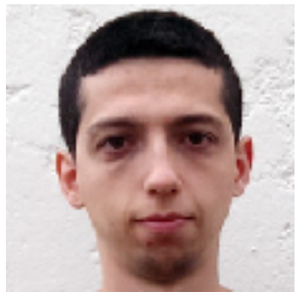
The Smart Hospital Living Lab

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

Presented at
University of Cambridge, 16 May 2019



Jorge Goncalves

Eduardo Velloso

Gabriele Marini

Niels van Berkel

Chu Luo

Zhanna Sarsenbayeva

Yitong Chen

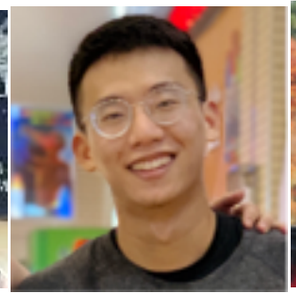
Chaofan Wang

Tilman Dingler

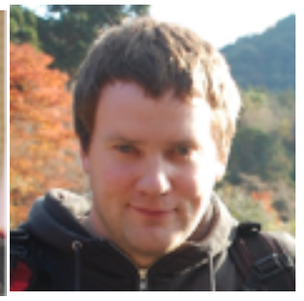
Weiwei Jiang

Danula Hettiachchi

Senuri Wijenayake



Xiuge Chen



Simo Hosio

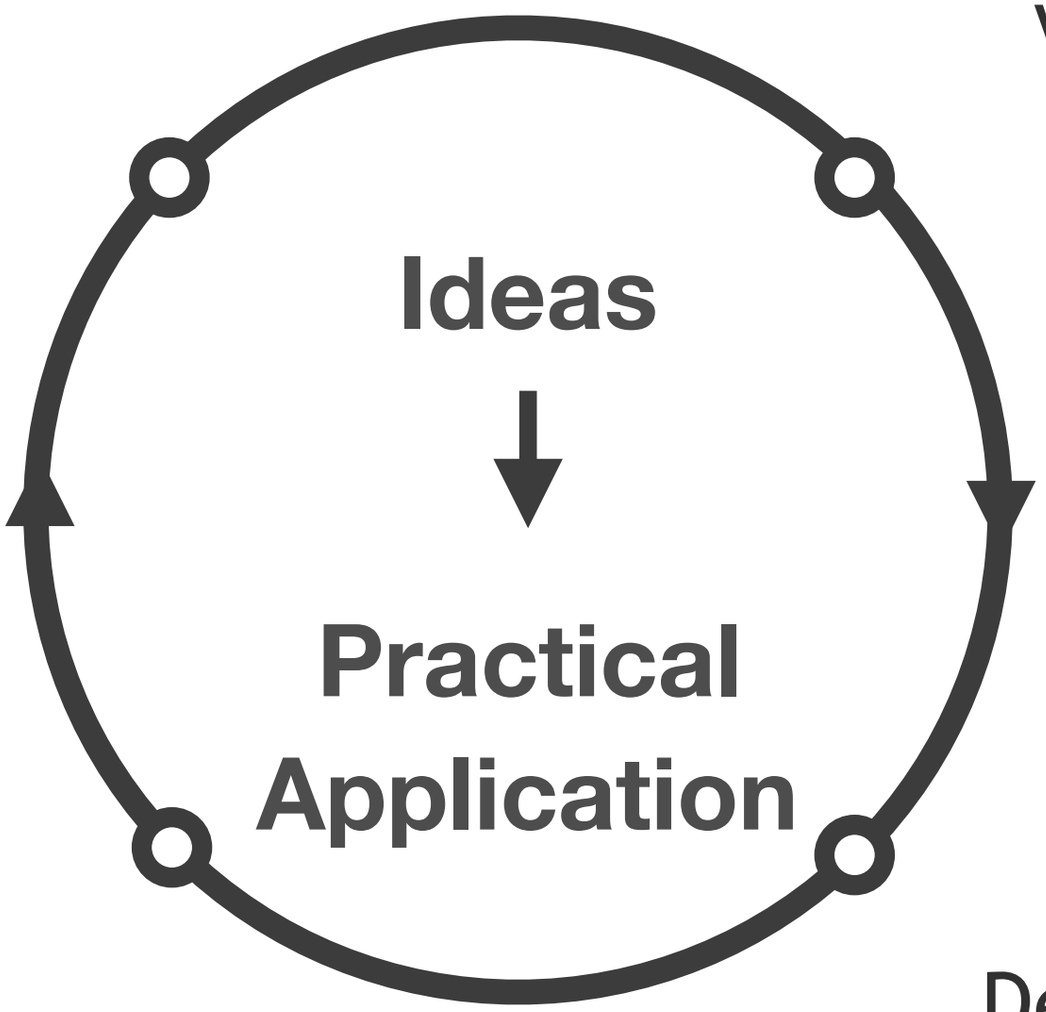
Simon Klakegg

Aku Visuri

JURASSIC PARK
An Adventure
65 Million Years In The Making.

Co-create
with end-users

Explore
with stakeholders



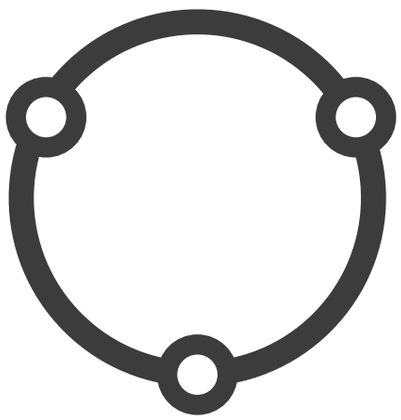
Evaluate &
collect evidence

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

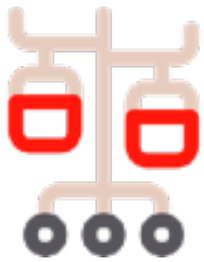
Safety: reduce errors
Efficiency: generate insights

Ongoing projects

Smart pill box
Identify pills using chemical signatures

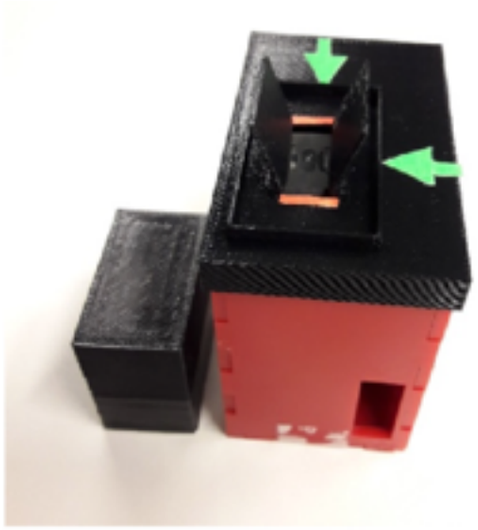
Operating theatre tracking
Track patients/staff in & out of operating theatres

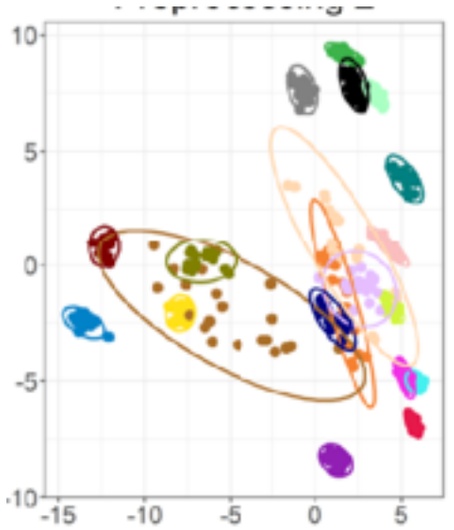
Hand washing detection
Detect (and quantify) hand washing in the hospital

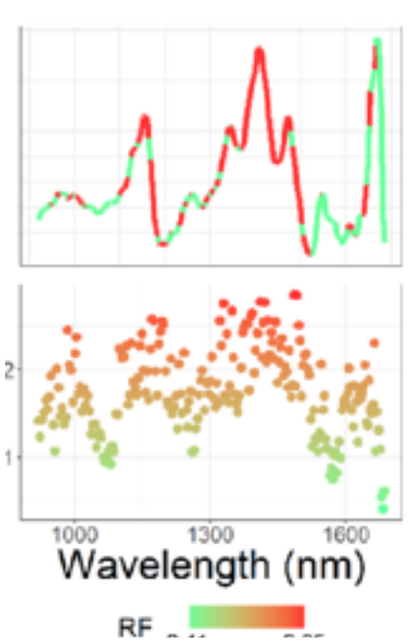


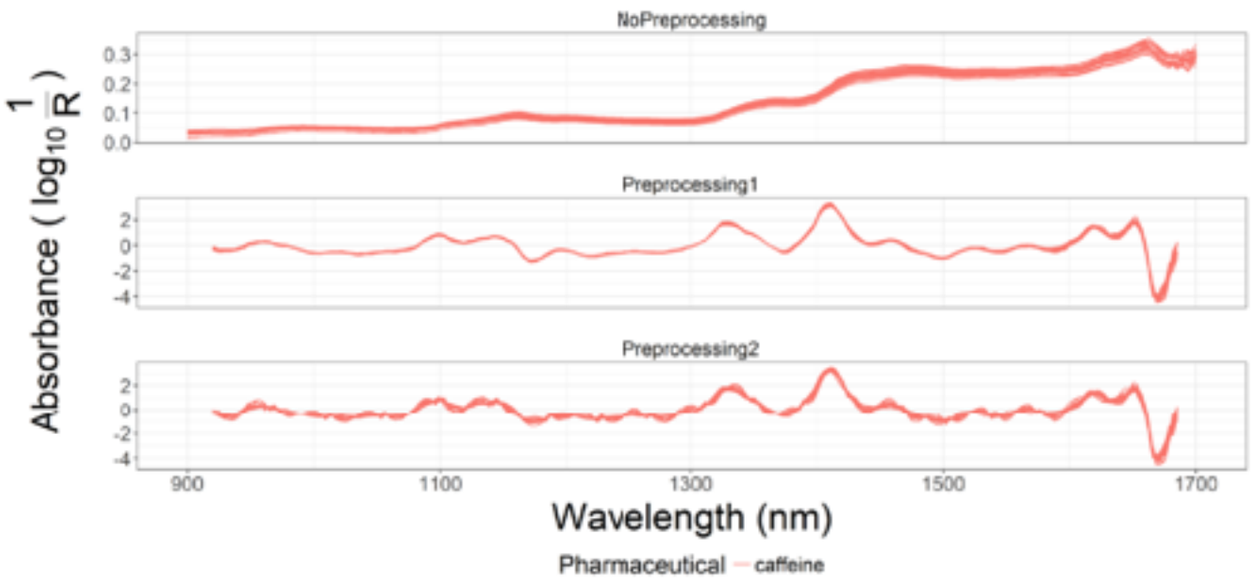
IV line monitoring
Continuous identification of liquids/concentrations in IV line

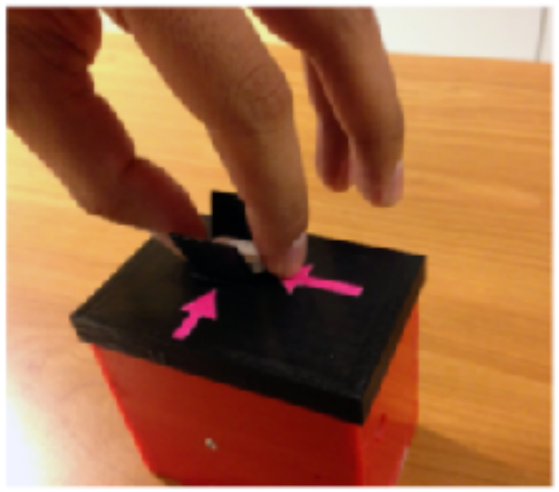
Smart pill box
Identify pills using chemical signatures

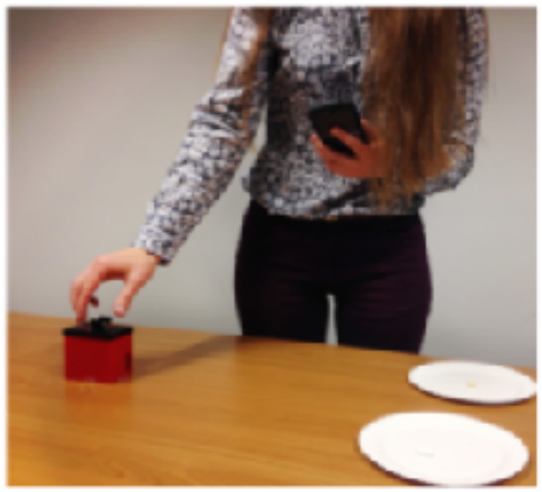








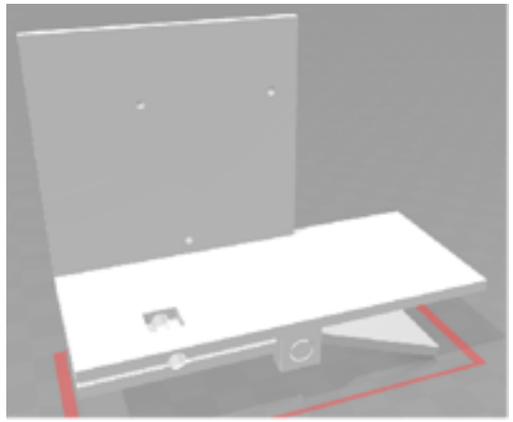


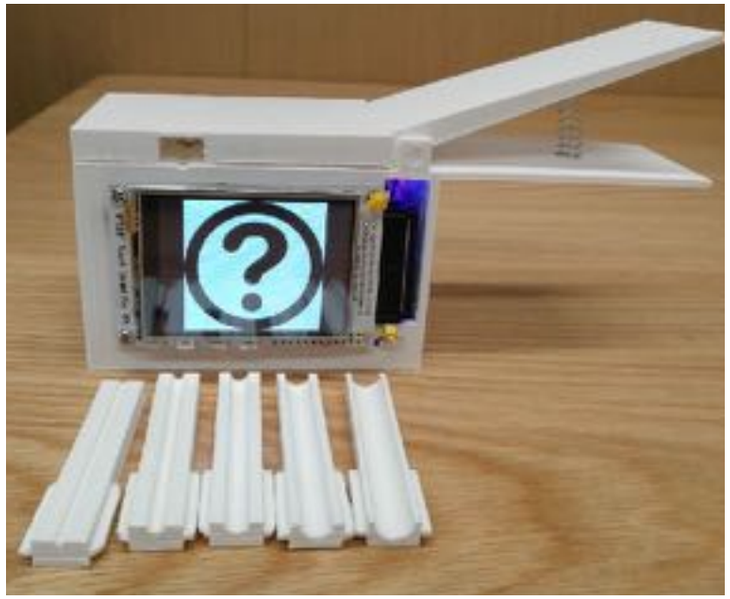


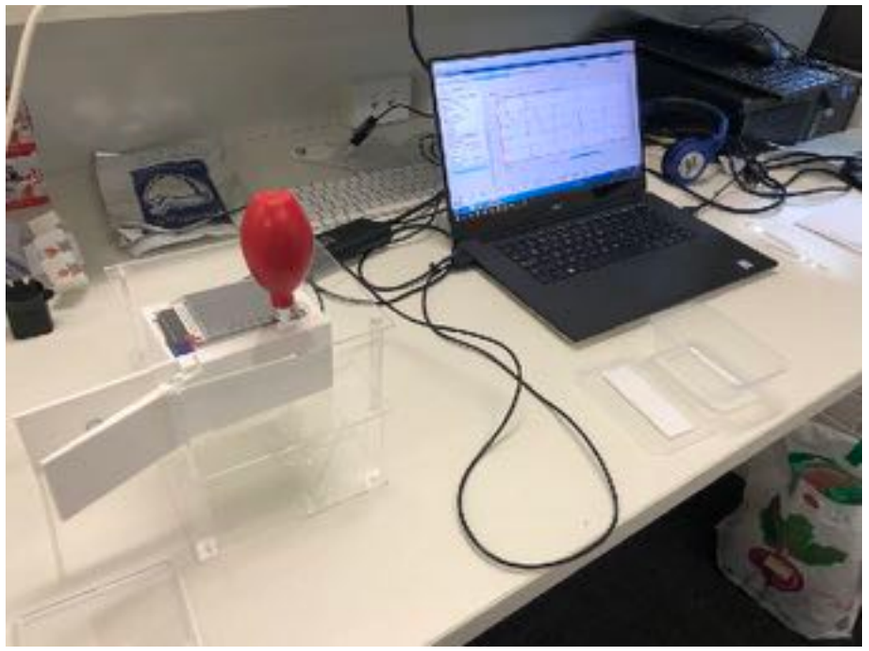
Scan
Stop

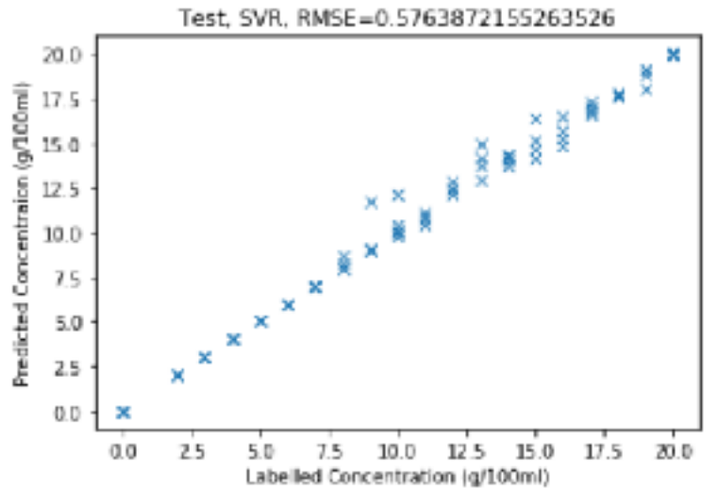
IV line monitoring

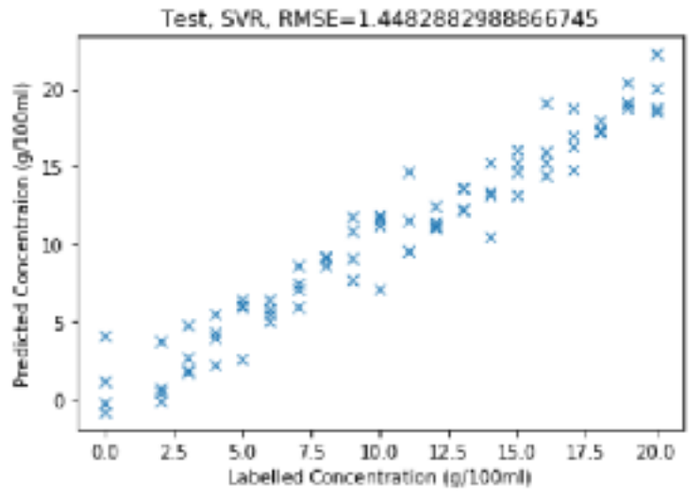
Continuous identification of liquids/concentrations in IV line



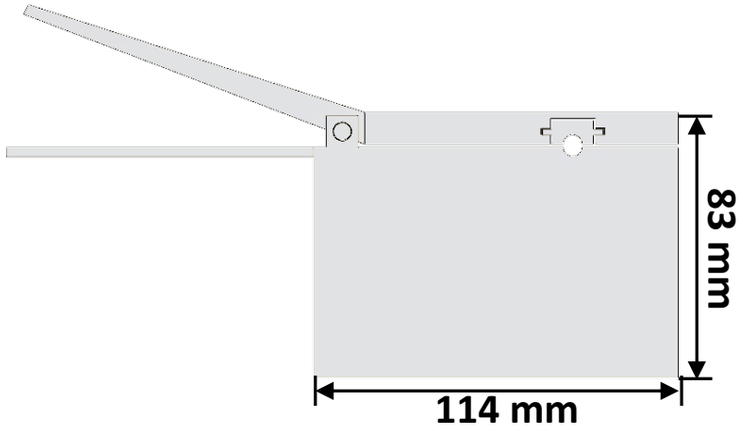


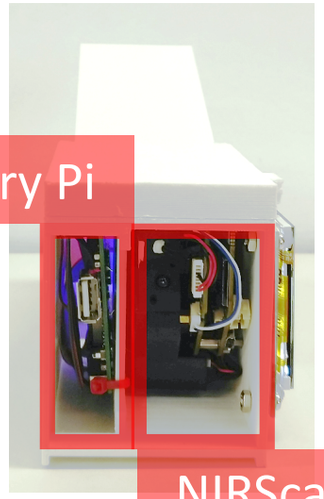






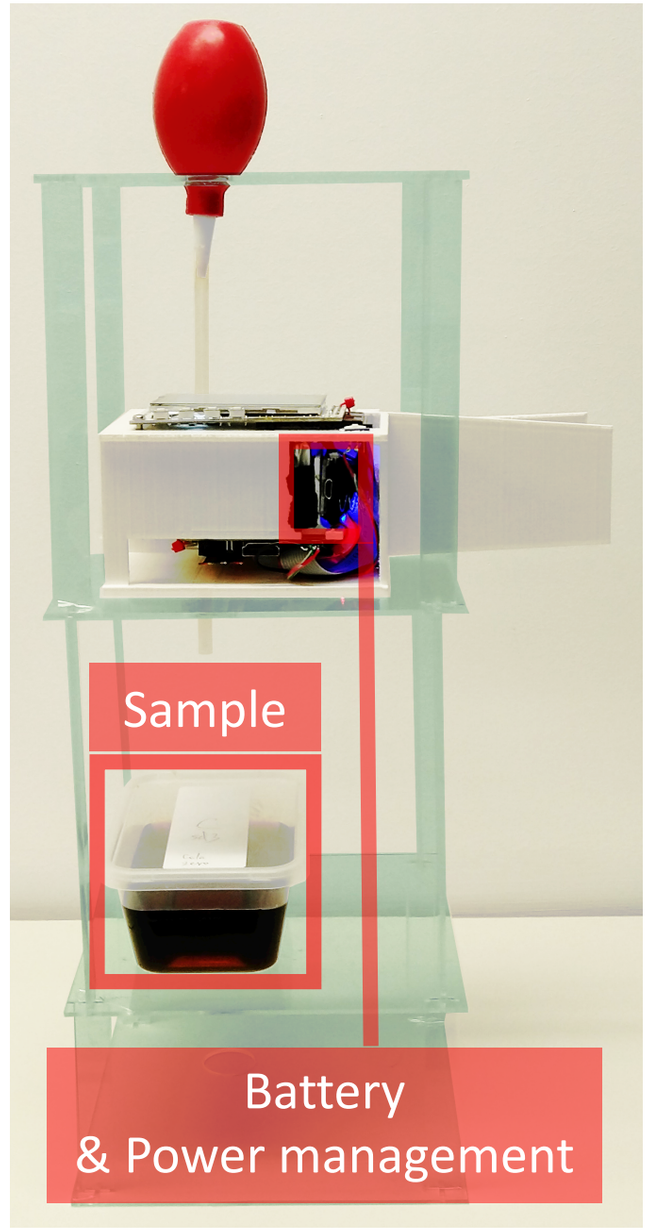
114 mm





Raspberry Pi

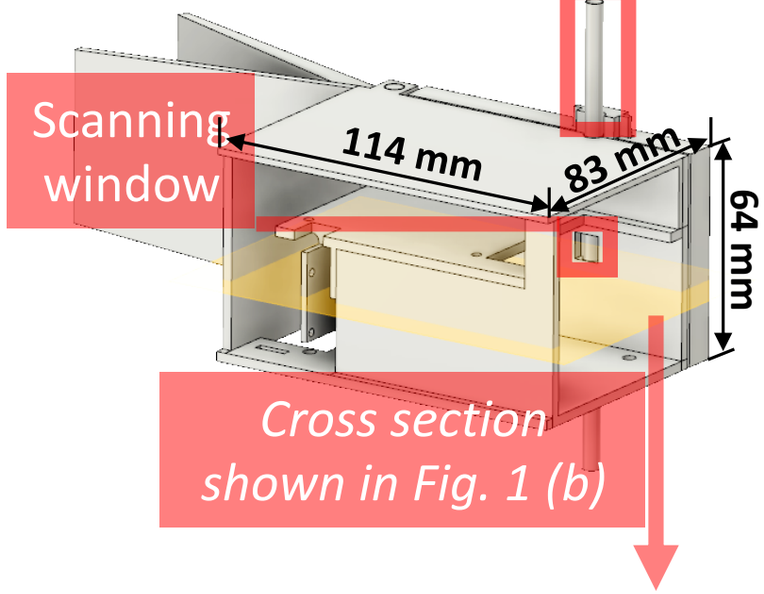
NIRScan Nano



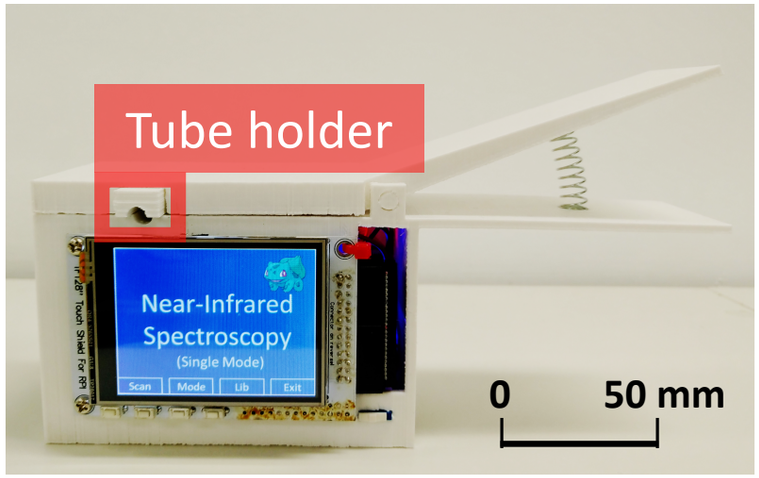
Sample

Battery
& Power management

Sampling tube

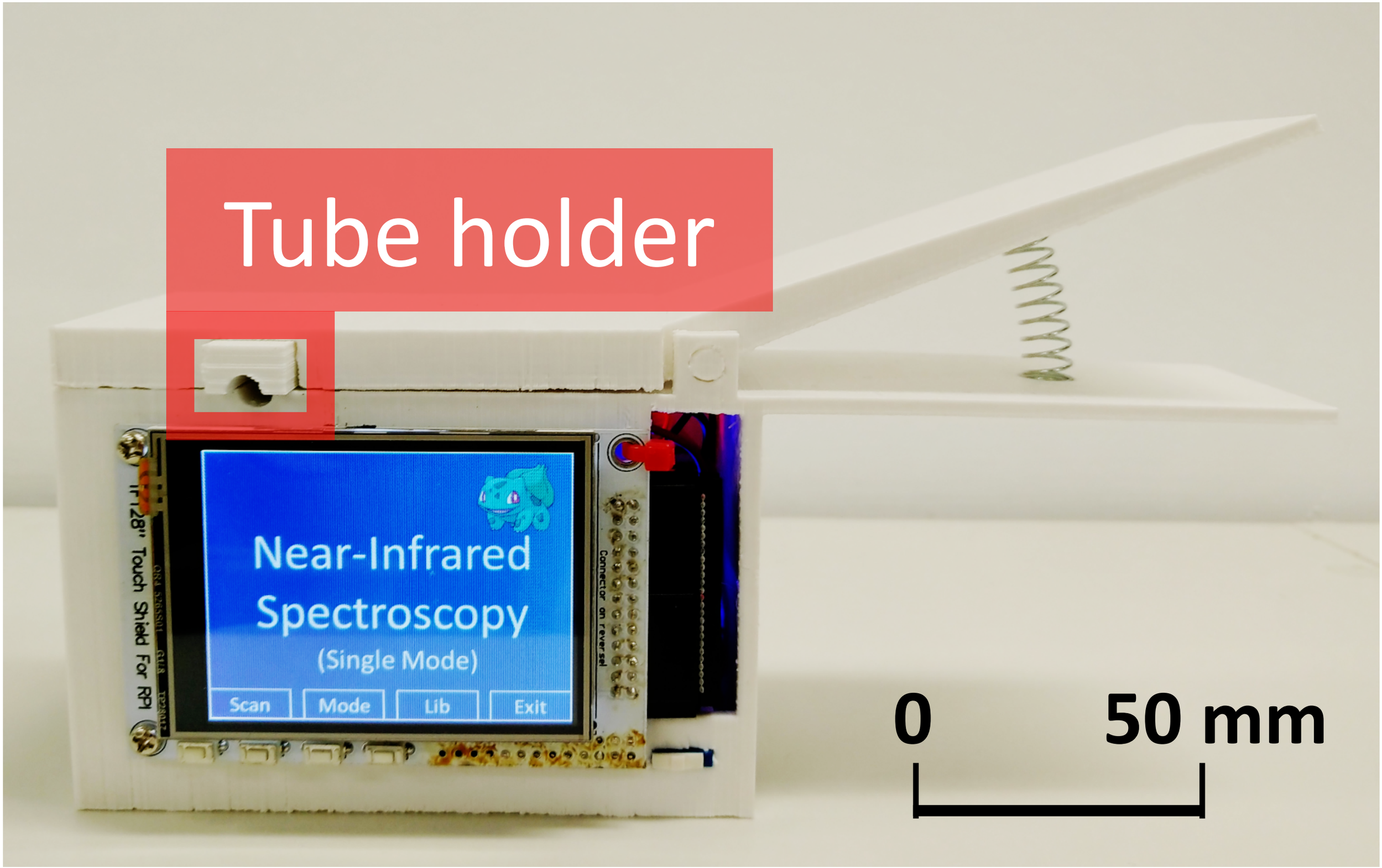


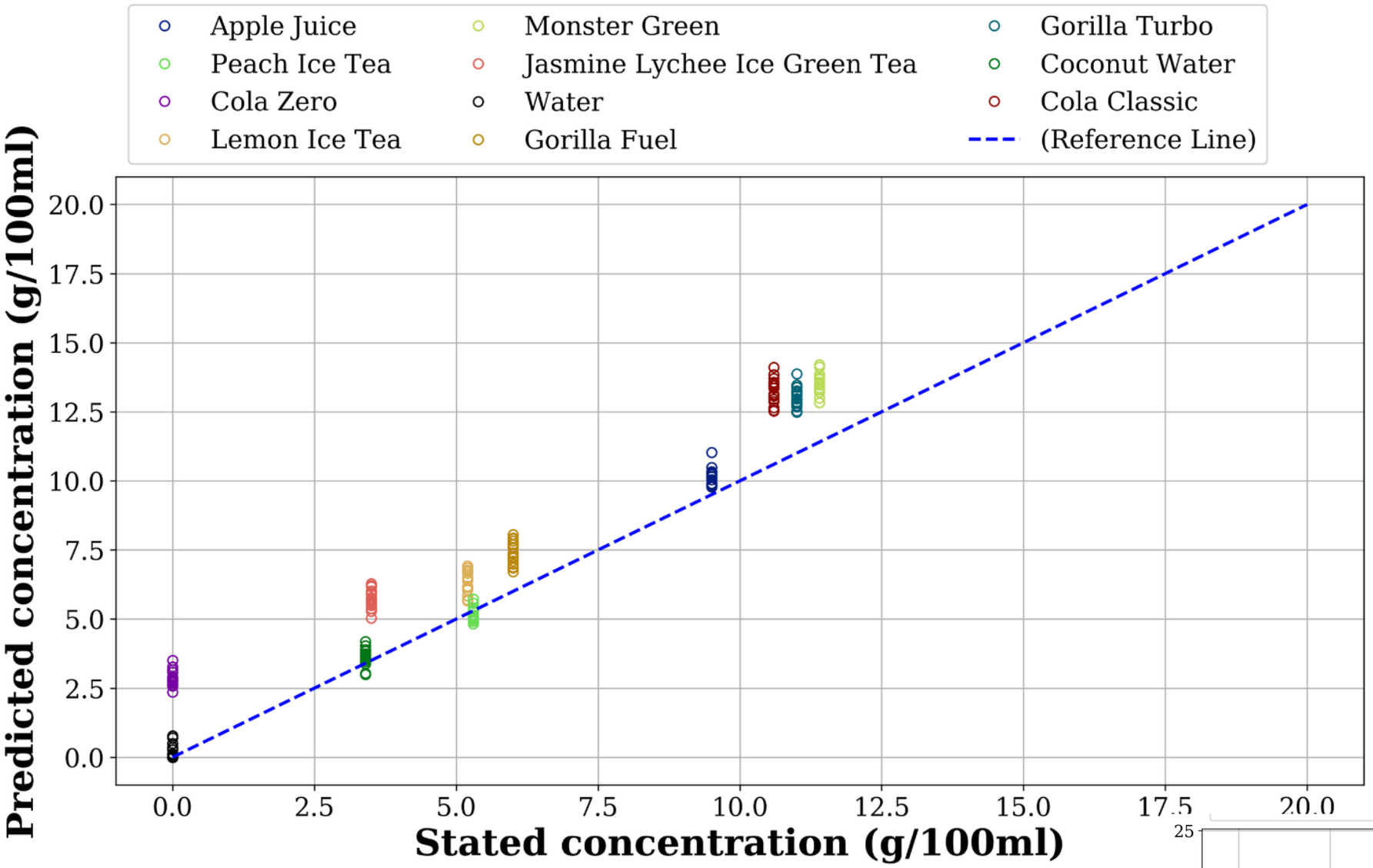
Cross section shown in Fig. 1 (b)

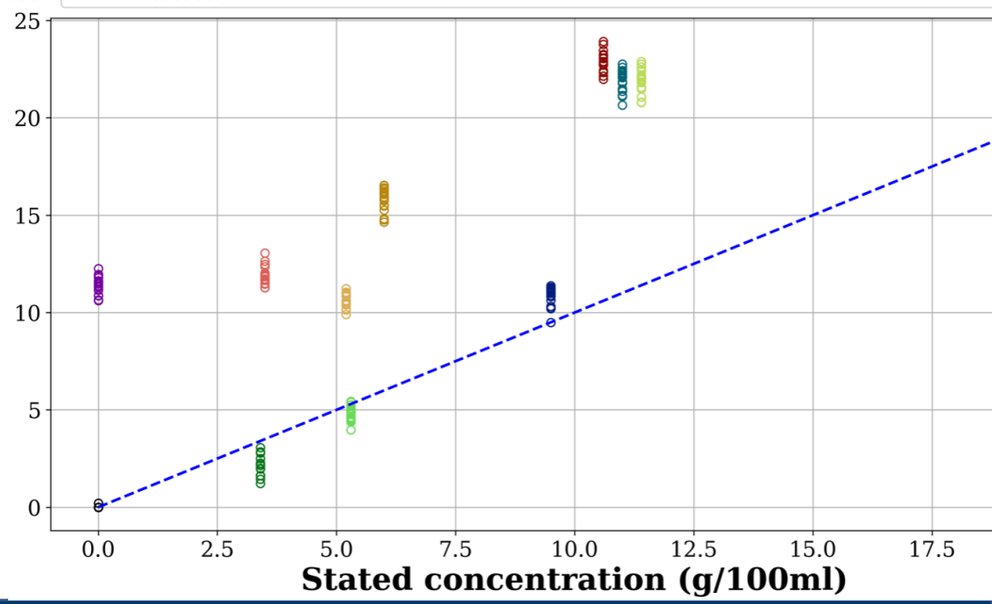


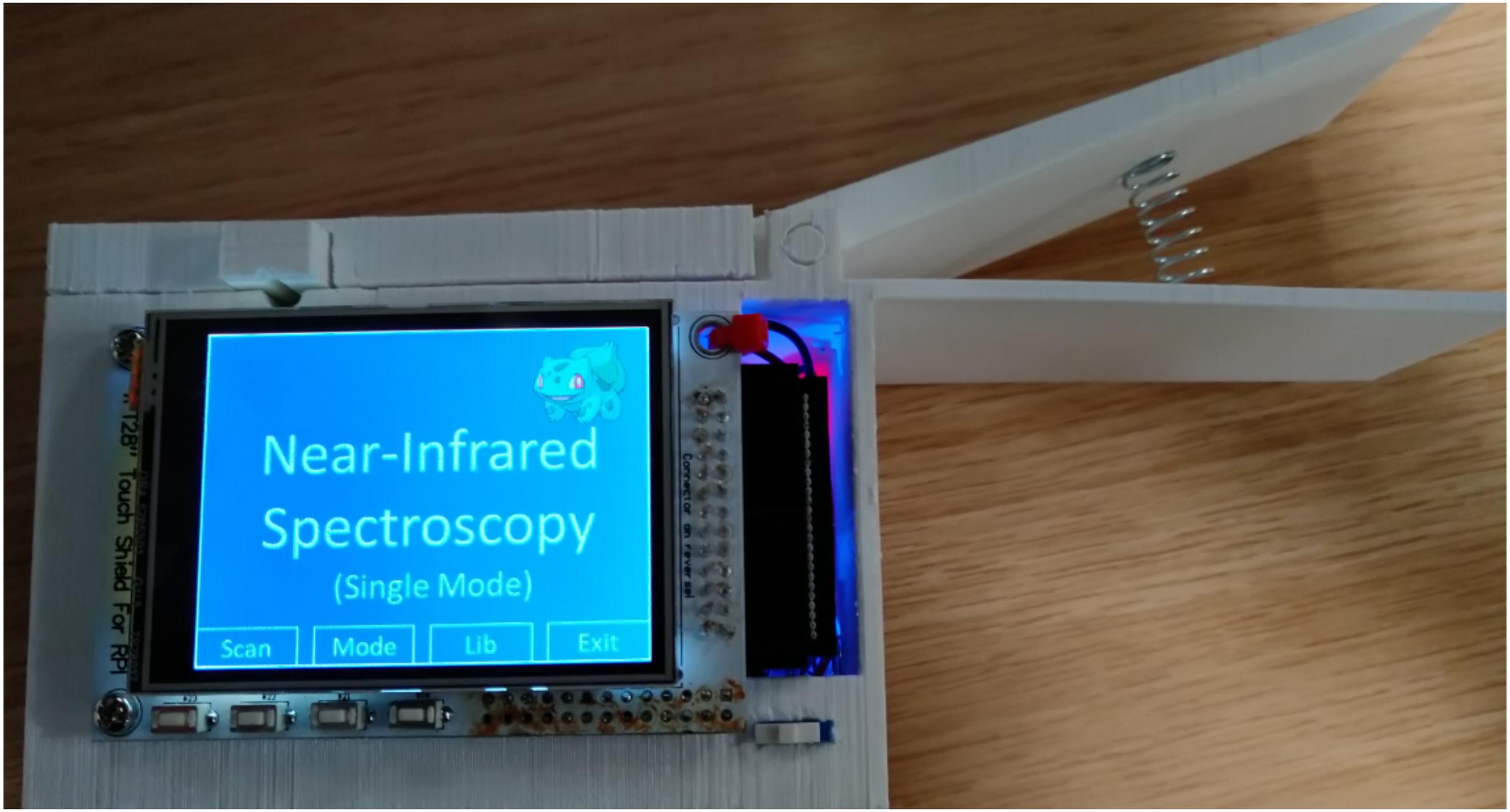
Tube holder

Tube holder


Near-Infrared
Spectroscopy
(Single Mode)
Scan
Mode
Lib
Exit
0
50 mm

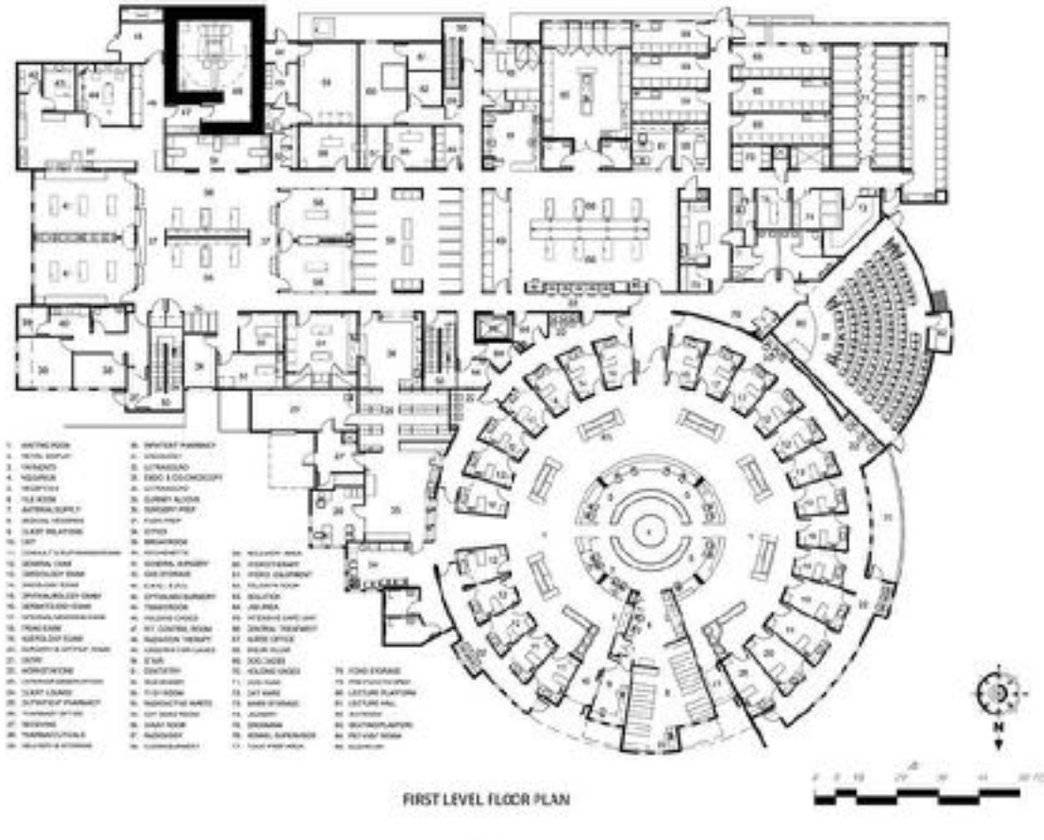

Apple Juice
Peach Ice Tea
Cola Zero
Lemon Ice Tea
Monster Green
Jasmine Lychee Ice Green Tea
Water
Gorilla Fuel
Gorilla Turbo
Coconut Water
Cola Classic
(Reference Line)
Predicted concentration (g/100ml)
Stated concentration (g/100ml)
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
20.0

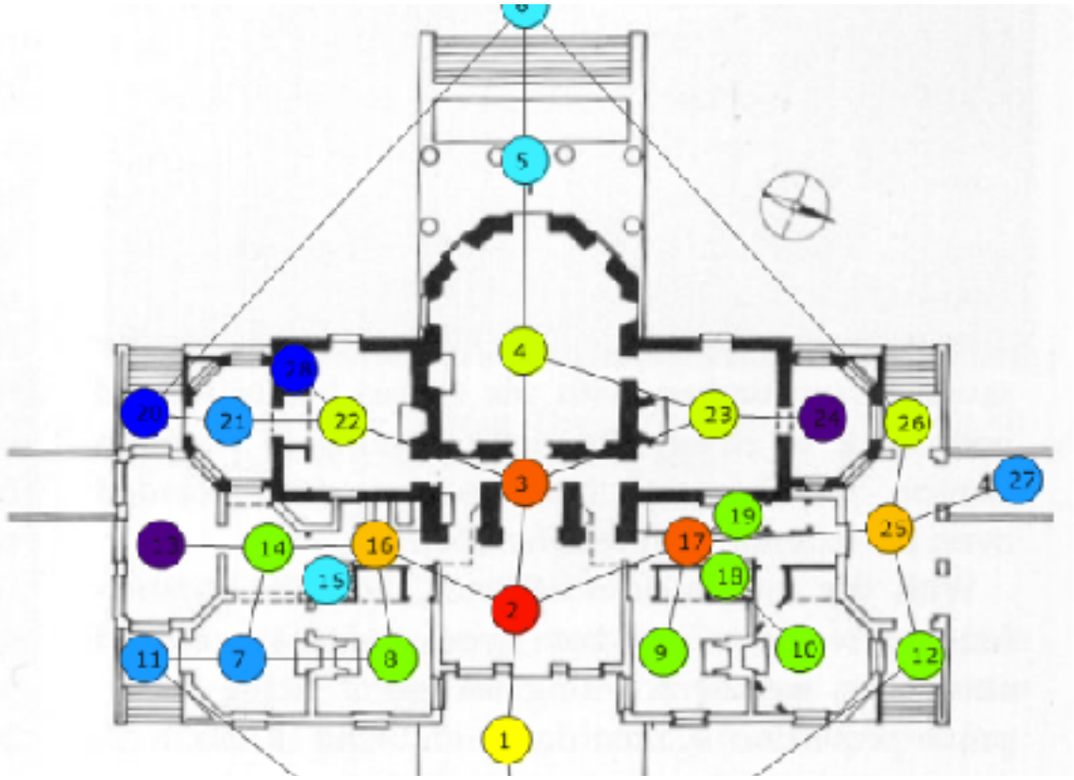

Stated concentration (g/100ml)
0
5
10
15
20
25
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5


Near-Infrared
Spectroscopy
(Single Mode)
Scan
Mode
Lib
Exit
Touch Shield For RPI

Operating theatre tracking

Track patients/staff in & out of operating theatres





University of Melbourne
Prof Vassilis Kostakos
26
27
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304
University of Melbourne
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University of Melbourne
301
University of Melbourne
303
University of Melbourne
302
University of Melbourne

526
423
360
315
342
405
486
567
462
487
408
409
442
320
597
406
513
499
446
536
477
435
605
333
512
568
395
343

3
Rommel
Daniel
Mandi
Mel Marsh
Pa moi
Bec Pang
Khim
Paris Zamani
Charmaine
Kathreen

Human Dermatomes

clinell

IV Stuff

OP Airway
NP Airway T Bag

Combine Large &
Small
Gauze

OR 3

THE UNIVERSITY OF MELBOURNE

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

16

OR 1

THE UNIVERSITY OF MELBOURNE

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

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
	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 cate

Settings: v-

355166080345184
Watchdog: offline

None

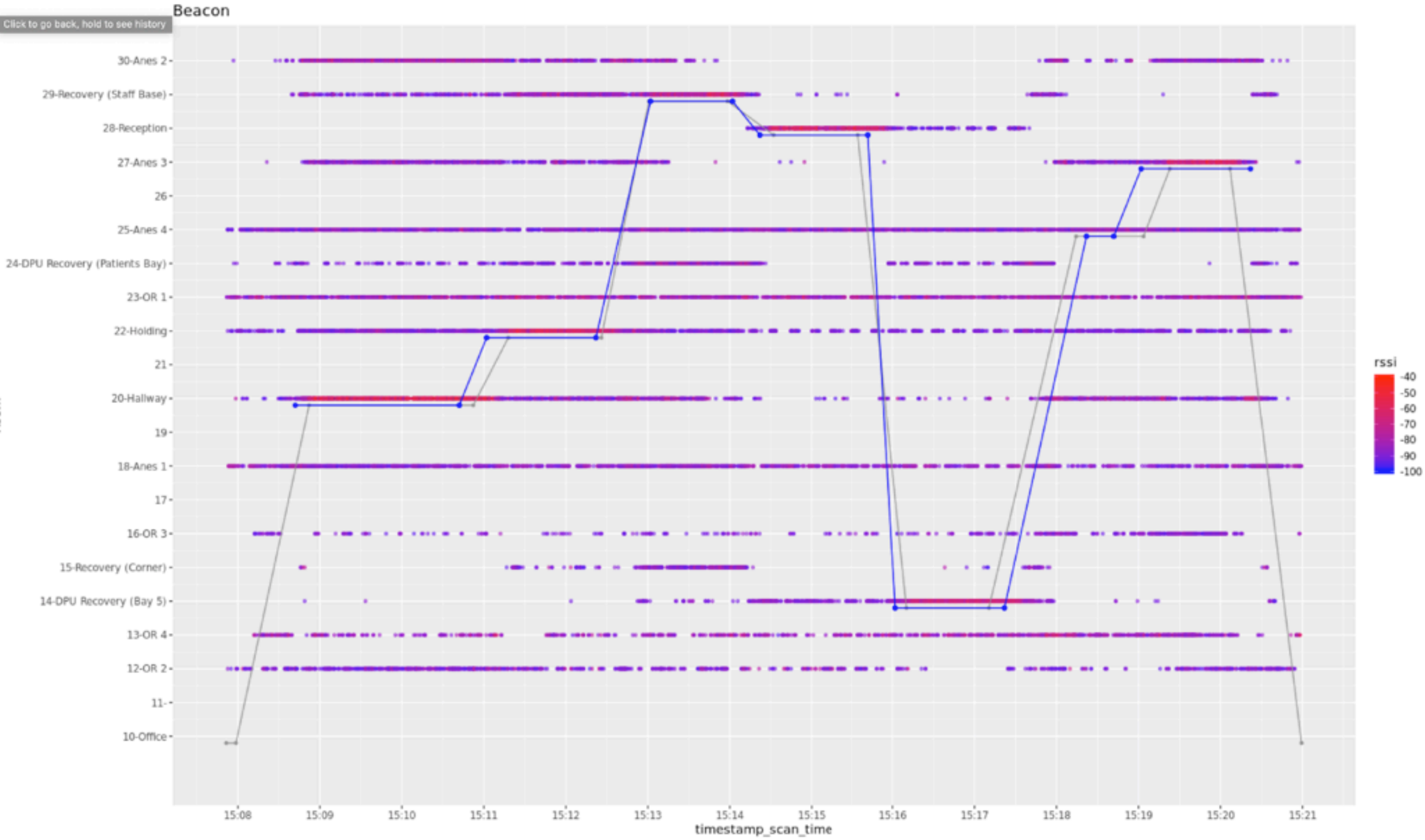
Device Number: 20

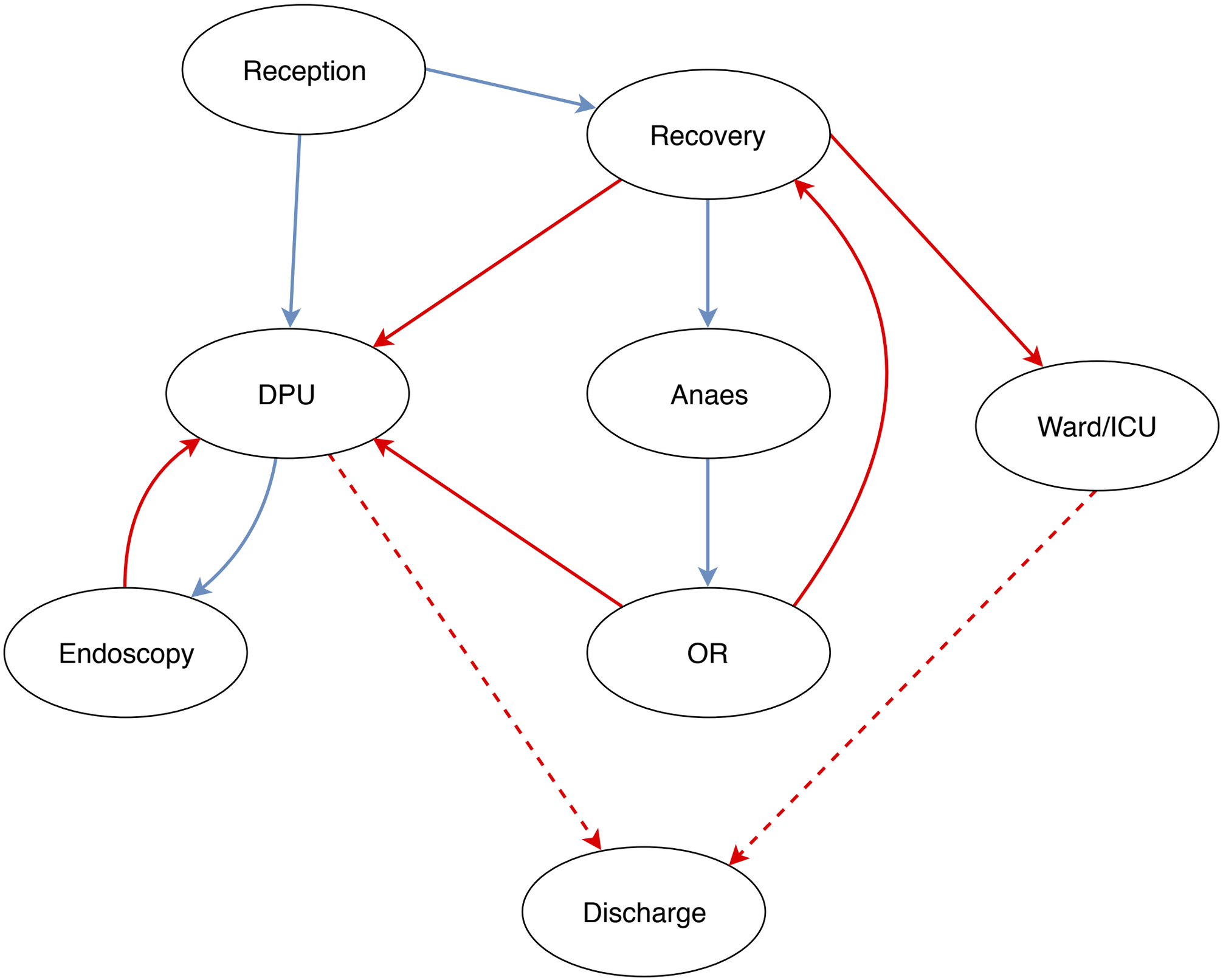
Room: Hallway

Last contact: 4 Nov 2018 16:04:17

100%

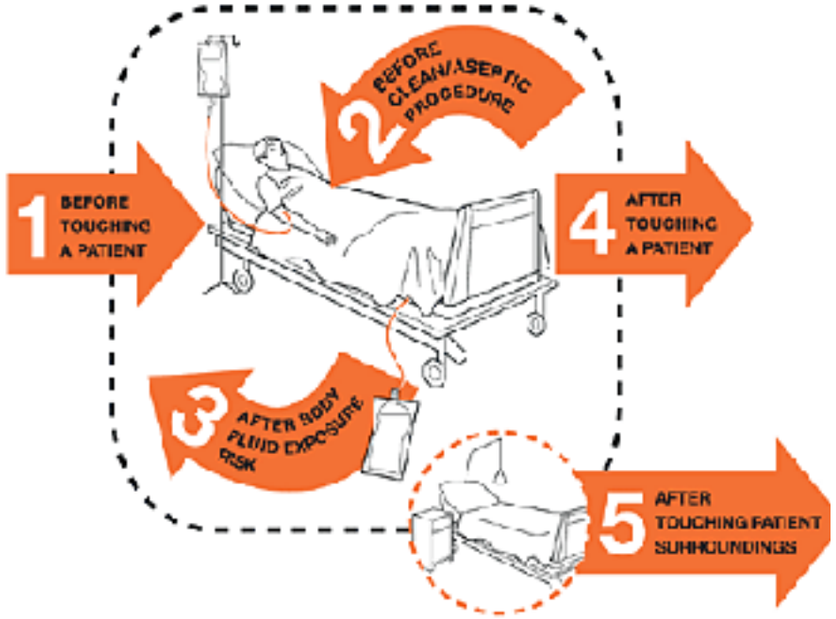
Settings: v0.003

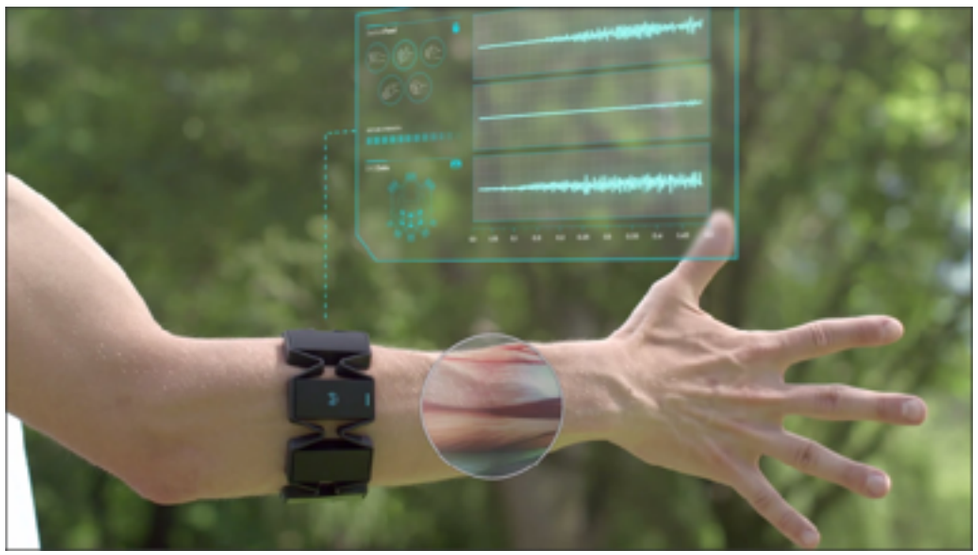

Beacon
Click to go back, hold to see history
30-Anes 2
29-Recovery (Staff Base)
28-Reception
27-Anes 3
26
25-Anes 4
24-DPU Recovery (Patients Bay)
23-OR 1
22-Holding
21
20-Hallway
19
18-Anes 1
17
16-OR 3
15-Recovery (Corner)
14-DPU Recovery (Bay 5)
13-OR 4
12-OR 2
11
10-Office
15:08
15:09
15:10
15:11
15:12
15:13
15:14
15:15
15:16
15:17
15:18
15:19
15:20
15:21
timestamp_scan_time
rssi
-40
-50
-60
-70
-80
-90
-100

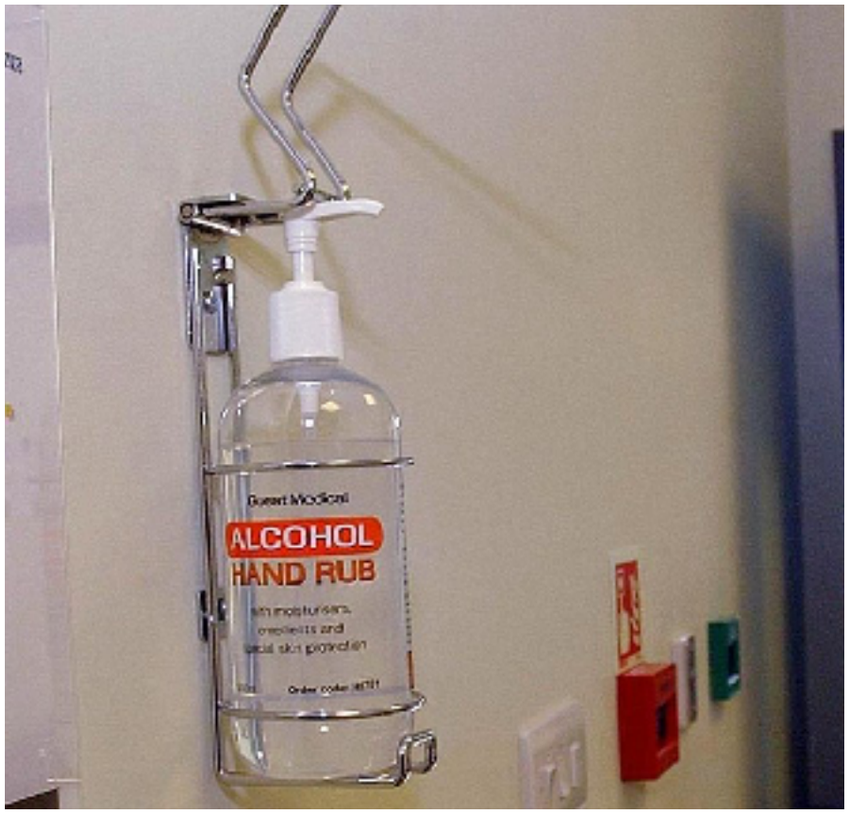

Reception
Recovery
DPU
Anaes
Ward/ICU
Endoscopy
OR
Discharge

Hand washing detection

Detect (and quantify) hand washing in the hospital







How to Handrub

RUB HANDS FOR HAND HYGIENE! WASH HANDS WHEN VISIBLY SOIL

Duration of the entire procedure: 20-30 seconds

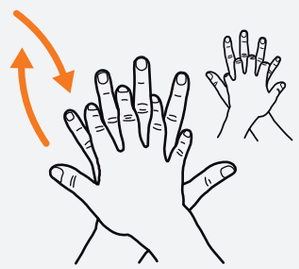
1a 1b

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

2

Rub hands palm to palm;

3

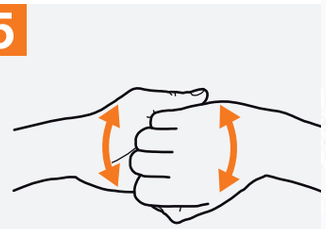


Right palm over left dorsum with interlaced fingers and vice versa;

4

Palm to palm with fingers interlaced;

5

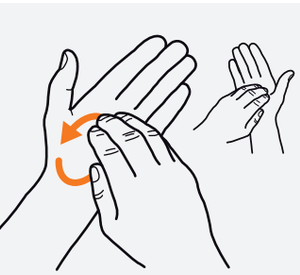


Backs of fingers to opposing pa
with fingers interlocked;

6

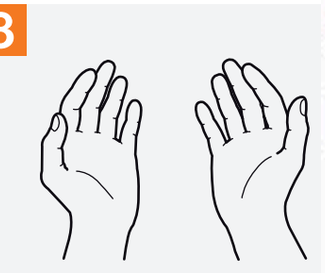
Rotational rubbing of left thumb clasped in right palm and vice versa;

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.

World Health Organization | Patient Safety — A World Alliance for Safer Health Care | **SAVE LIVES** Clean **Your** Hands

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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

0

Wet hands with water;

1

Apply enough soap to cover all hand surfaces;

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

Rinse hands with water;

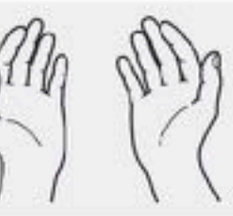
9

Dry hands thoroughly with a single use towel;

10

Use towel to turn off faucet;

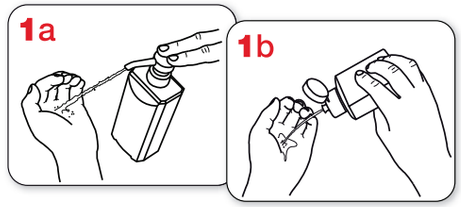
11



Your hands are now safe.

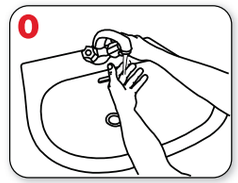
World Health Organization | Patient Safety — A World Alliance for Safer Health Care | **SAVE LIVES** Clean **Your** Hands

How to handrub?
WITH ALCOHOL-BASED FORMULATION

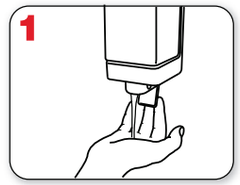


Apply a palmful of the product in a cupped hand and cover all surfaces.

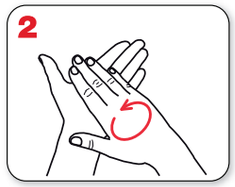
How to handwash?
WITH SOAP AND WATER



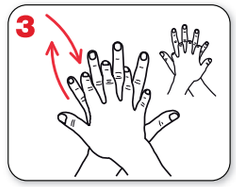
Wet hands with water



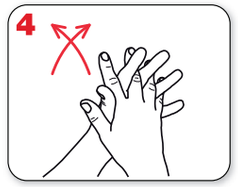
apply enough soap to cover all hand surfaces.



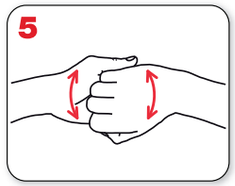
Rub hands palm to palm



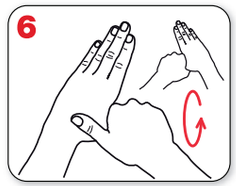
right palm over left dorsum with interlaced fingers and vice versa



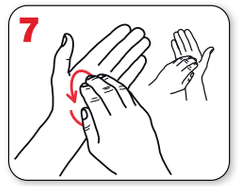
palm to palm with fingers interlaced



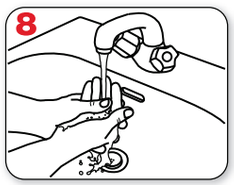
backs of fingers to opposing palms with fingers interlocked



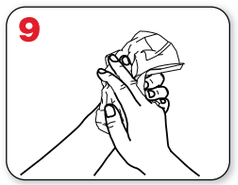
rotational rubbing of left thumb clasped in right palm and vice versa



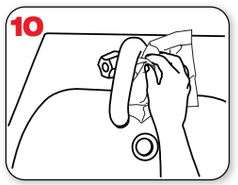
rotational rubbing, backwards and forwards with clasped fingers of right hand in left palm and vice versa



rinse hands with water

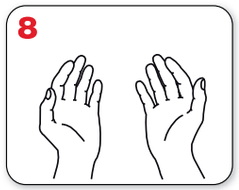


dry thoroughly with a single use towel



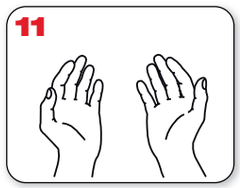
use towel to turn off faucet

20-30 sec



…once dry, your hands are safe.

40-60 sec



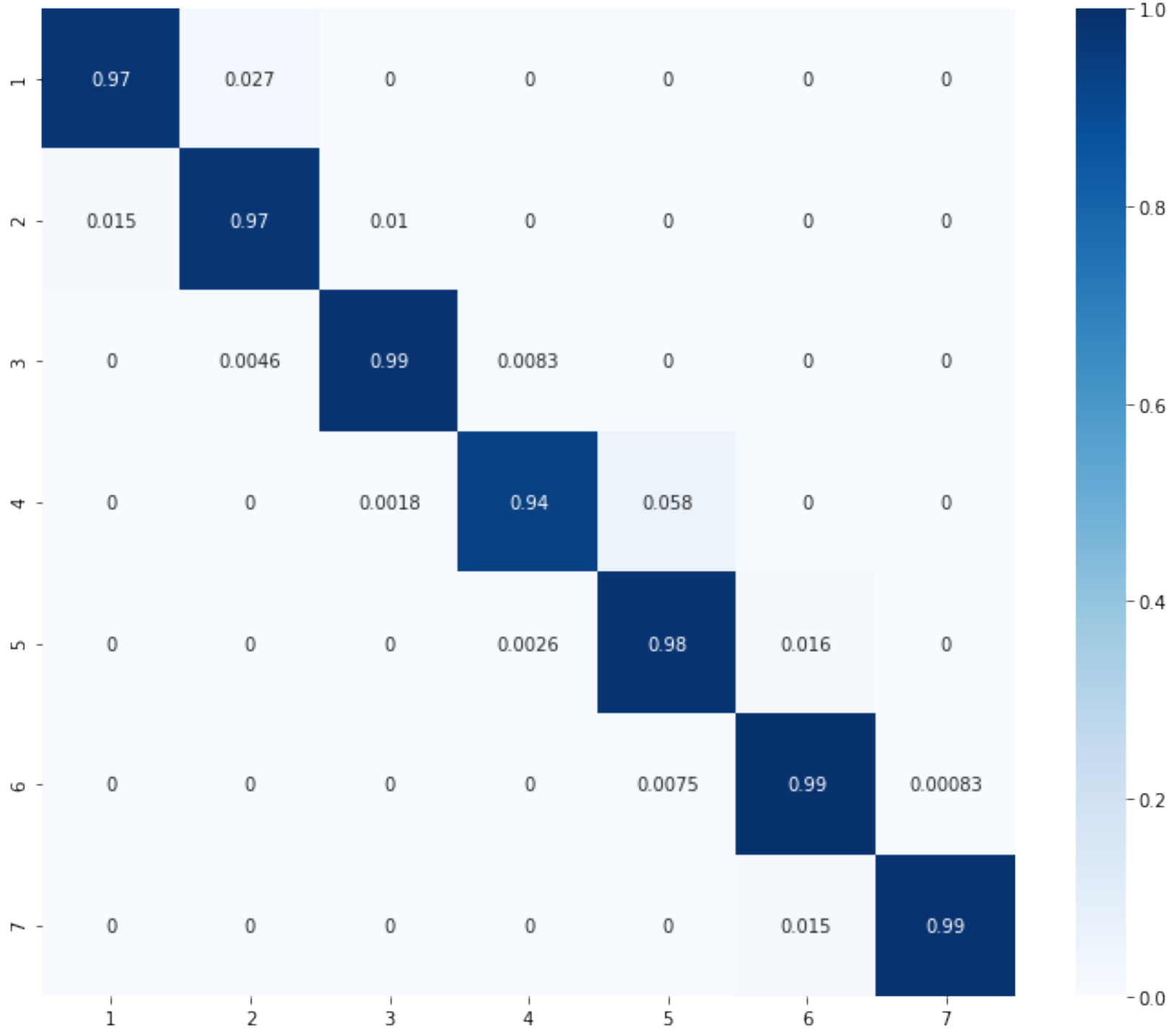
…and your hands are safe.

Design: mondofragilis network

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.

October 2006, version 1.

Upper Arm with Both Hands(smoothed with ecp)



9:41

Home

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

9:41

Home

01 Wet your hands with 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 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

9:41

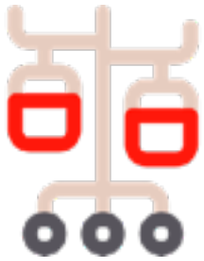
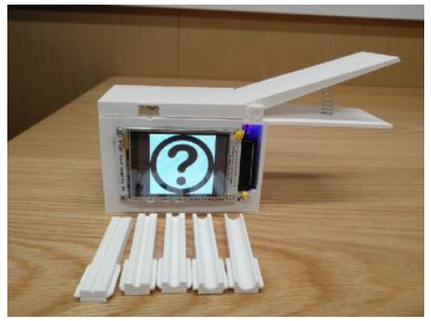
Home

01 Wet your hands with water
Completeness: 50%

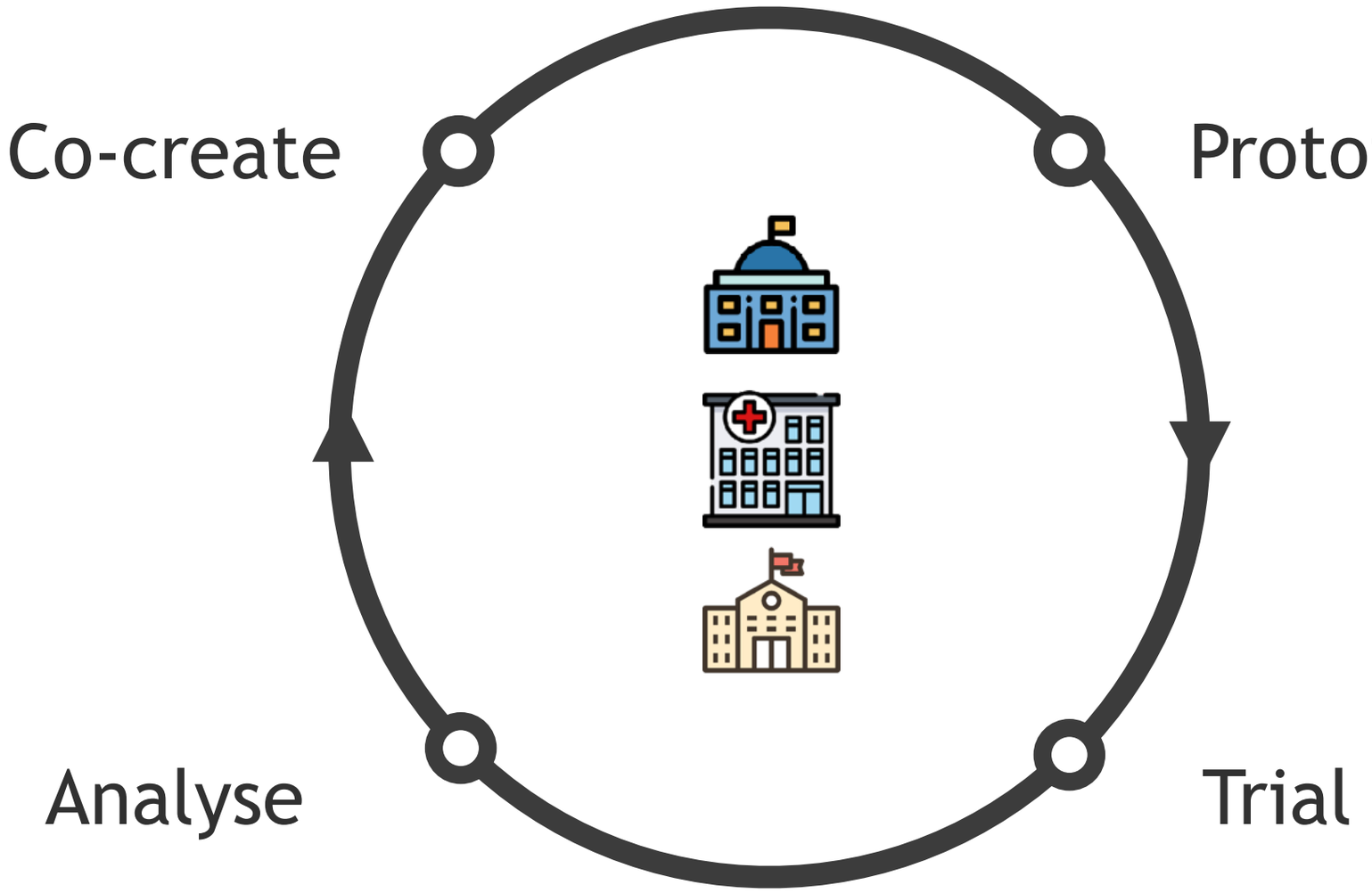
Description

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

Standard Procedure

Co-create	Explore	Prototype	Evaluate	Publish	Funding	Trials
	✓	✓		✓	✓	✓
	✓	✓		✓		
	✓	✓		✓	✓	
	✓	✓		✓		

Living Lab: Continuous Innovation



Outcomes and benefits

Improved operations

Generalisable solutions

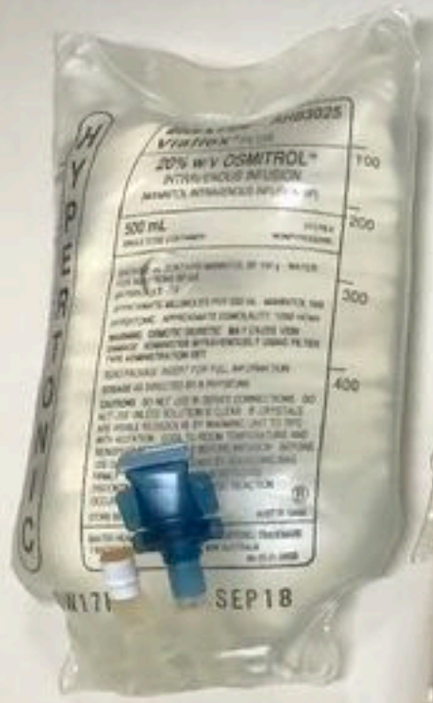
Pathway to funding

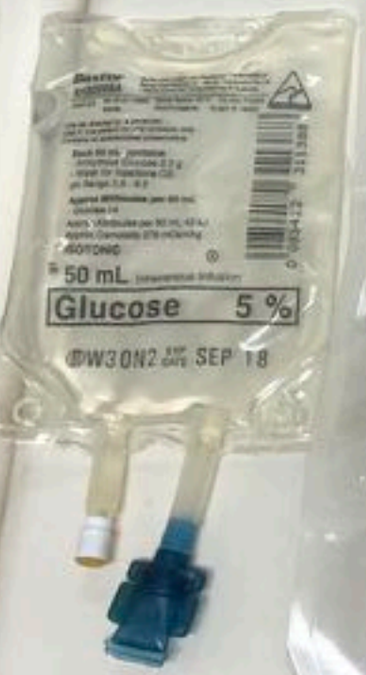
Establish critical mass

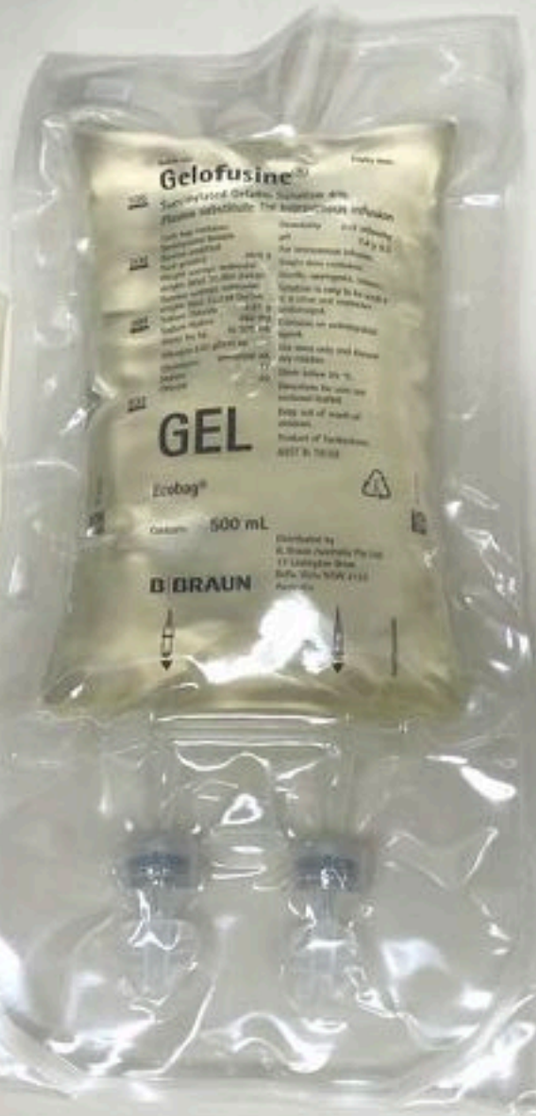
Innovation beyond hospitals

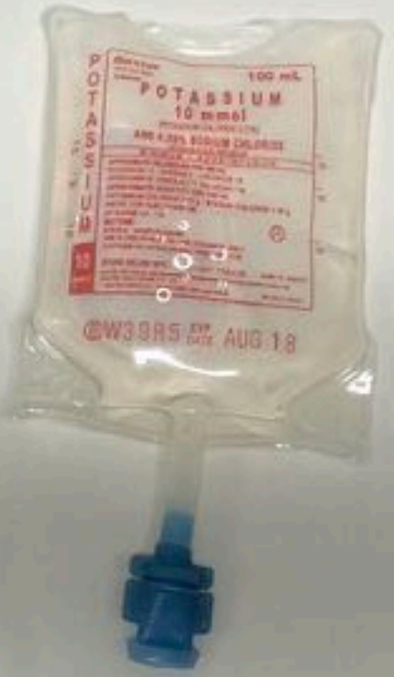
Lessons learned

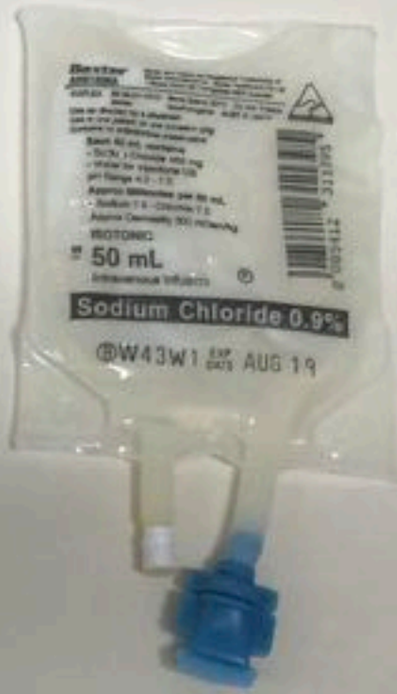
- The focus of our work is not "owned" by medical experts
  - Good: we do not become "programers"
  - Bad: who drives this? Need support from higher management.
- This is a highly regulated space
  - Linking our work to a regulation makes it highly attractive
- Health funding can be very different from "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.


20% w/v OSMITROL®
INTRAVENOUS INFUSION
500 mL
SEP18


50 mL
Glucose 5 %
SEP 18


Gelofusine®
GEL
Ecobag®
500 mL
B BRAUN


POTASSIUM
10 mmol
100 mL
AUG 18


50 mL
Sodium Chloride 0.9%
AUG 19

1 PU

The ~~end~~ beginning!

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University of Melbourne