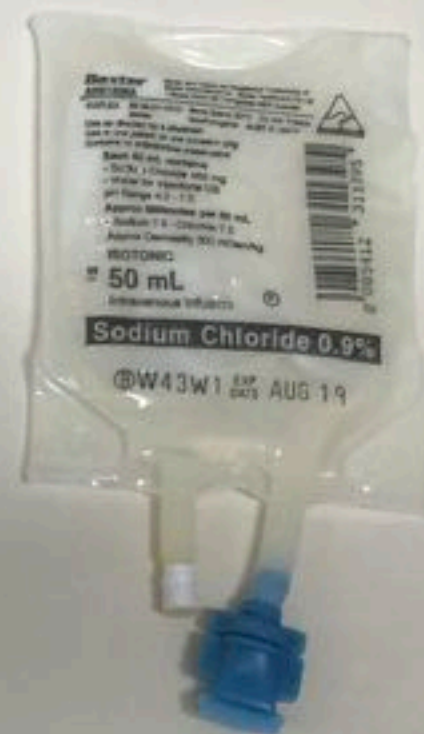
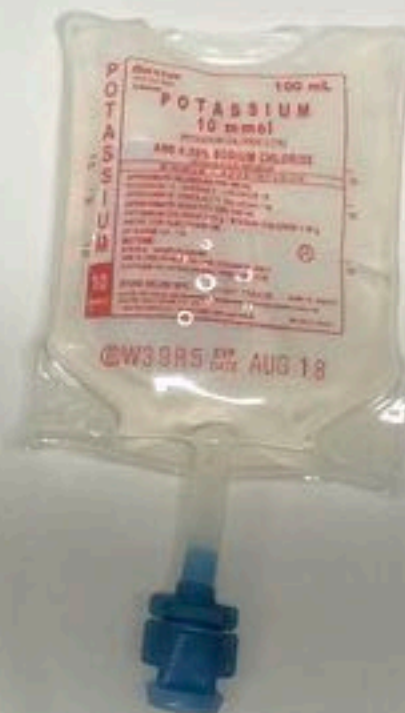
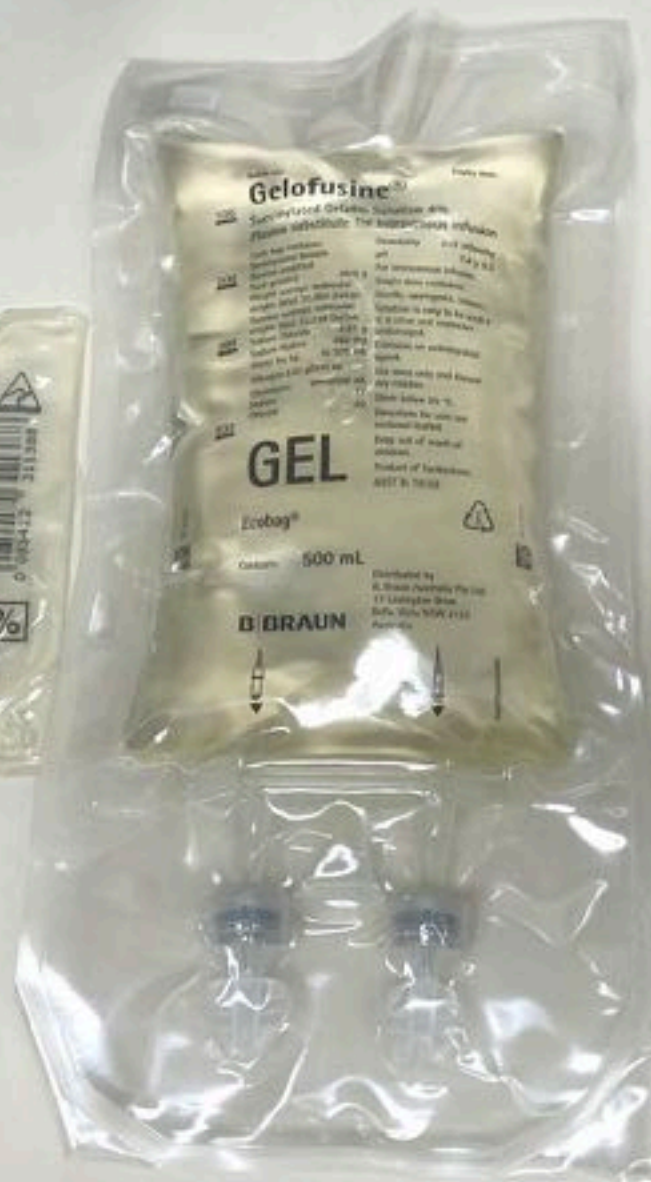
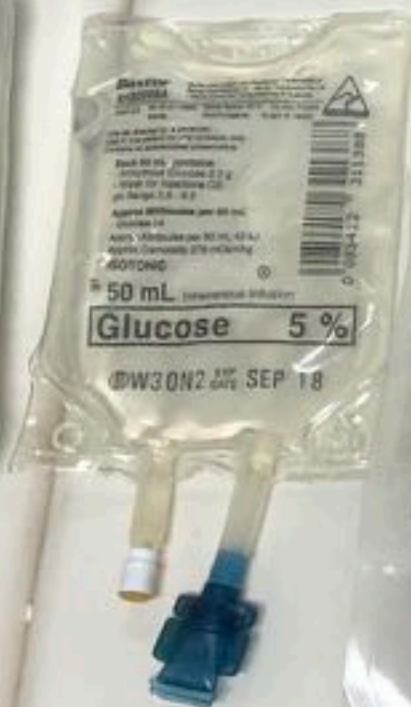
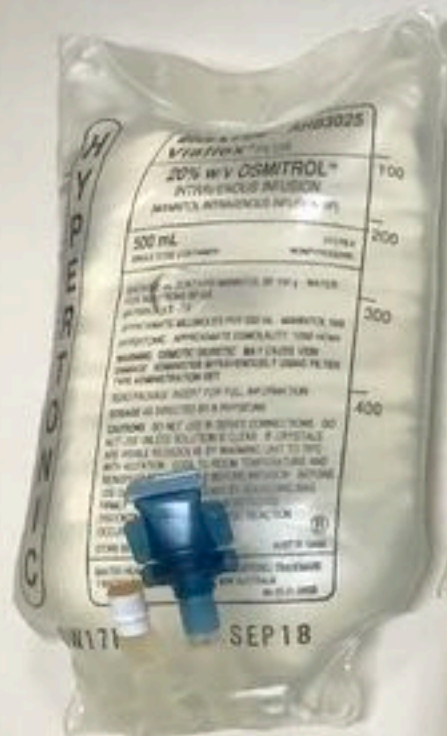


Innovation beyond hospitals

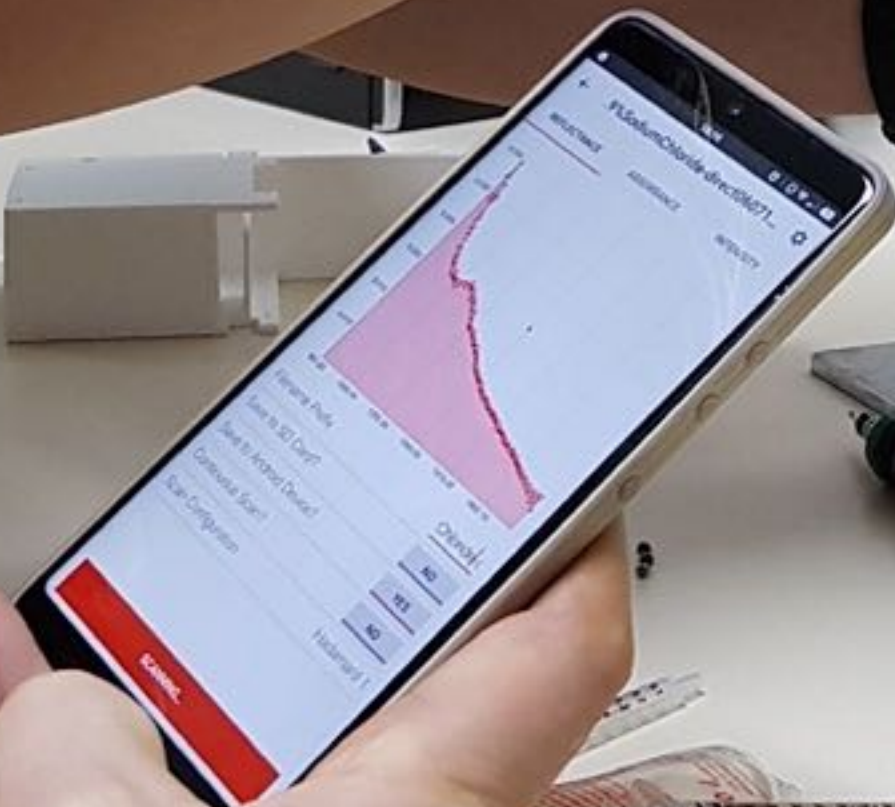
# Lessons learned

- The focus of our work is not “owned” by medical experts
  - Good: we do not become “programmers”
  - 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!*

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