

A human-centred approach to digital health

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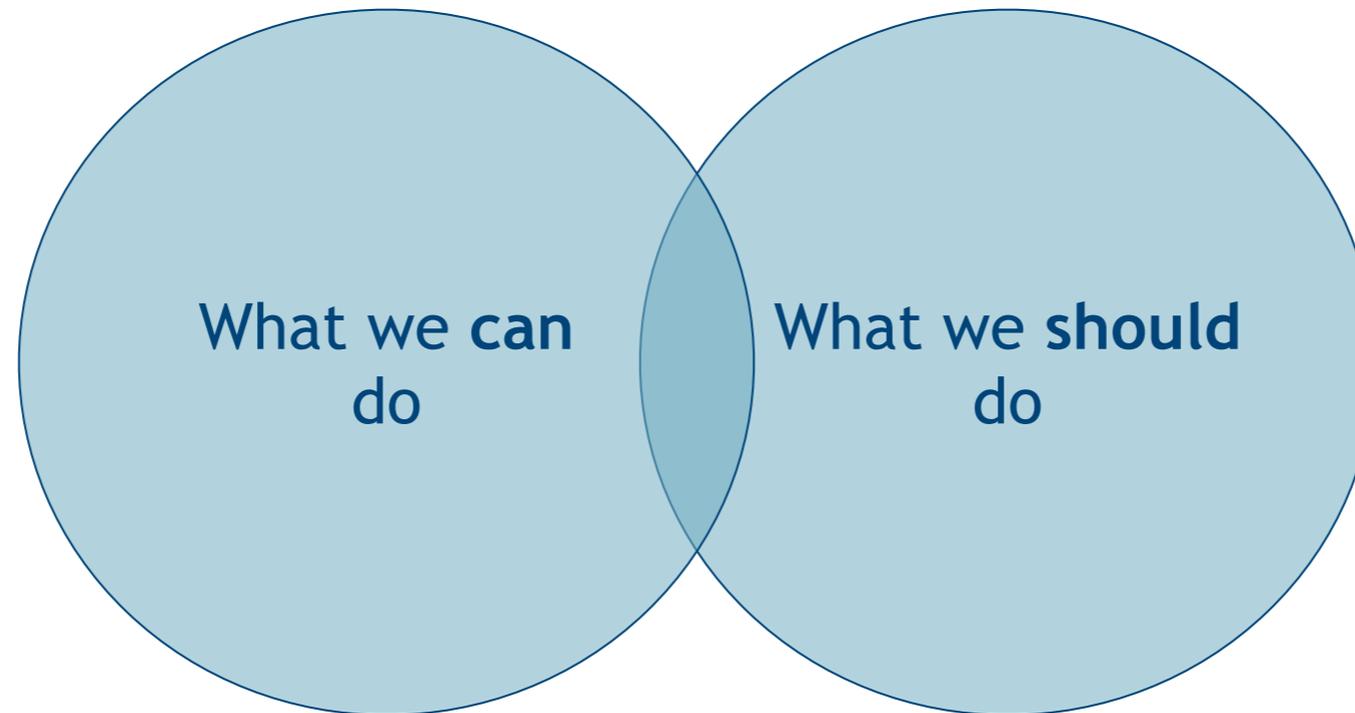
Presented 20 Oct 2025
Northern Health Hospital, Melbourne, Australia

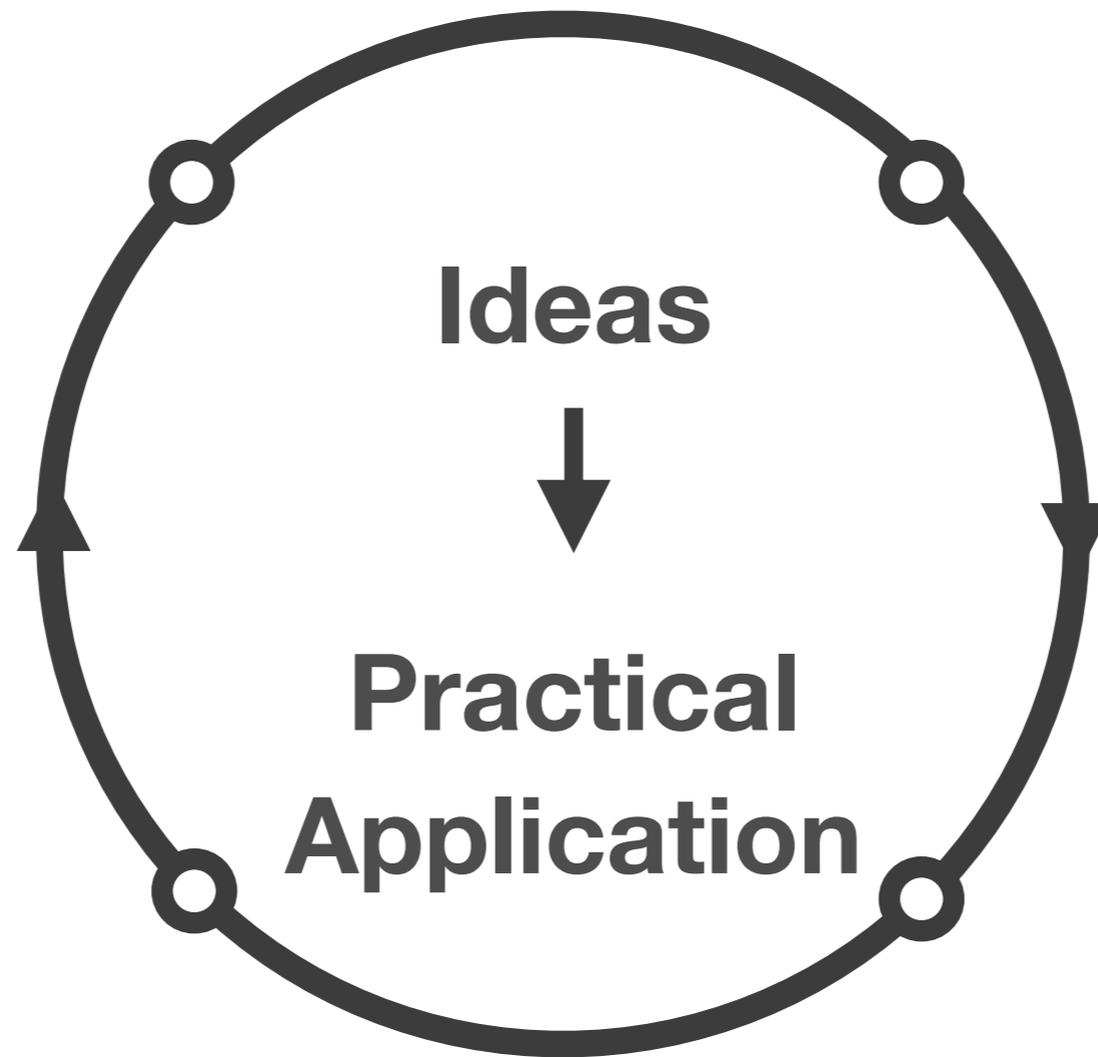
Human-Computer Interaction

Computing
Psychology & Social Sciences
Design

Mission:
**Create the next generation
of Interactive Technologies**

Designing technology

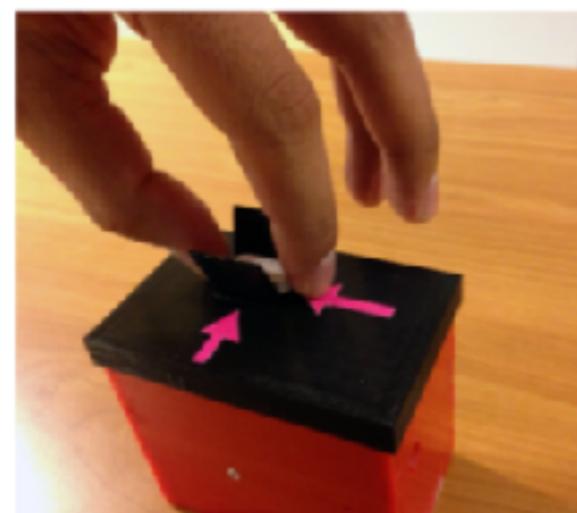
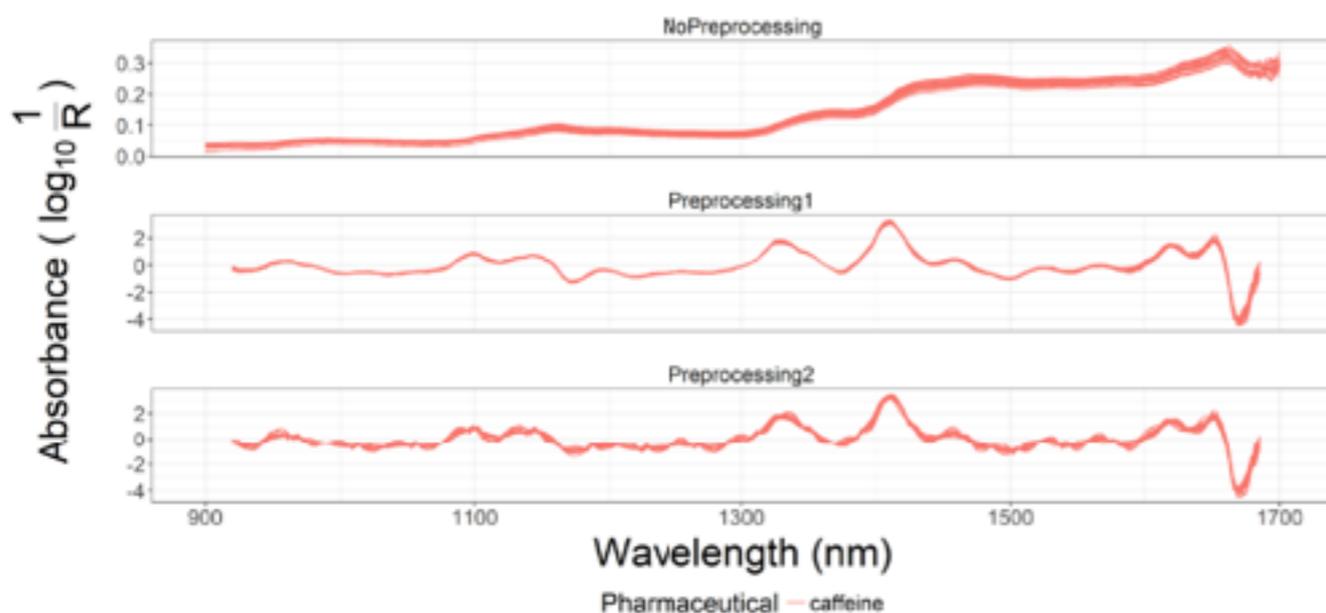
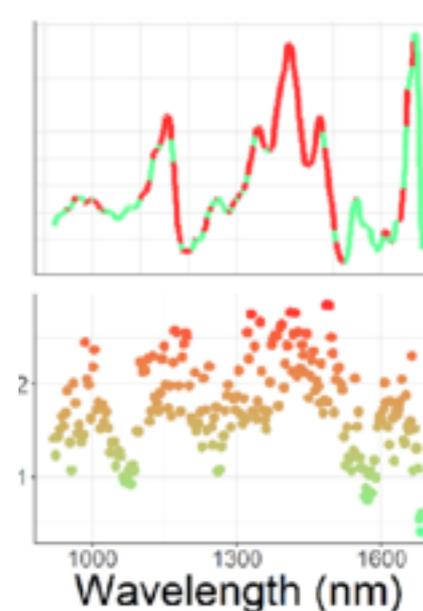
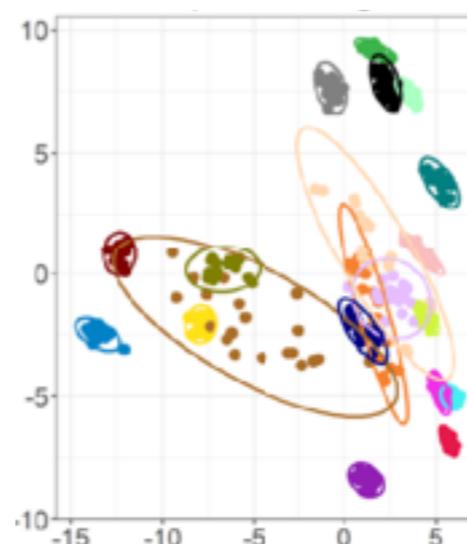
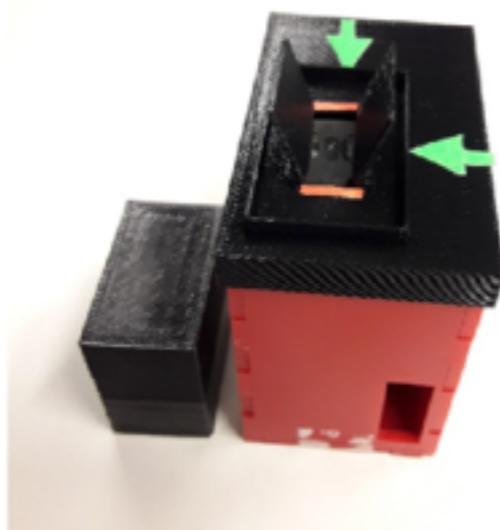




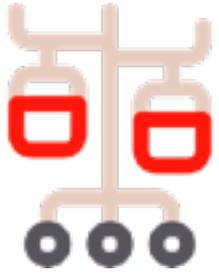


Smart pill box

Identify pills using chemical signatures

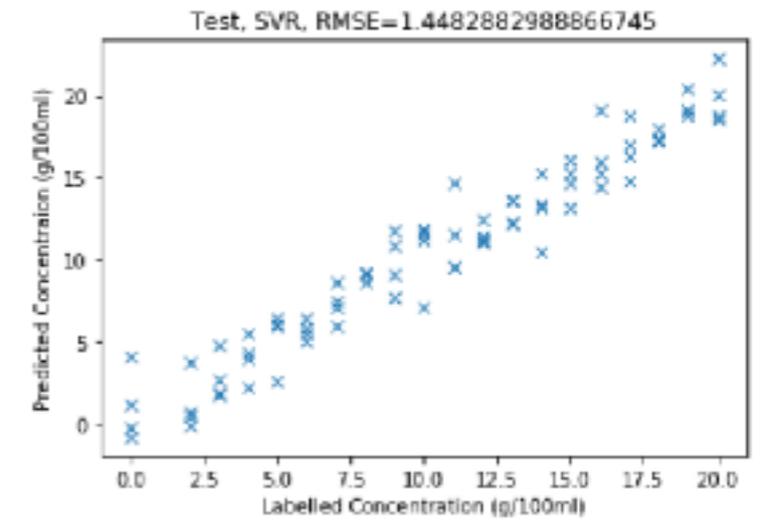
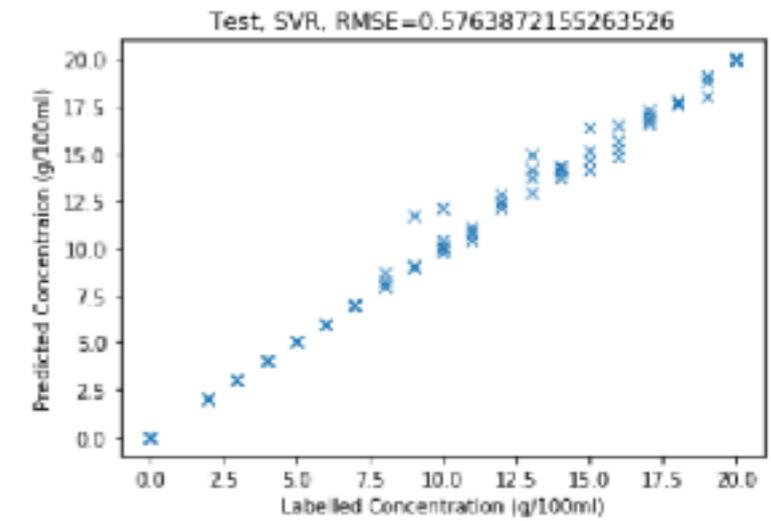
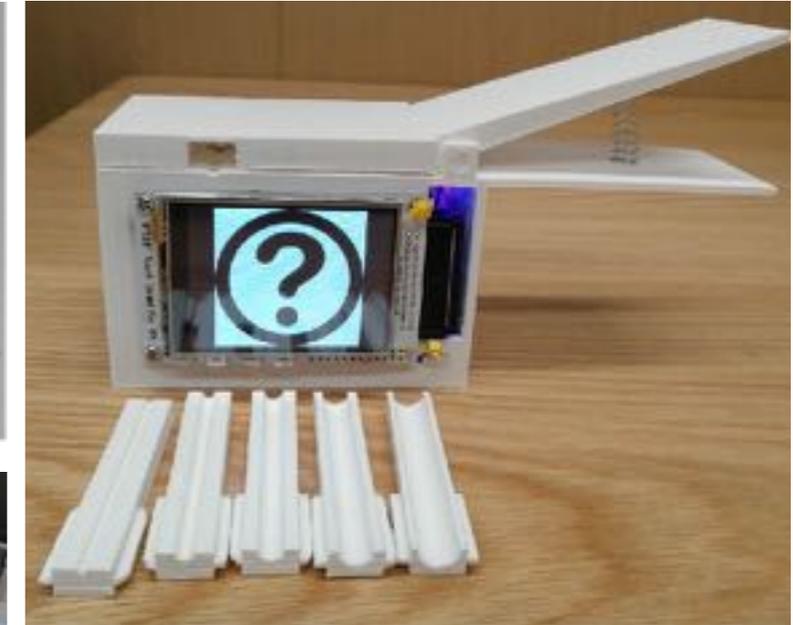
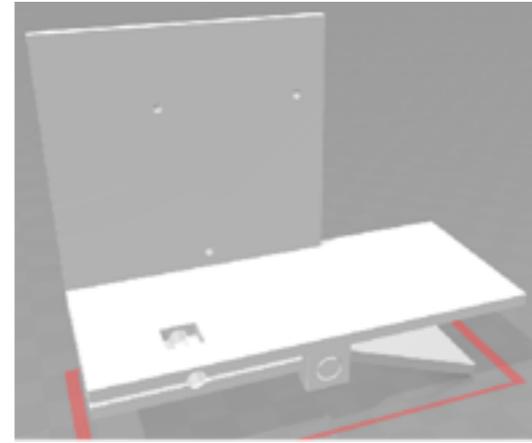


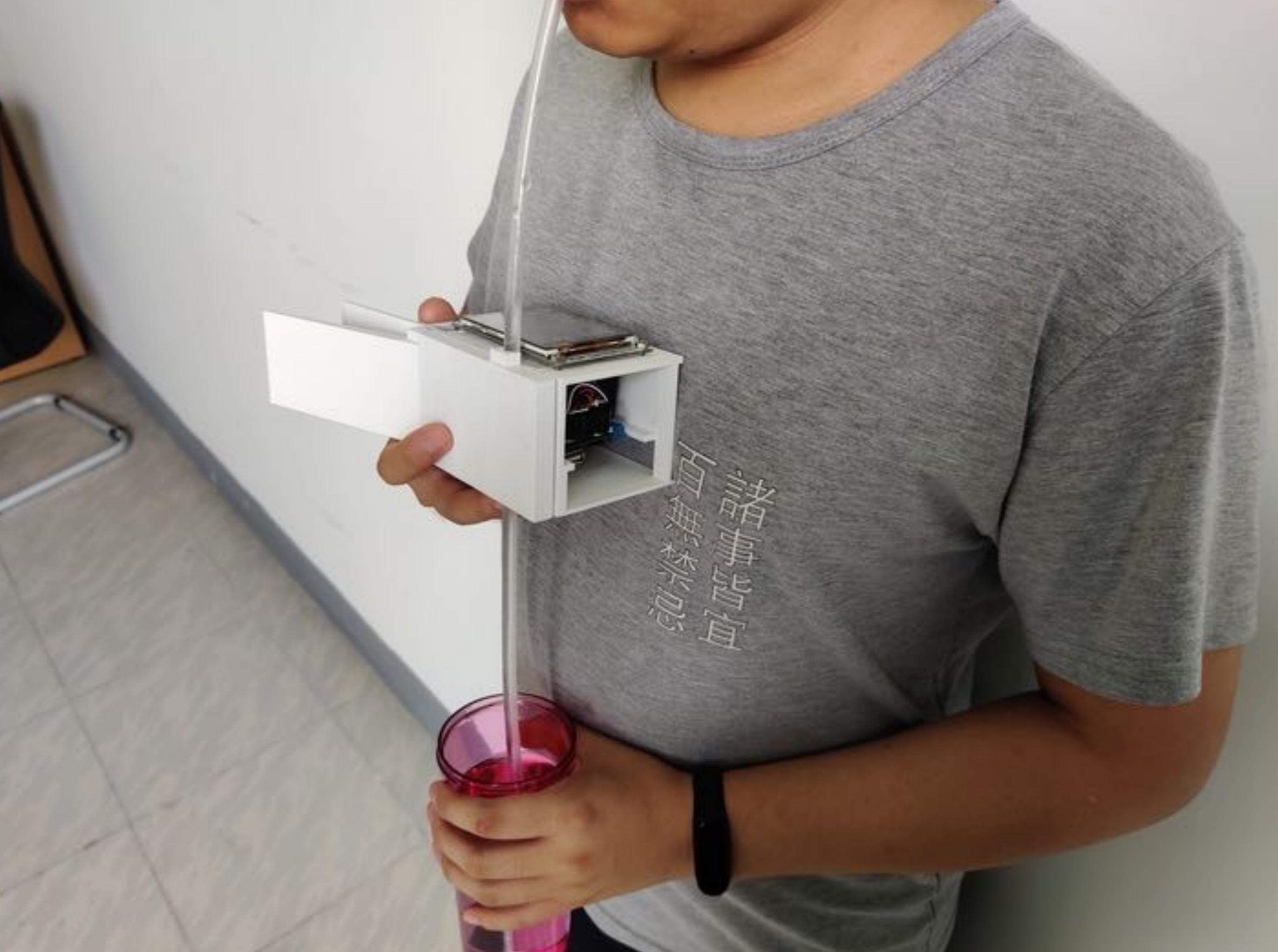




IV line monitoring

Continuous identification of liquids/concentrations in IV line





諸事皆宜
百無禁忌



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



Marini et al. 2020. Measuring Mobility and Room Occupancy in Clinical Settings: System Development and Implementation. JMIR mHealth and uHealth, vol. 8, no. 10, article e19874, 17 pages.









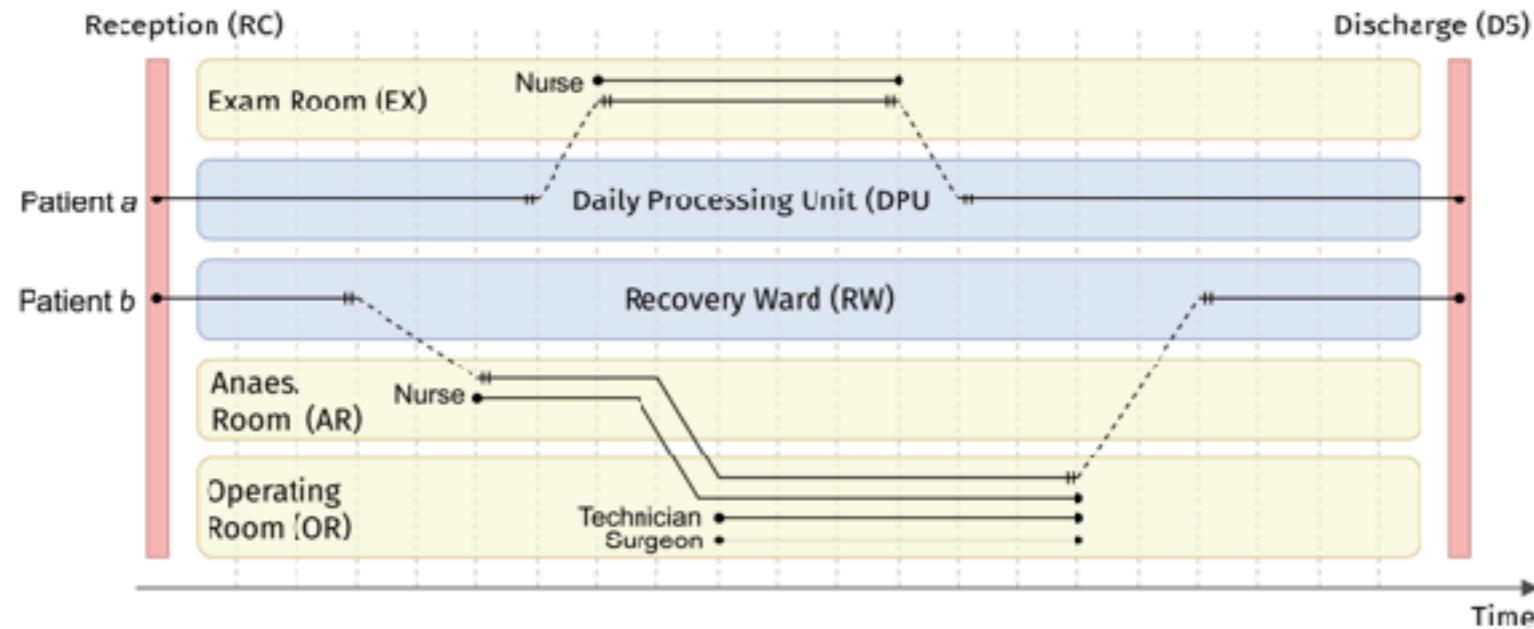


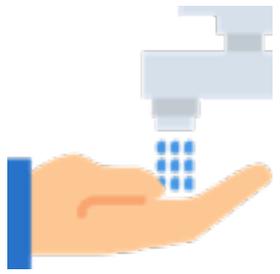
Fig. 4. A graphical visualisation of the journey of two patients. Patient *a* is scheduled for a daily exam, a nurse appears in the exam room together with the patient for the duration of the exam. Patient *b* is scheduled for a surgery and therefore goes through the anaesthetic room, then to the surgery room and finally to the recovery ward before discharge.

```
patients_alone <- start(data) %>%
  add_state(agents(set(P)), rooms(set(RC))) %>%
  add_state(agents(set(P), !set(patients)), rooms(set(DPU))) %>% end()
```

Surgery cases tend to be naturally more complex. The surgery itself can last for hours and the patient (P) stay spans over multiple days. The transition from AR to OR should also be considered as a direct, non-fuzzy transition. This is due to the fact that usually ARs are usually located just besides ORs. More importantly, anaesthesia only lasts for a certain amount of time so the patient should immediately move to the OR after going under anaesthesia, if that is not the case then the surgery most likely did not take place and that should be treated as a special case.

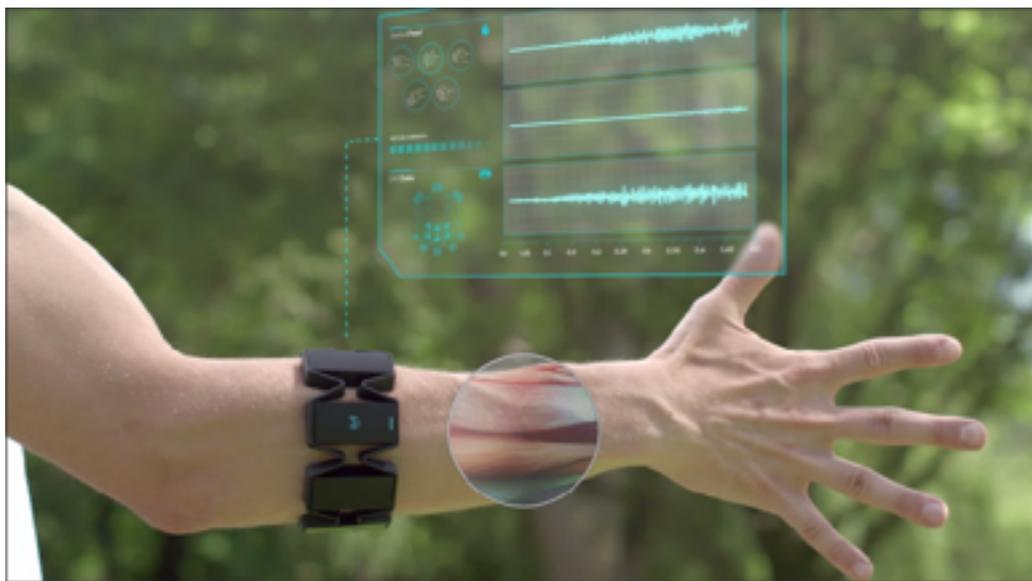
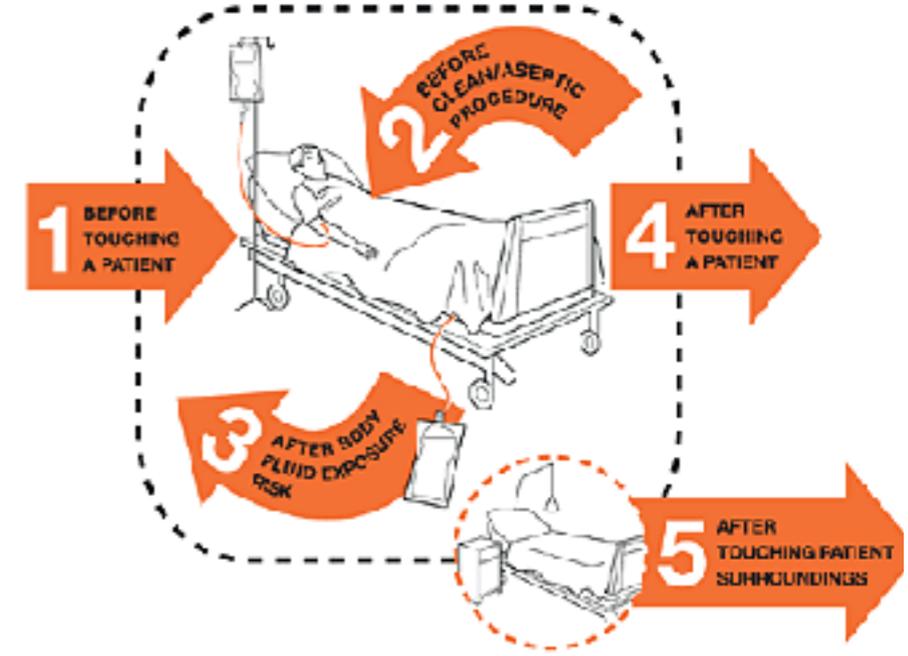
$\langle P, RC \rangle \rightsquigarrow \langle P, RW \rangle \rightsquigarrow \langle P, \{ARs\} \rangle \rightarrow \langle P, \{ORs\} \rangle \rightsquigarrow \langle P, DS \rangle$ (Surgeries)

Marini et al. 2024. A toolkit for localisation queries.
 Pervasive and Mobile Computing, vol. 103, article 101946, 22 pages



Hand washing detection

Detect (and quantify) hand washing in the hospital







How to Handrub?

Cohen Group & Meyer
Gift Card
\$10



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

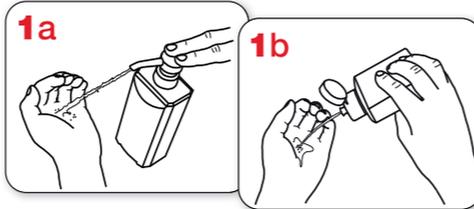
This is the first step from the stancard hand washing process from WHO; however, it seems like you may need to prolong the curat on of hand washing.

Standard Procedure

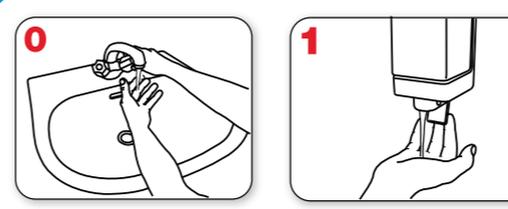


How to handrub? WITH ALCOHOL-BASED FORMULATION

How to handwash? WITH SOAP AND WATER

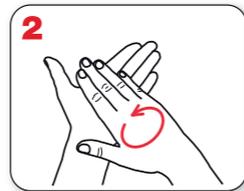


Apply a palmful of the product in a cupped hand and cover all surfaces.

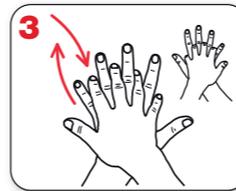


Wet hands with water

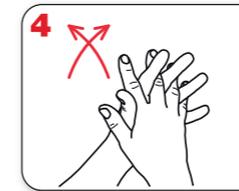
apply enough soap to cover all hand surfaces.



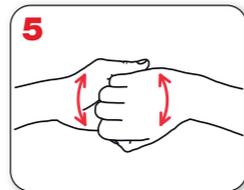
Rub hands palm to palm



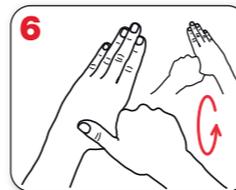
right palm over left dorsum with interlaced fingers and vice versa



palm to palm with fingers interlaced



backs of fingers to opposing palms with fingers interlocked



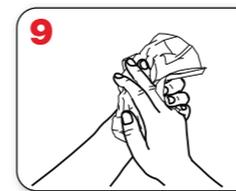
rotational rubbing of left thumb clasped in right palm and vice versa



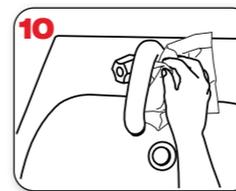
rotational rubbing, backwards and forwards with clasped fingers of right hand in left palm and vice versa



rinse hands with water



dry thoroughly with a single use towel



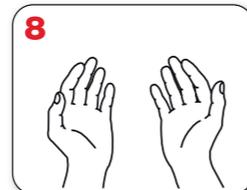
use towel to turn off faucet



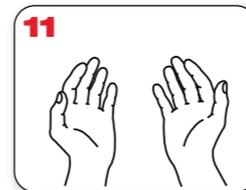
20-30 sec



40-60 sec

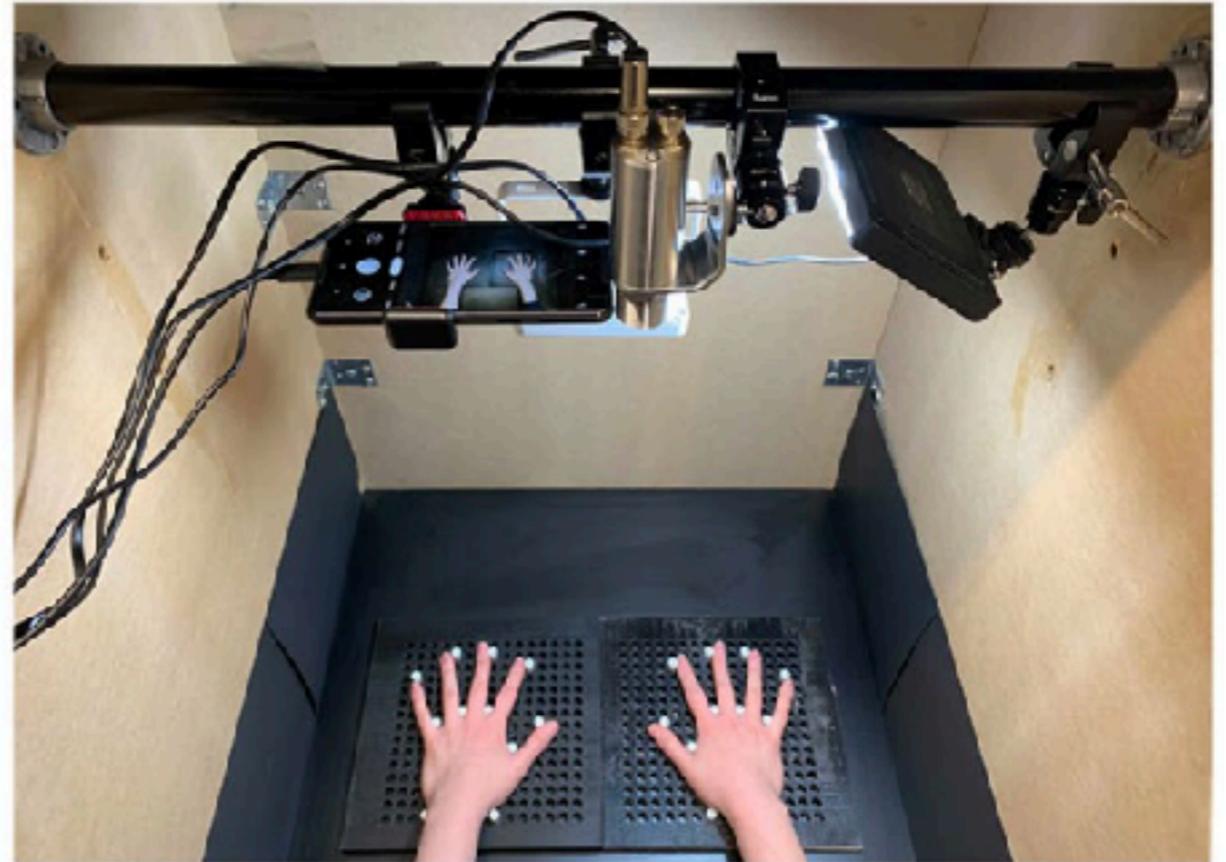
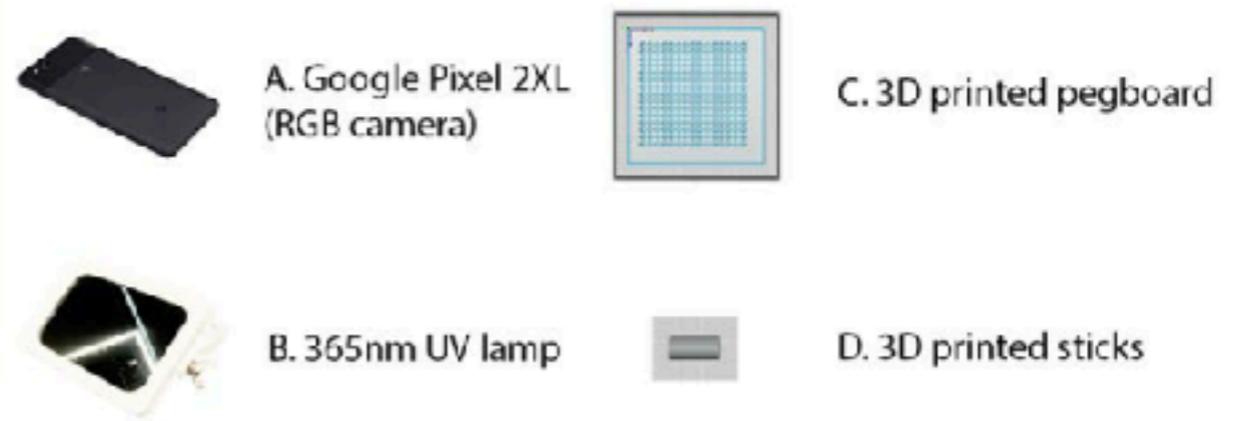
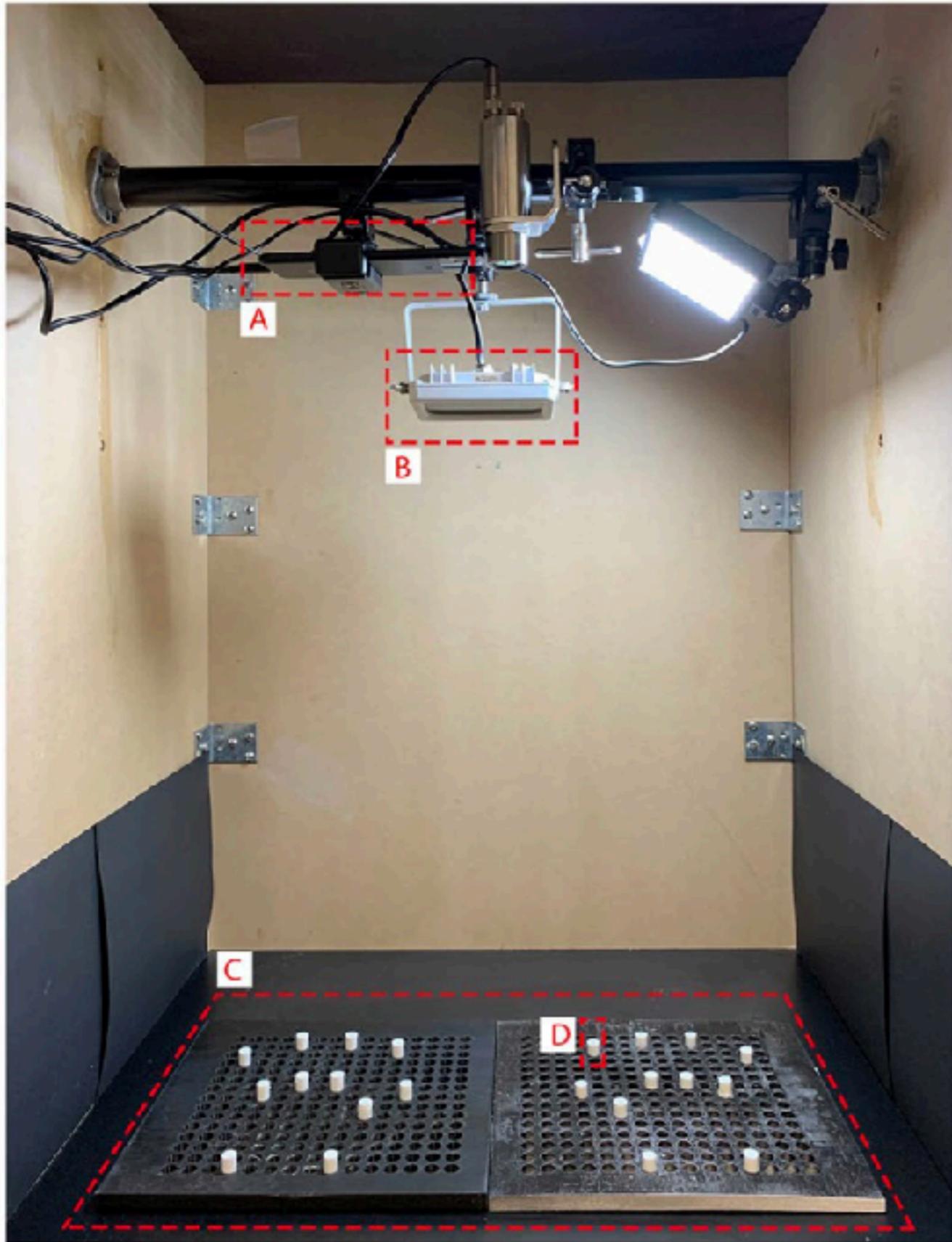


...once dry, your hands are safe.



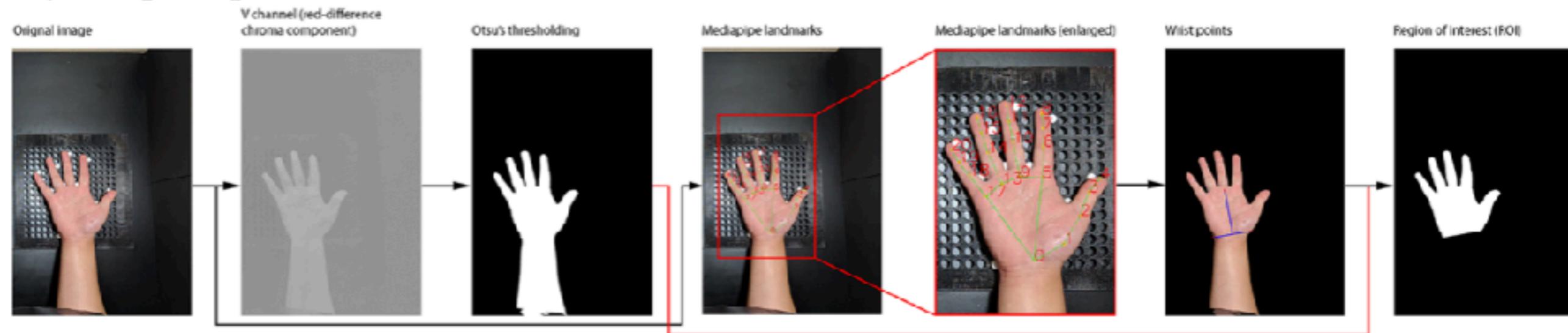
...and your hands are safe.

Design: monofragilis network

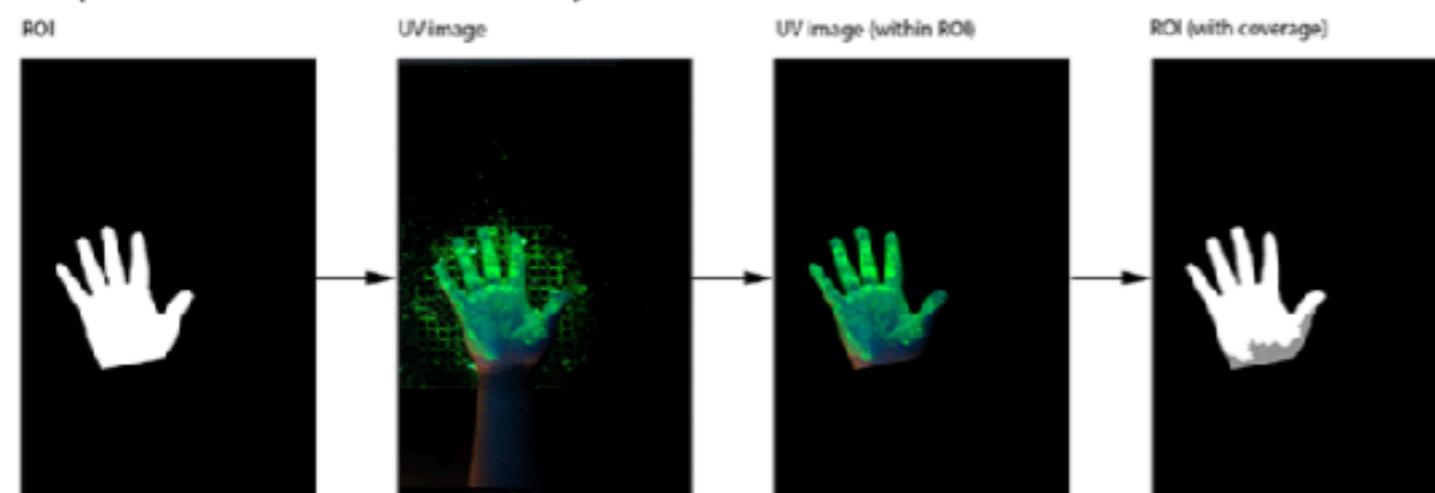


Device setup during experiment

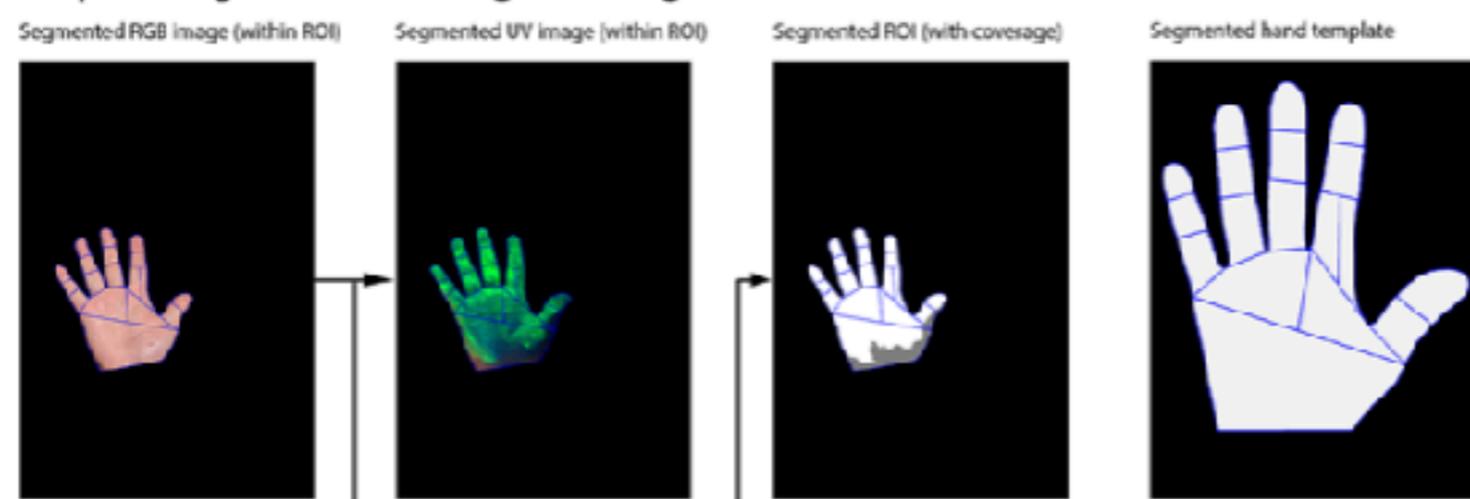
Step 1: recognize region of interest (hand)



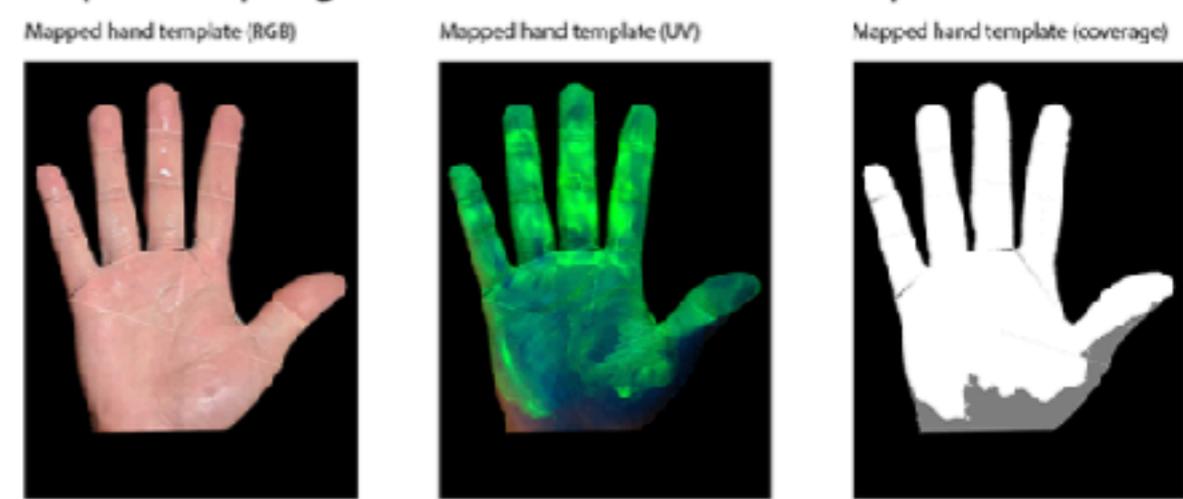
Step 2: extract areas covered by fluorescent handrub



Step 3a: segment the recognized regions



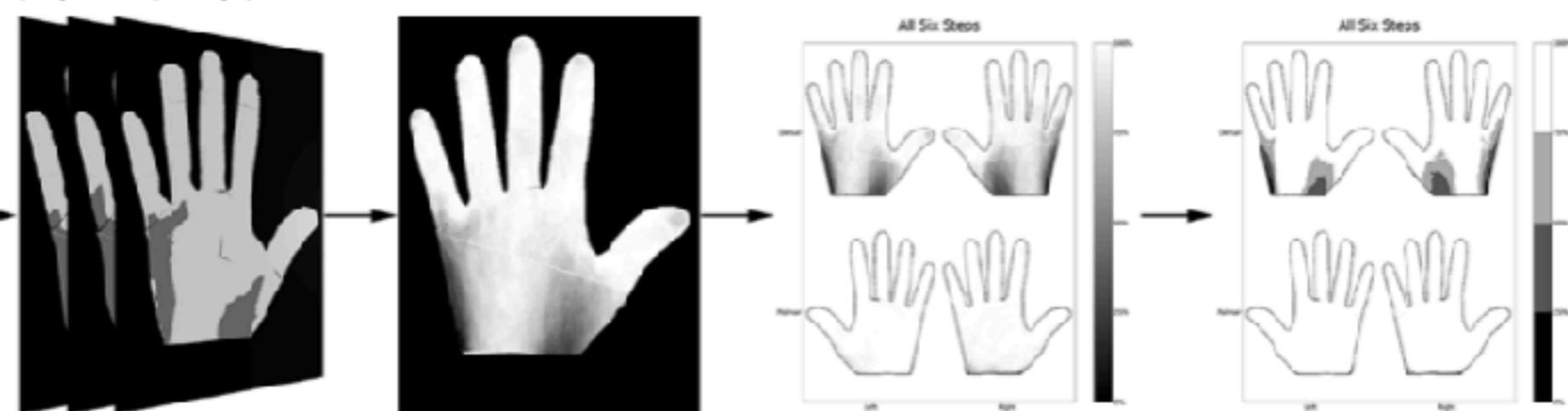
Step 3b: map segments into standard hand templates



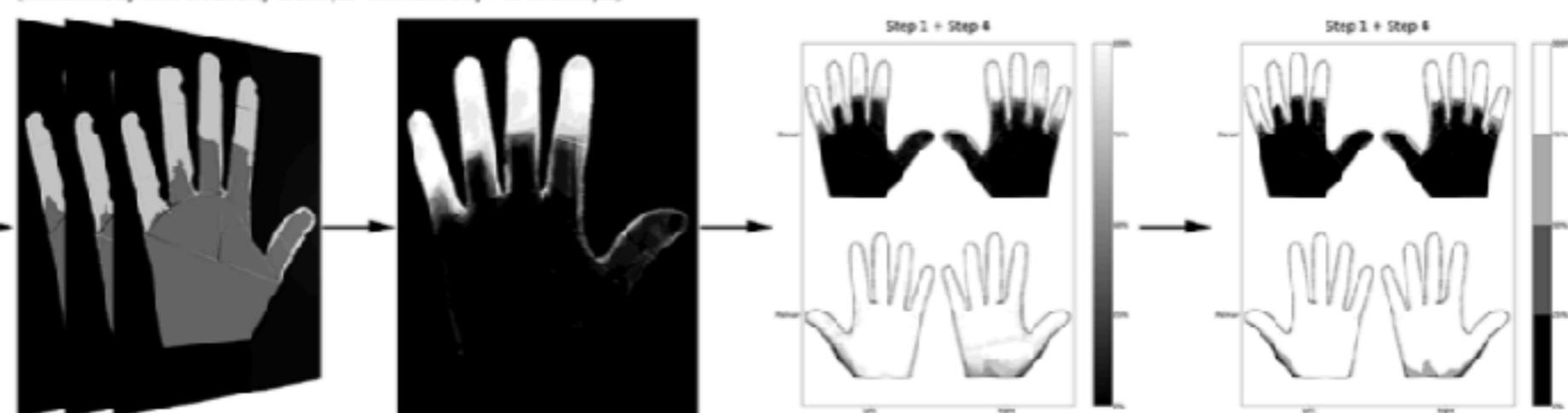
Step 4: aggregate hand templates (to summarize skin coverage)

Mapped hand templates (coverage) Aggregated hand template Summarized hand template (coverage) Summarized hand template (with threshold)

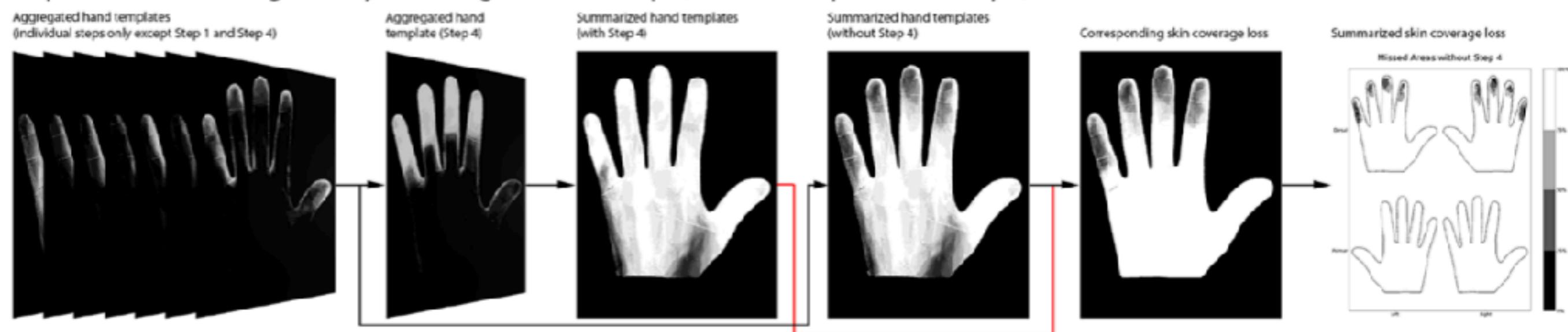
(Complete six-step technique)

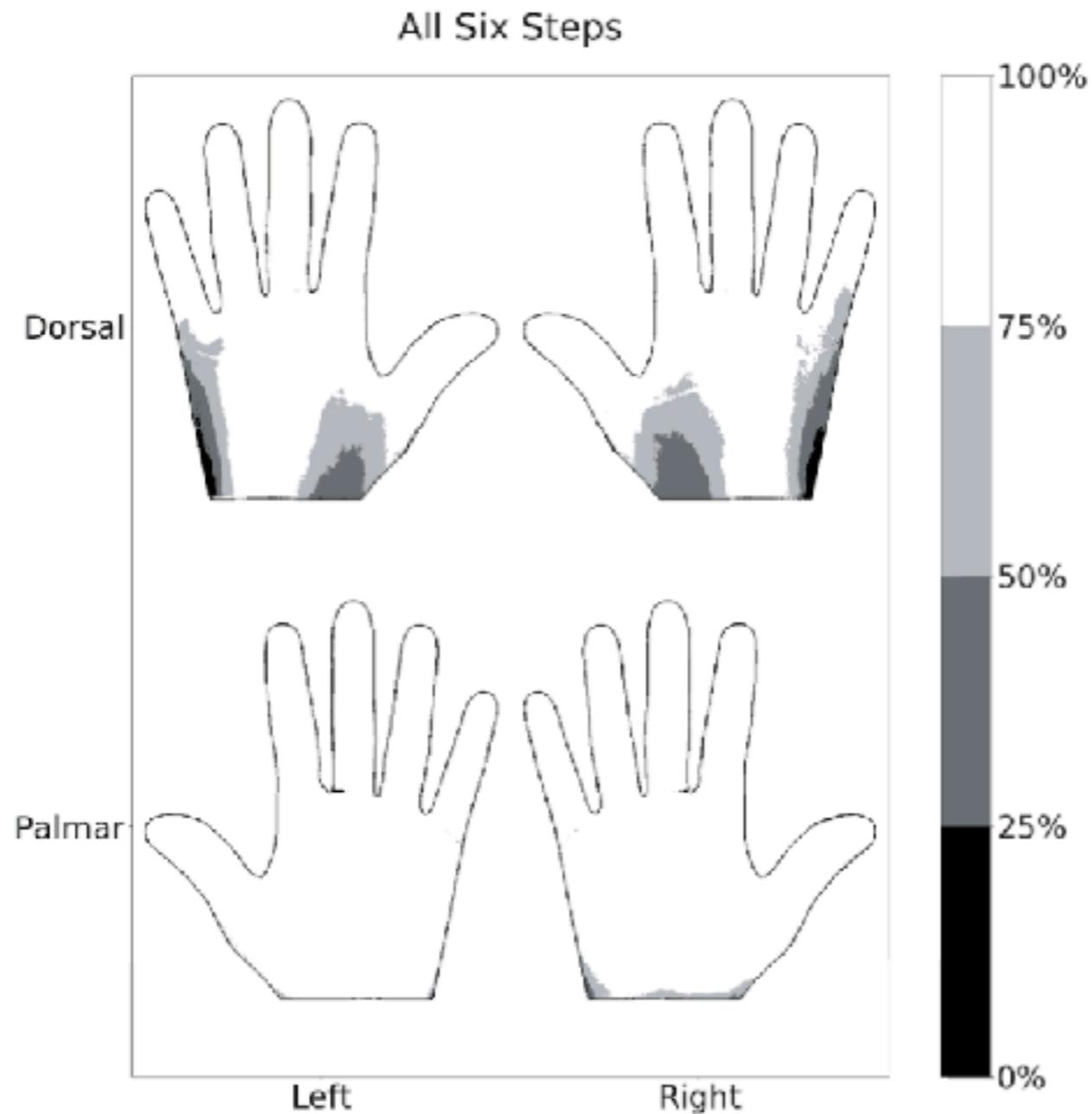


(Individual step from the six-step technique - individual step 4 as an example)



Step 5: visualize coverage loss by excluding individual steps (individual step 4 as an example)





We can exclude steps 3 & 6
We need a new step

Wang et al. 2022. A System for Computational Assessment of Hand Hygiene Techniques. Journal of Medical Systems, vol. 46, article 32, 12 pages.



Wang et al. 2023. Using Thermal Imaging to Measure Hand Hygiene Quality. The Journal of Hospital Infection, vol. 139, pp. 113-120.

Figure 1. Examples of the MedTasker mobile app interface [18]. Names and task details are fictional.

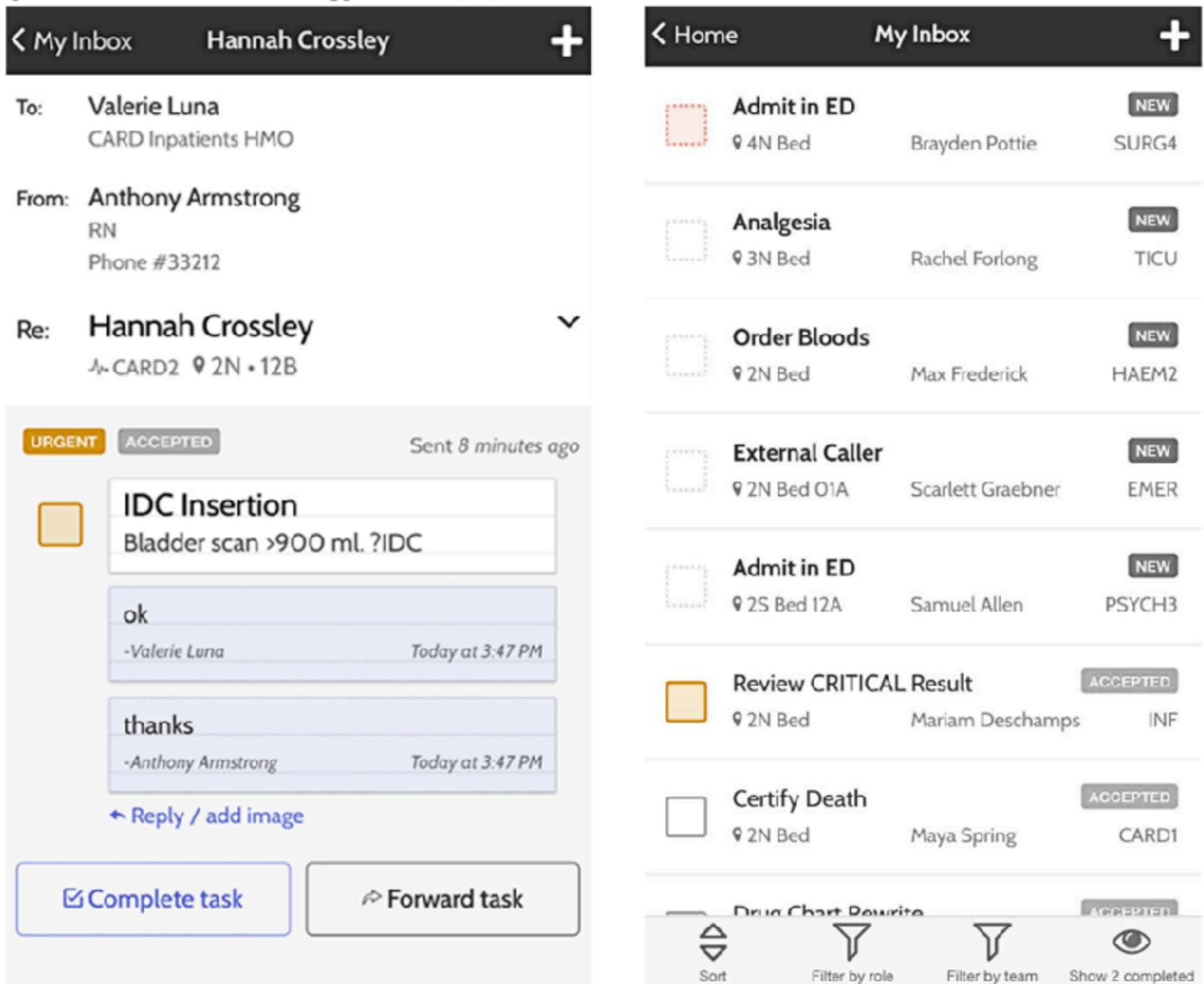


Figure 3. Task acceptance (A) and completion (B) throughout the day.

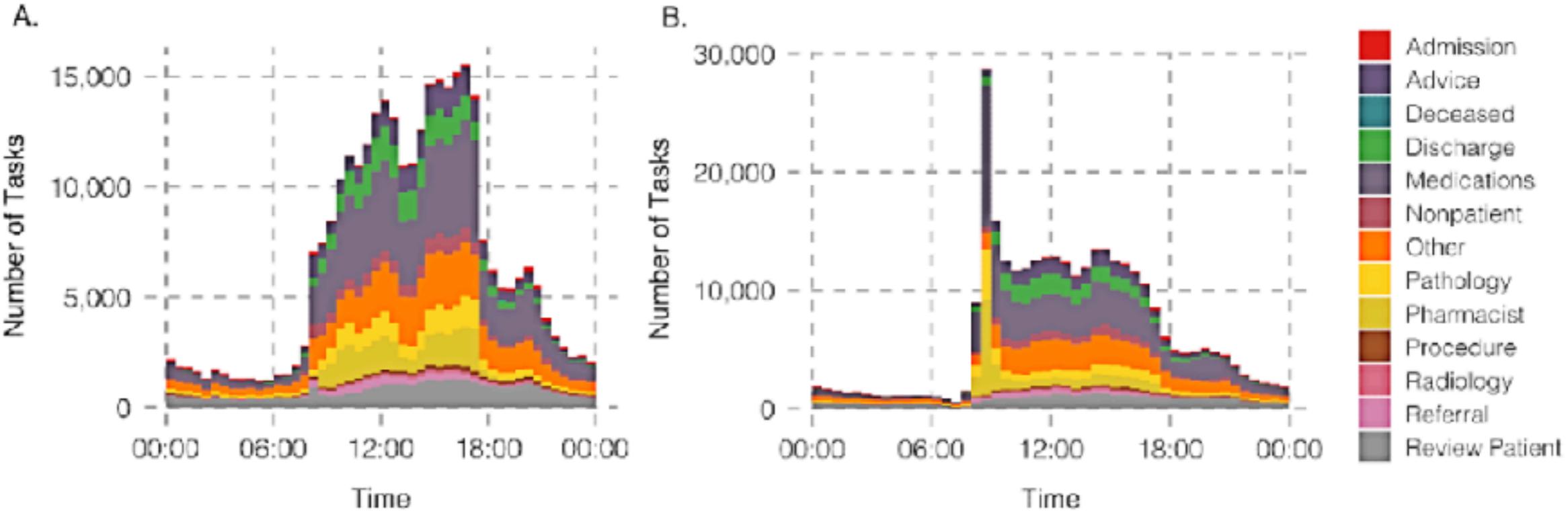
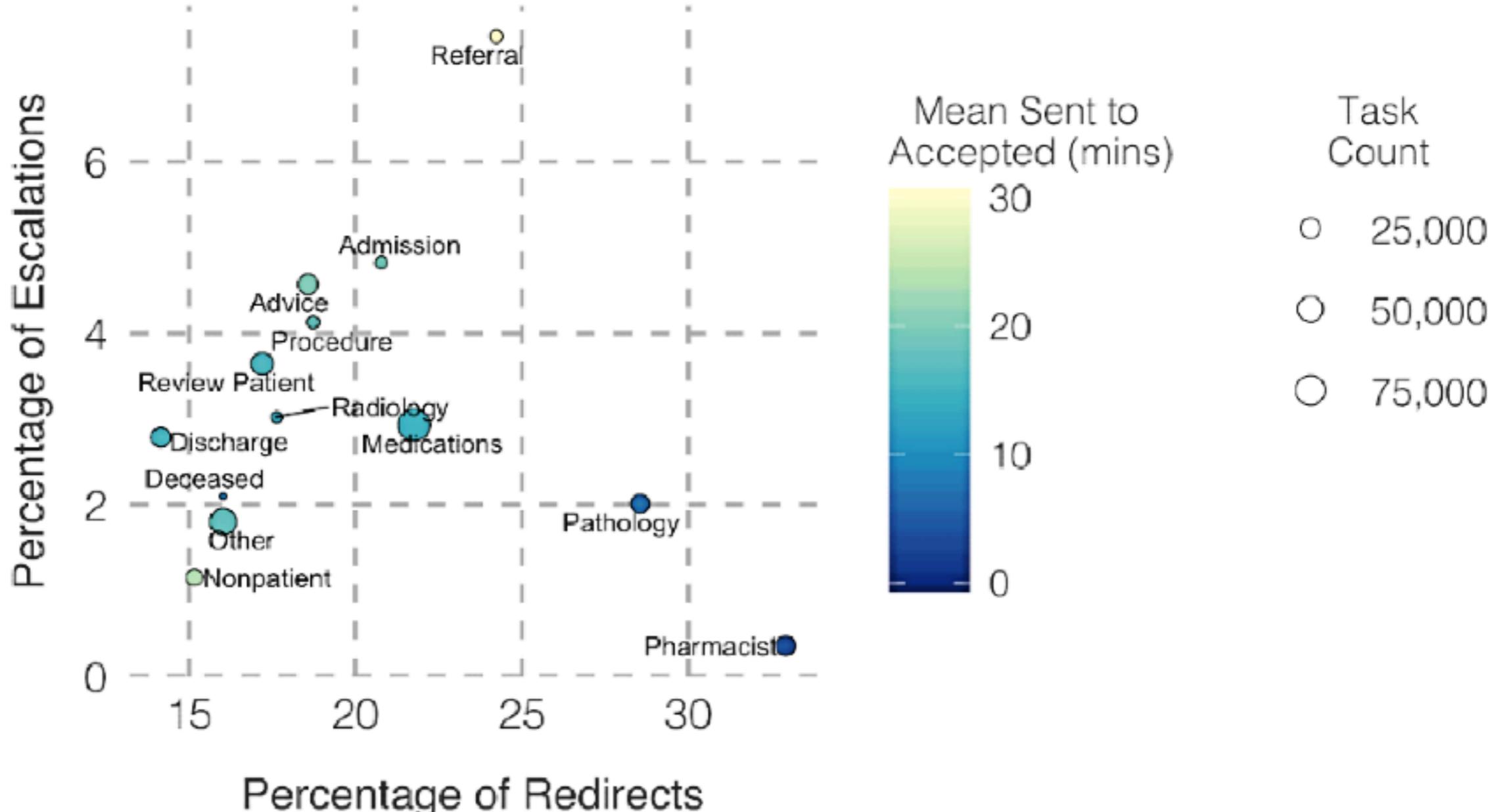
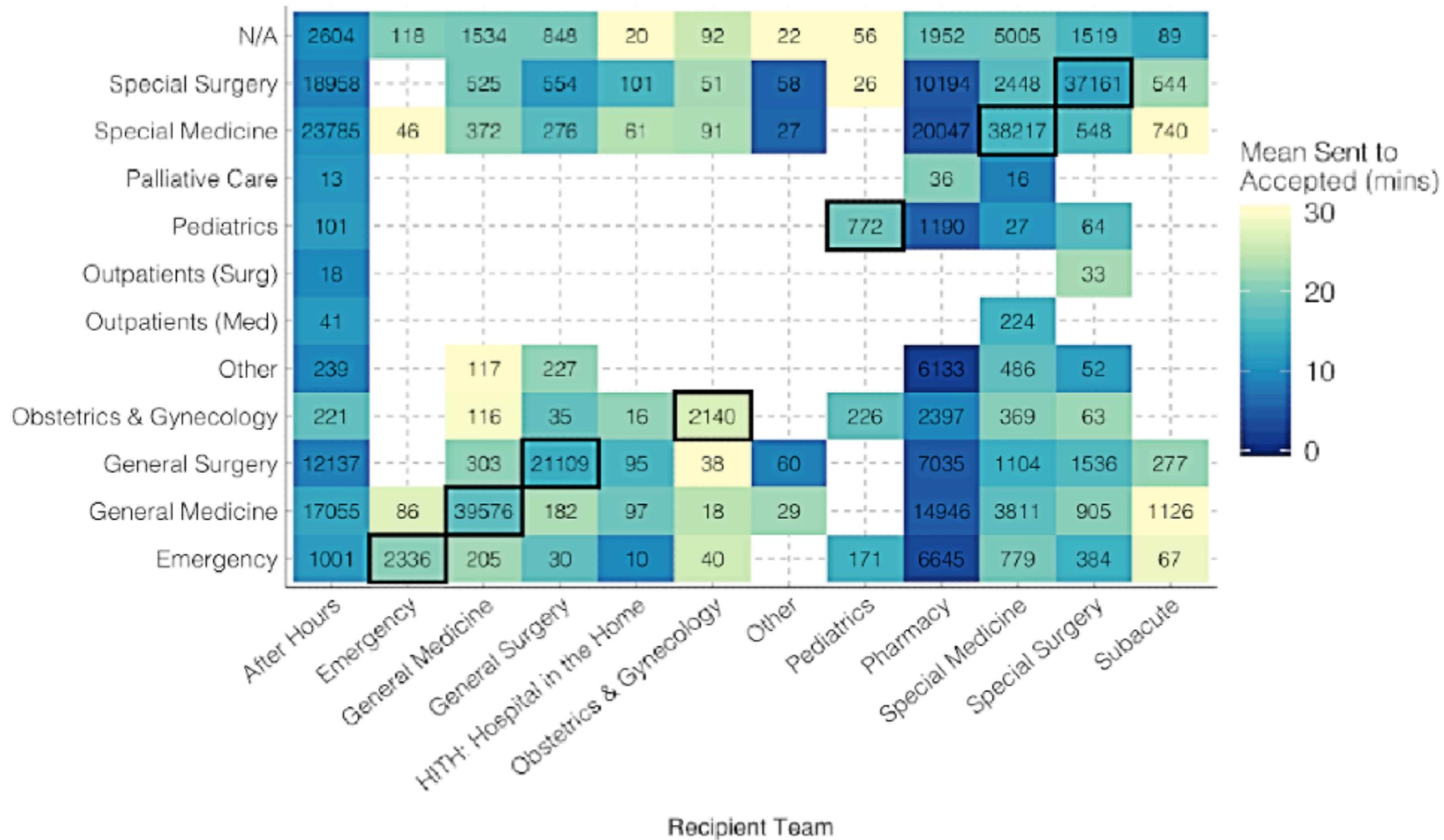


Figure 5. Task count, redirects, escalations, and mean sent-to-accepted time for different task types.



Patient Team



Hettiachchi et al. 2021. Team Dynamics in Hospital Workflows: An Exploratory Study of a Smartphone Task Manager. JMIR Medical Informatics, vol. 9, no. 8, article e28245, 9 pages

What have we been up to?

Large Language Models: empowering the study of human behaviour

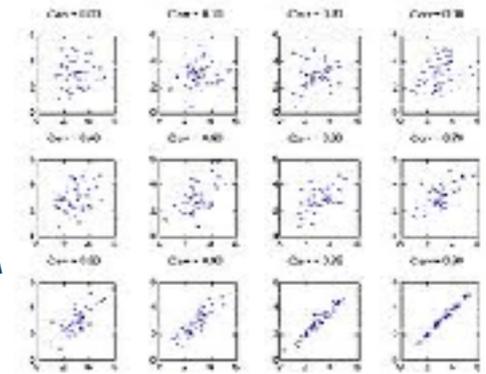


Measurement

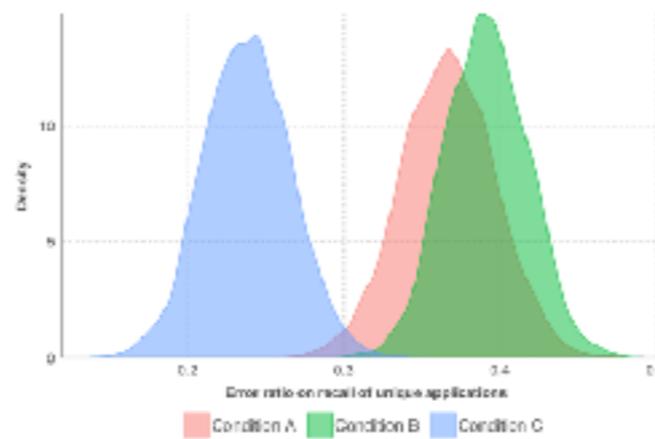
Phenomena



Sample data



Analysis/Statistics



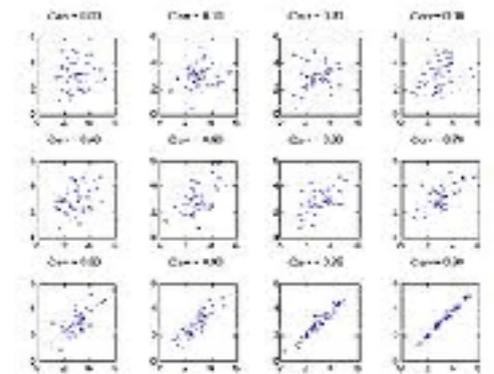
Modus operandi



Smartphone/Sensors



Calculate metrics



Establish correlations
Describe behaviour



Behaviour, attitudes,
questionnaires, etc.



Calculate metrics

Sources

Social Media

Smartphone use

Smart city

Hospital



Insights

Happiness

Personality

Habits

Performance

Lifestyle sensing





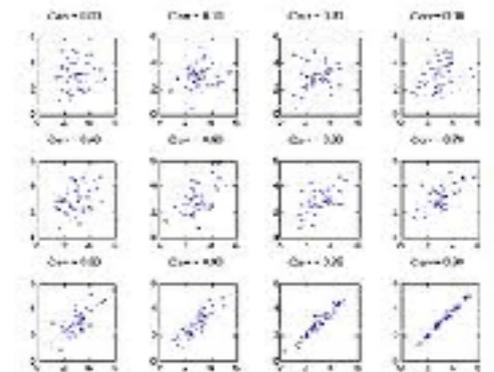
Modus operandi



Digital phenotype



Calculate metrics



Establish correlations
Prescribe treatment



Treatments



Calculate metrics

A.I. and Chatbots | Google's RT-2 Robot | Smart Ways to Use Chatbot

Courts and lawmakers are only beginning to sort out questions of ownership when it comes to A.I., and copyrights in music can be complicated as it is. For now, protected intellectual property can only be created by humans, but what about when musicians collaborate with the machines?

Eminem but with AI (i'm not r...)

Martin Clancy, a musician and the chair of a global committee that seeks to explore the ethics of A.I. in the arts, said the music industry was more organized than some other fields grappling with the rise of A.I.

Unlimited access to all of The Times.
Only A\$6.25 A\$0.50 a week for your first year.

Buckingham Palace, London...

Constitution Hill

See nearby attractions

Victoria Memorial
Not busy

Buckingham Palace
Home of British monarch & State Rooms

Spur Rd

Buckingham Palace
4.5 ★★★★★ (153,353)
Cultural landmark · ♿
Closed · Opens 9:30 am Thu

Directions Tickets Call

IMMERSIVE VIE...

| Word | Count |
|--------------|-------|
| relevant | 1070 |
| unit | 856 |
| teaching | 758 |
| lecturer | 689 |
| information | 642 |
| accounting | 535 |
| professional | 535 |
| academic | 535 |
| cyber | 535 |
| security | 535 |

**App: SEEK (Job-Finding)
(All Participants)**

| Word | Count |
|----------|-------|
| cal | 11348 |
| km | 7875 |
| distance | 5473 |
| set | 5057 |
| heart | 4995 |
| sleep | 4949 |
| hr | 4811 |
| fitbit | 4793 |
| rate | 4162 |
| 2023 | 4100 |

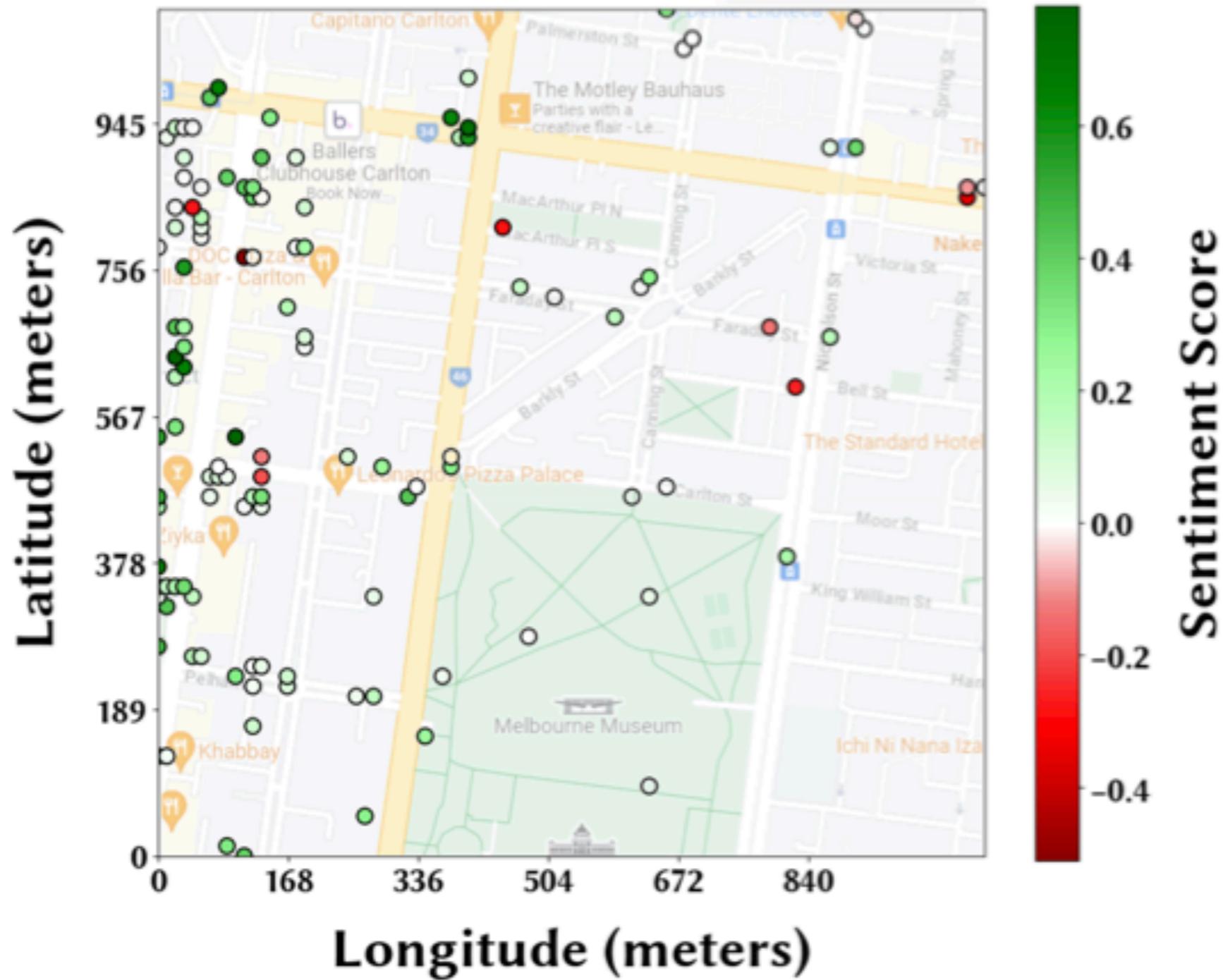
**Category: Health
(All Participants)**

| Word | Count |
|----------|-------|
| taylor | 3964 |
| swift | 3248 |
| version | 1832 |
| playlist | 1749 |
| red | 1628 |
| loving | 1174 |
| english | 980 |
| never | 927 |
| chou | 879 |
| g.e.m | 860 |

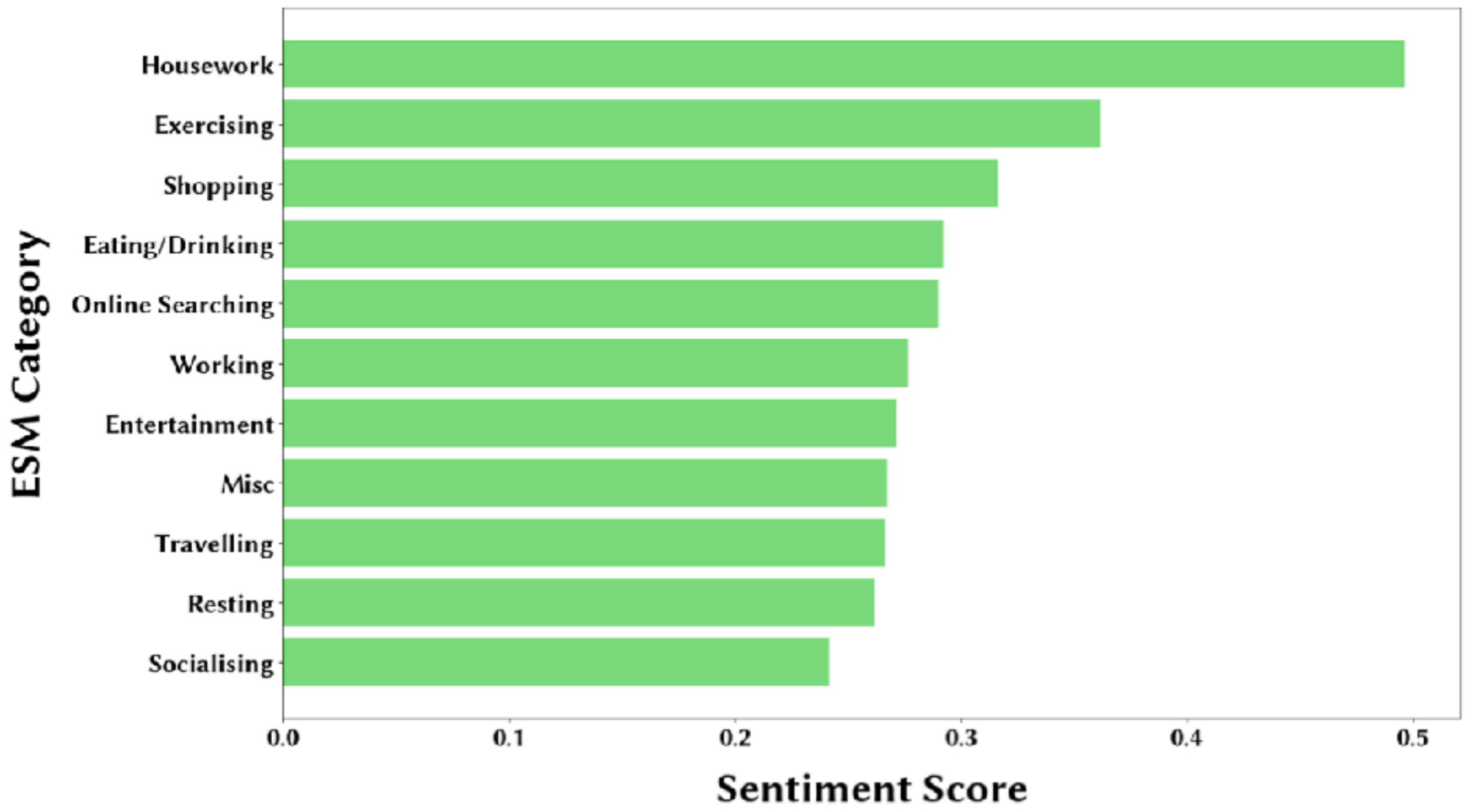
**App: Spotify (Music)
(P8)**

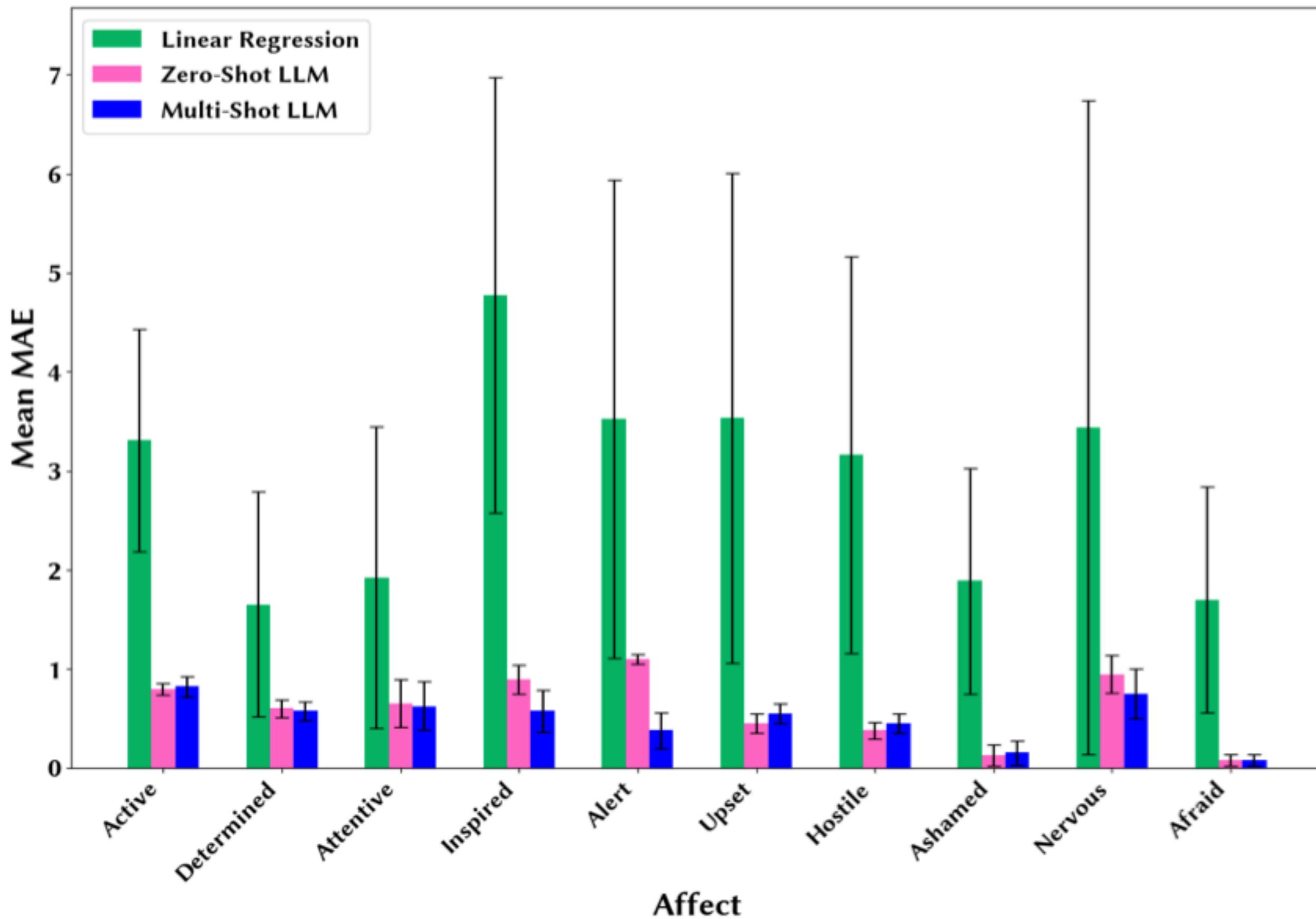
| Word | Count |
|------------|-------|
| foo | 3197 |
| fighters | 3197 |
| bon | 3031 |
| jovi | 3016 |
| led | 2490 |
| zeppelin | 2490 |
| remaster | 1747 |
| jukebox | 1594 |
| postmodern | 1592 |
| rock | 1346 |

**App: Spotify (Music)
(P11)**



(a) Average sentiment.





Here are the sentiments of text that a university student has viewed on their smartphone for each day over a week. The sentiments range from -1 to 1, with -1 being most Negative and 1 being most Positive.

Your task is to rate how the student felt for each of the following feelings based on the sentiments of the text they have viewed:

Active

Determined

Attentive

Inspired

Alert

Upset

Hostile

Ashamed

Nervous

Afraid

For each feeling, choose a Likert score ranging from 1 to 5 that best represents how the student generally felt during the week, where 1 represents Never and 5 represents Always.

Sentiments of text the student has viewed on their smartphone over a week:

Day 1: {sentiment of text viewed on the first day of the week}

Day 2: {sentiment of text viewed on the second day of the week}

Day 3: {sentiment of text viewed on the third day of the week}

Day 4: {sentiment of text viewed on the fourth day of the week}

Day 5: {sentiment of text viewed on the fifth day of the week}

Day 6: {sentiment of text viewed on the sixth day of the week}

Day 7: {sentiment of text viewed on the seventh day of the week}

When predicting information for a single week, only consider data from that

StudentSense - 150 students

- Deployment to 150 students
- Observe for a whole semester
- Most smartphone sensors
- A wide range of questionnaires

Ongoing work: Guardian Angel



User: “I want to loose weight”

...

Guardian Angel: “You should not add sausages to your shopping cart”

Ongoing work: Digital self



Observe user behavior

Answer questions on behalf of the user

“If the user took a mental health questionnaire now, what would they answer?”

“What was the most stressful part of the user’s day today?”

“Why did you not take your medication?”



LLM PERCEPTION
HUMAN REALITY



Concluding thoughts on what the future holds

- Will AI take our jobs?
 - Everyone I speak to says “AI will replace jobs, but not my job”
 - If a job can be done by reading and sending emails, it can be replaced
 - Robots will not take over the world
- Key limitations of LLMs
 - Cannot learn on the job
 - Cannot plan ahead very well
 - Very expensive (Tesla has spent \$10 - \$20 Billion on self-driving)
- New technology > ChatGPT
 - AI has run out of data, so how do we get better data?
 - How can hospitals generate better data?
 - How to help people/experts generate better data?
- In the future, there will likely be 2 kinds of jobs:
 - Those who tell a computer what to do
 - Those who are told by a computer what to do
 - In both cases, technology should be designed for humans

The ~~end~~

beginning!

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