Managing the Mental Health of the Armed Forces

The role of digital health technologies and personalised healthcare

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_Dr_Daniel

King's Centre for Military Health Research

- **Aim:** to produce high quality research which has a positive impact on the health & wellbeing of the armed forces community.
- **Multi-disciplinary team in:** computer science, psychiatry, epidemiology, military history, psychology, public health.
- Over 1000+ refereed articles published to-date on military health.
- Co-located with ADMMH (Academic Department of Military Mental Health) – composed of members of the British Armed Forces.

KCMHR

KING'S CENTRE FOR MILITARY HEALTH RESEARCH

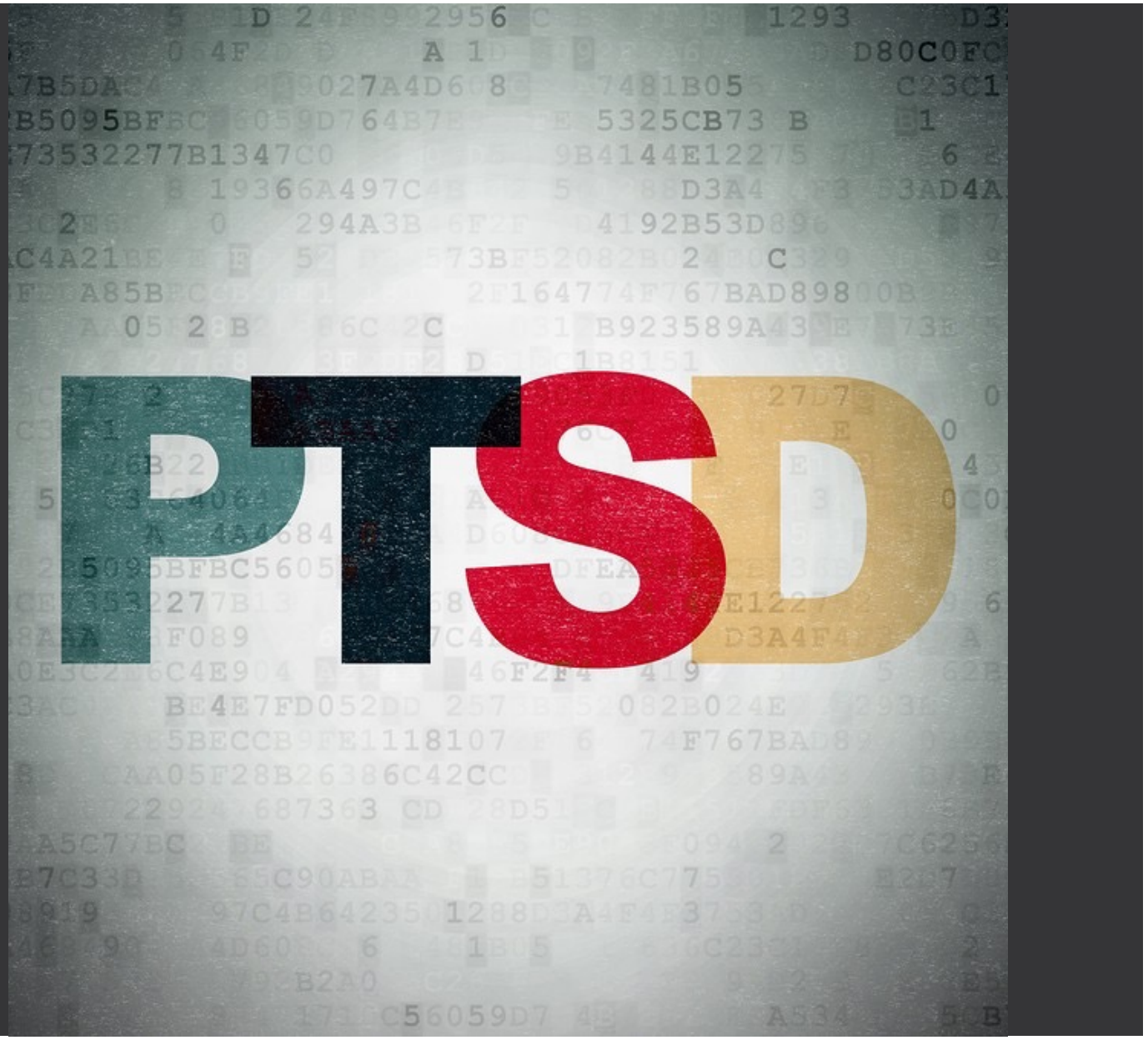
ADMMH

ACADEMIC DEPARTMENT OF MILITARY MENTAL HEALTH

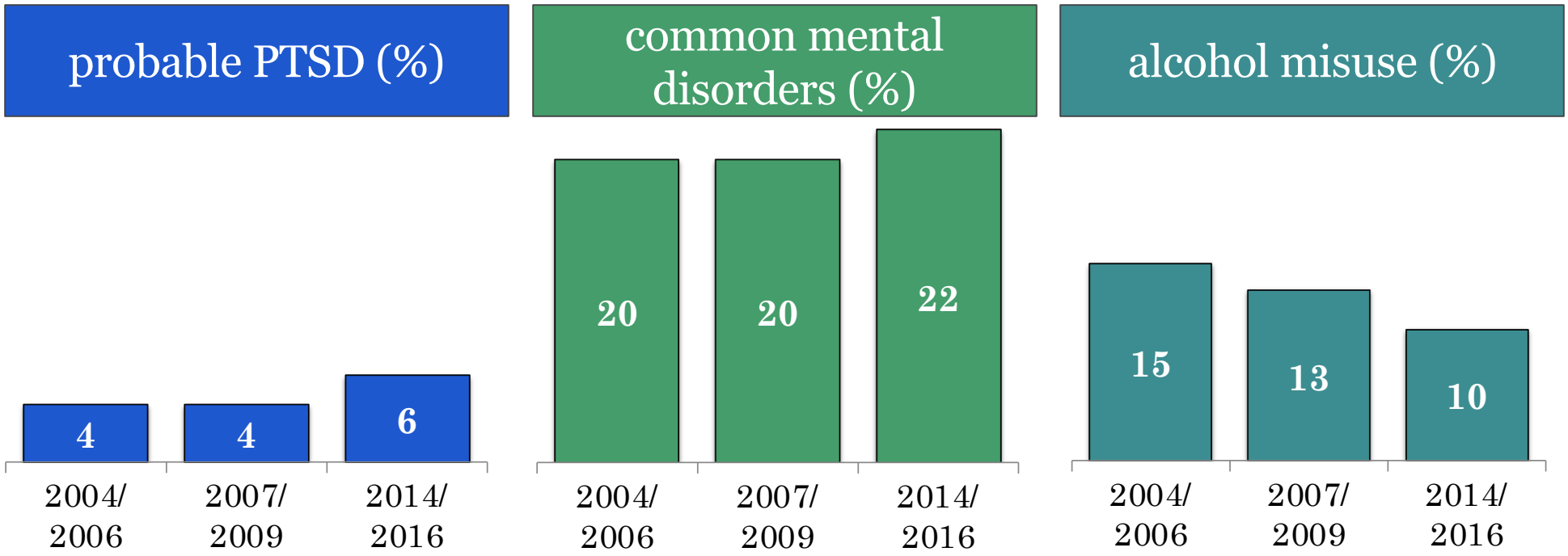
Established in 2003

thewarriorprogramme
HIGH GROUND
Anglia Ruskin University
Ministry of Justice
E·S·R·C ECONOMIC & SOCIAL RESEARCH COUNCIL
NatCen Social Research that works for society
THE ROYAL BRITISH LEGION
Ulster University
Greenwich Hospital
Imperial College London
Ipsos
UNIVERSITY OF OXFORD
UNIVERSITY OF ABERDEEN
RC PSYCH ROYAL COLLEGE OF PSYCHIATRISTS
FiMT forces in mind trust SUCCESSFUL SUSTAINABLE TRANSITION
HELP for HEROES Support for our Wounded
The BRITISH FORCES FOUNDATION
OXFORD BROOKES UNIVERSITY
Blind Veterans UK
COMBAT STRESS THE VETERANS' MENTAL HEALTH CHARITY
Department of Health
Ministry of Defence
MRC Medical Research Council
aff
CIMVHR Canadian Institute for Military and Veteran Health Research
ICRSMV L'Institut canadien de recherche sur la santé des militaires et des vétérans
ROBERT GORDON UNIVERSITY ABERDEEN
NHS England

Identifying probable PTSD using machine learning



PTSD compared to other disorders



The prevalence of alcohol misuse has decreased from 2004/06, whereas the prevalence of PTSD has increased from 4% to 6%

See **Stevelink *et.al.*** Mental health outcomes at the end of the British involvement in the Iraq and Afghanistan conflicts: a cohort study: The British Journal of Psychiatry (2018) 213, 690–697. doi: 10.1192/bjp.2018.175

Machine learning as an aid…*for now*

- The risks:
  - **Perception**: Deep Mind and Greenwich hospital
  - **Understanding**: ‘Black box’
  - **Accountability**: ‘Blame’
  - **Human factor**: ‘Loss of jobs’

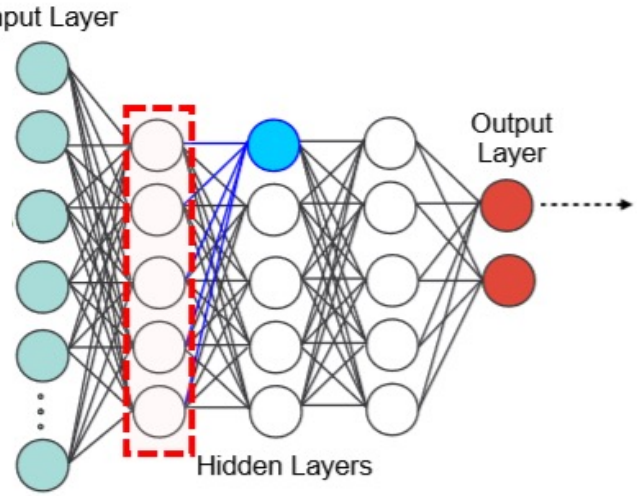
Work on-going to mitigate these risks

Approach

Leightley *et al*. Identifying probable Post-Traumatic Stress Disorder: Applying supervised machine learning to data from a UK military cohort. Journal of Mental Health. 2018.

80% retained for training

20% used for testing



Prediction
Induction of probable PTSD
No indication PTSD

Self-report questionnaire data

13,690 completed PCL-C
22 variables

Classical machine learning
Support Vector Machines
Random Forests
Artificial Neural Network
Bagging

Features contributing to a prediction

Approach

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80% retained for training

20% used for testing

Classifier	Accuracy	Sensitivity	Specificity	MCC
Support Vector Machines	0.91	0.70	0.92	0.74
Random Forests	0.97	0.60	0.98	0.64
Artificial Neural Networks	0.89	0.61	0.92	0.45
Bagging	0.95	0.69	0.96	0.55

13,690 completed PCL-C

Support Vector Machines
Random Forests
Artificial Neural Network
Bagging

Approach

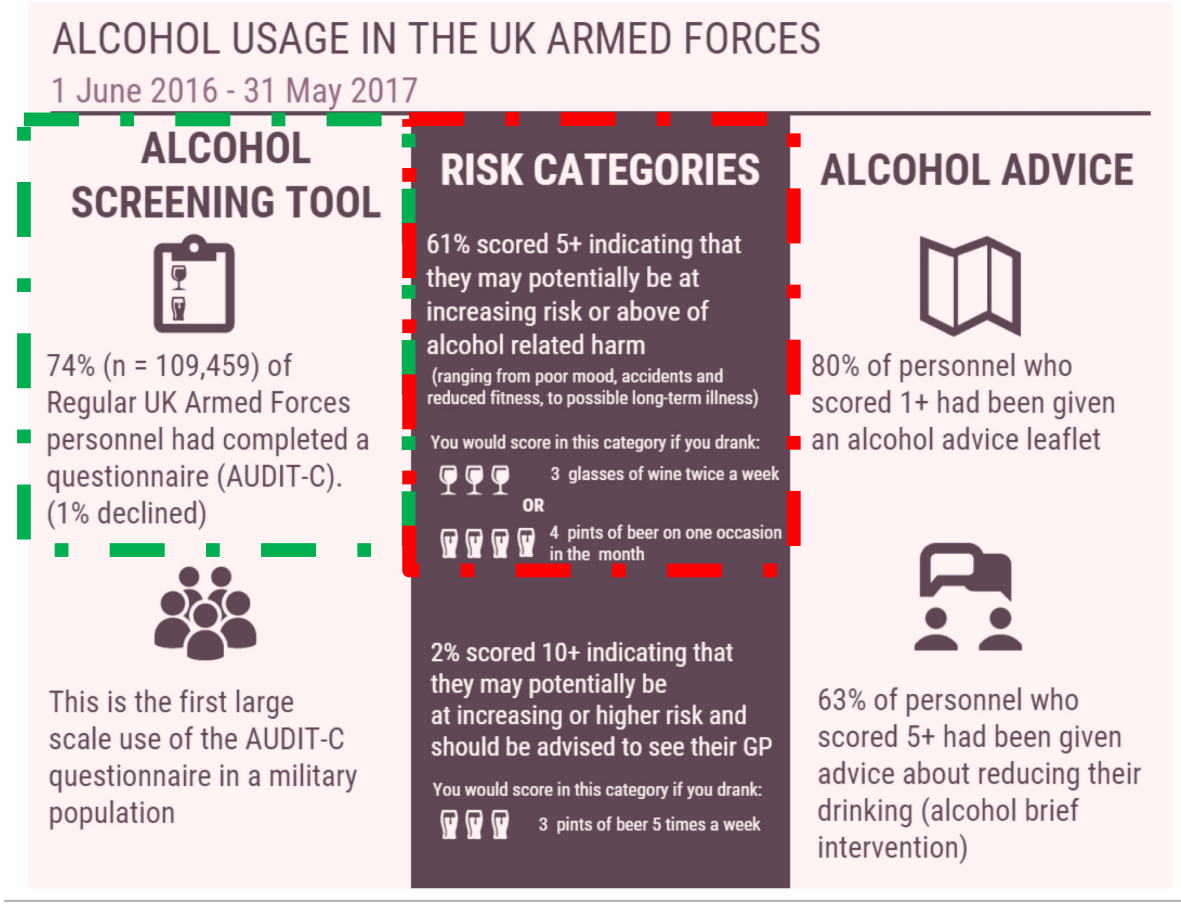
Leightley *et al*. Identifying probable Post-Traumatic Stress Disorder: Applying supervised machine learning to data from a UK military cohort. Journal of Mental Health. 2018.

Machine learning analysis is helping us to determine WHICH variables are most important

Classifier	Rank 1	Rank 2	Rank 3	Rank 4
Support Vector Machines	AUDIT Score	GHQ-12 score	Age (years)	Consumes alcohol (y/n)
Random Forests	Gender	AUDIT Score	GHQ-12 score	Service type
Artificial Neural Networks	GHQ-12 score	AUDIT case (y/n)	AUDIT Score	Consumes alcohol (y/n)
Bagging	Age	Consumes alcohol (y/n)	Smoking	GHQ-12 score

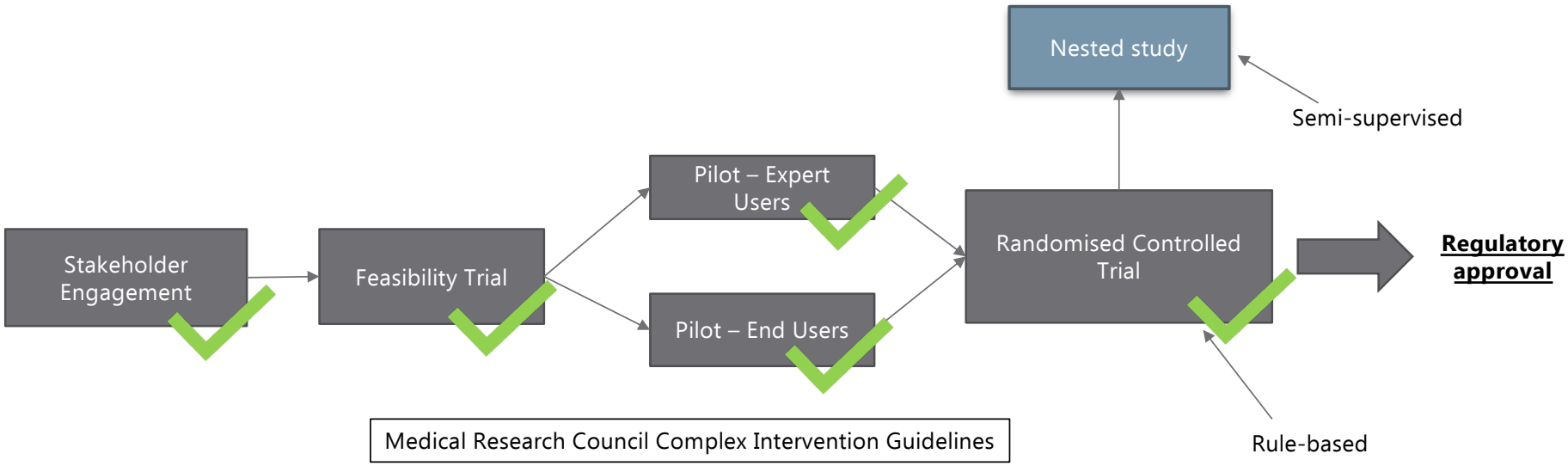
Guyon, I., & Elisseeff, A. (2003). An Introduction to Variable and Feature Selection. Journal of Machine Learning Research, *3*, 1157–1182

Drinks:**Ration** - an Android and iOS app for Armed Forces personnel
FEEL BETTER AND SAVE MONEY
BY DRINKING LESS ALCOHOL



Is there a problem with drinking in the UK military?

The story so far…

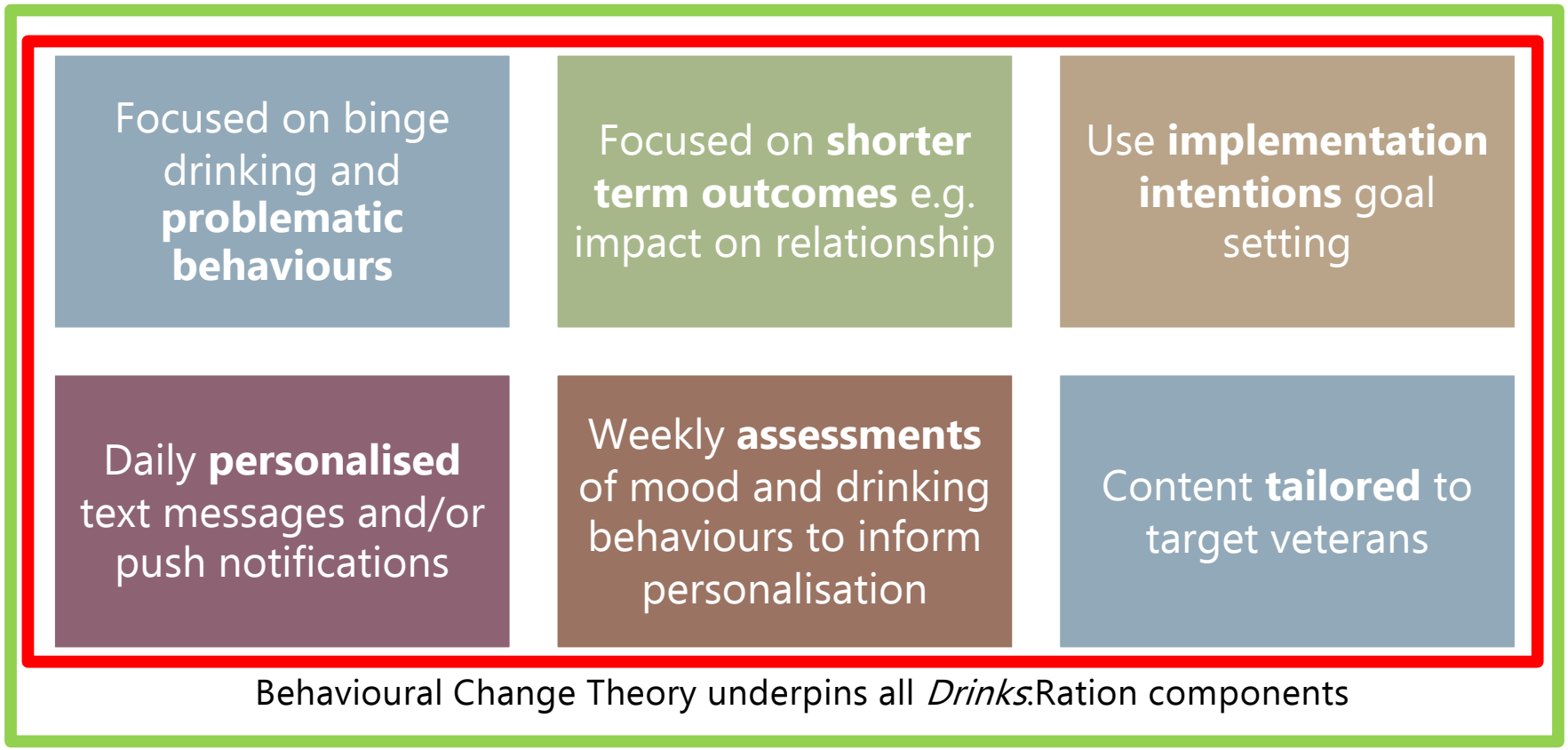


Evaluating the efficacy of a mobile app (Drinks:Ration) to reduce alcohol consumption in a help-seeking military veteran population: Randomised Controlled Trial. Daniel Leightley, Charlotte Williamson, Roberto Rona, Ewan Carr, James Shearer, Jordan D. Davis, Amos Simms, Nicola T. Fear, Laura Goodwin and Dominic Murphy. *Journal of Internet Medical Research: mHealth & uHealth*, 2022.

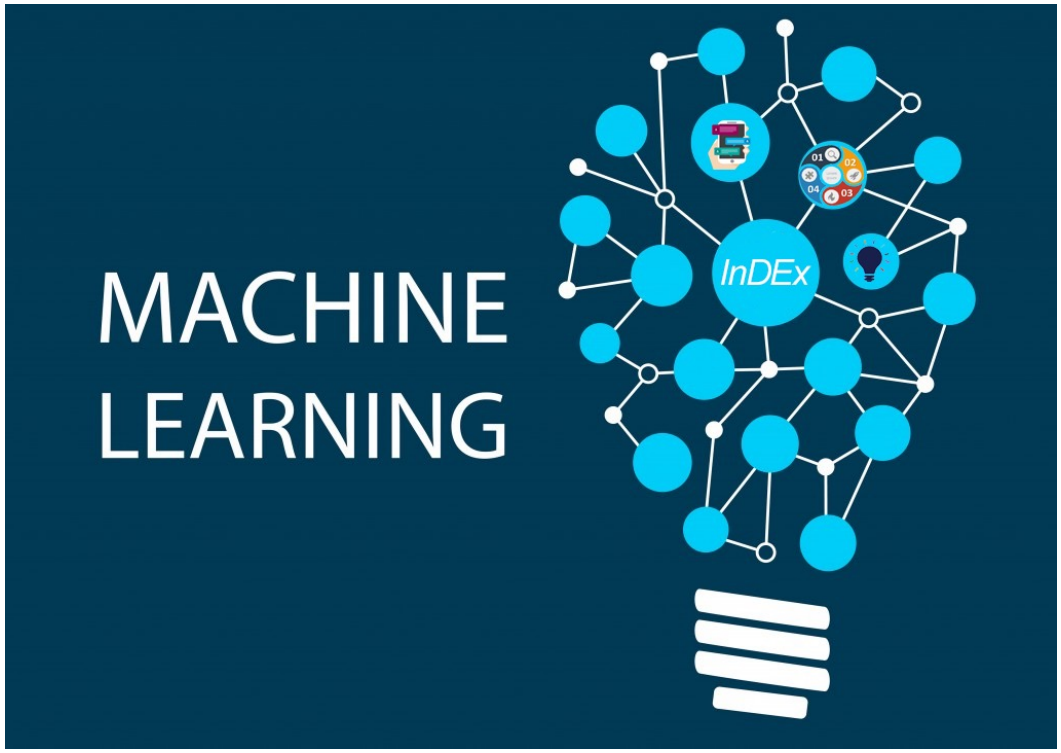
A Qualitative Evaluation of the Acceptability of a Tailored Smartphone Alcohol Intervention for a Military Population: Information About Drinking for Ex-Serving Personnel (InDEx) App. Jo-Anne Puddephatt, Daniel Leightley, Laura Palmer, Norman Jones, Toktam Mahmoodi, Colin Drummond, Roberto Rona, Nicola T Fear, Matt Field and Laura Goodwin. *Journal of Internet Medical Research: mHealth & uHealth*, 2019.

A Smartphone App and Personalized Text Messaging Framework (*InDEx*) to Monitor and Reduce Alcohol Use in Ex-Serving Personnel: Development and Feasibility Study. Daniel Leightley, Jo-Anne Puddephatt, Norman Jones, Toktam Mahmoodi, Zoe Chui, Matt Field, Colin Drummond, Roberto J. Rona, Nicola T Fear and Laura Goodwin. *Journal of Internet Medical Research: mHealth & uHealth*, 2018.

How is *Drinks*:Ration different to others?



Machine Learning (semi-supervised)

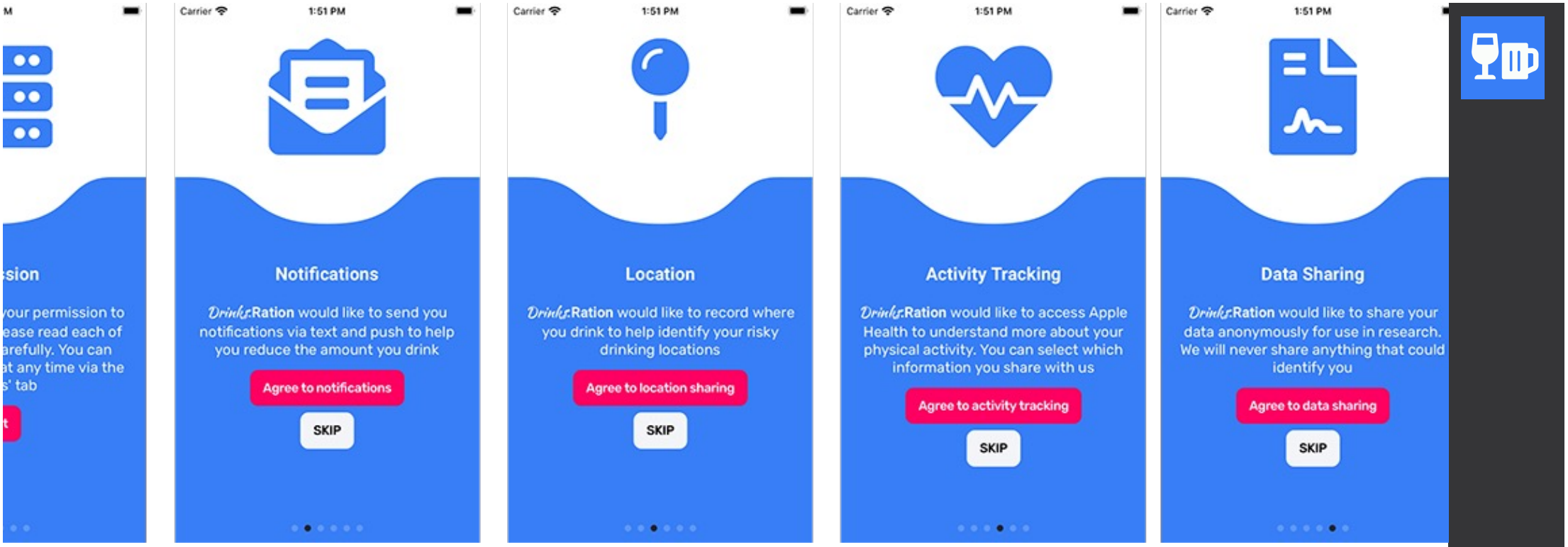


- User behaviours (insights)
- Stage transition (progress)
- Messaging (adherence)

Note: Users do not directly interface with *MLaaS*

Data problem: user persona data (synthetic)

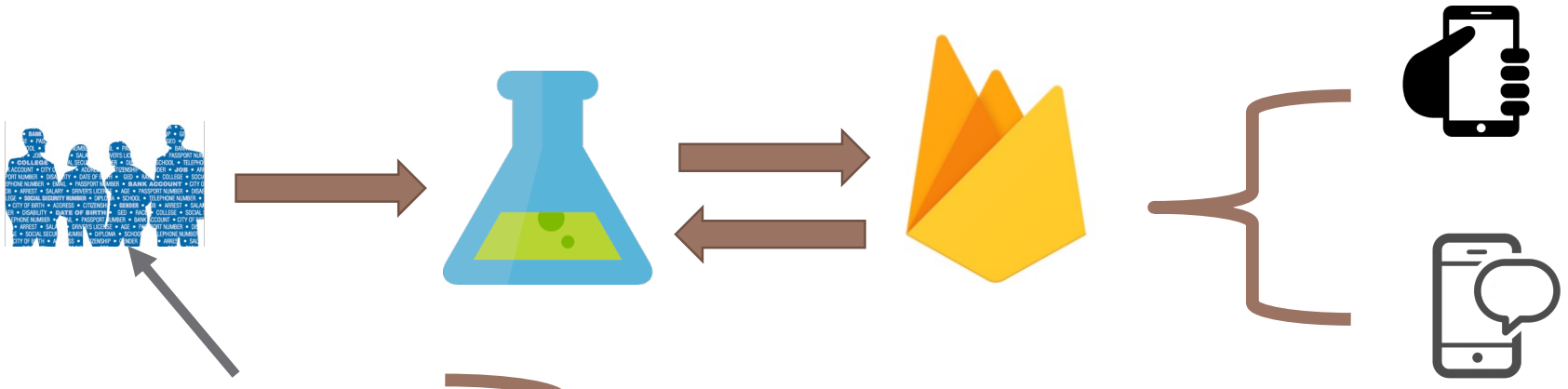
Signal problem: what is ‘meaningful’



DrinksRation Data

- Socio-demographics
- Self-reported mental and physical health (weekly)
- Drinking behavior (location, time, type)
- Goals (and barriers to goals)
- Physical activity (Google Fit/Apple Health)
- Notification interactions
- App usage

Personalising the ‘message’

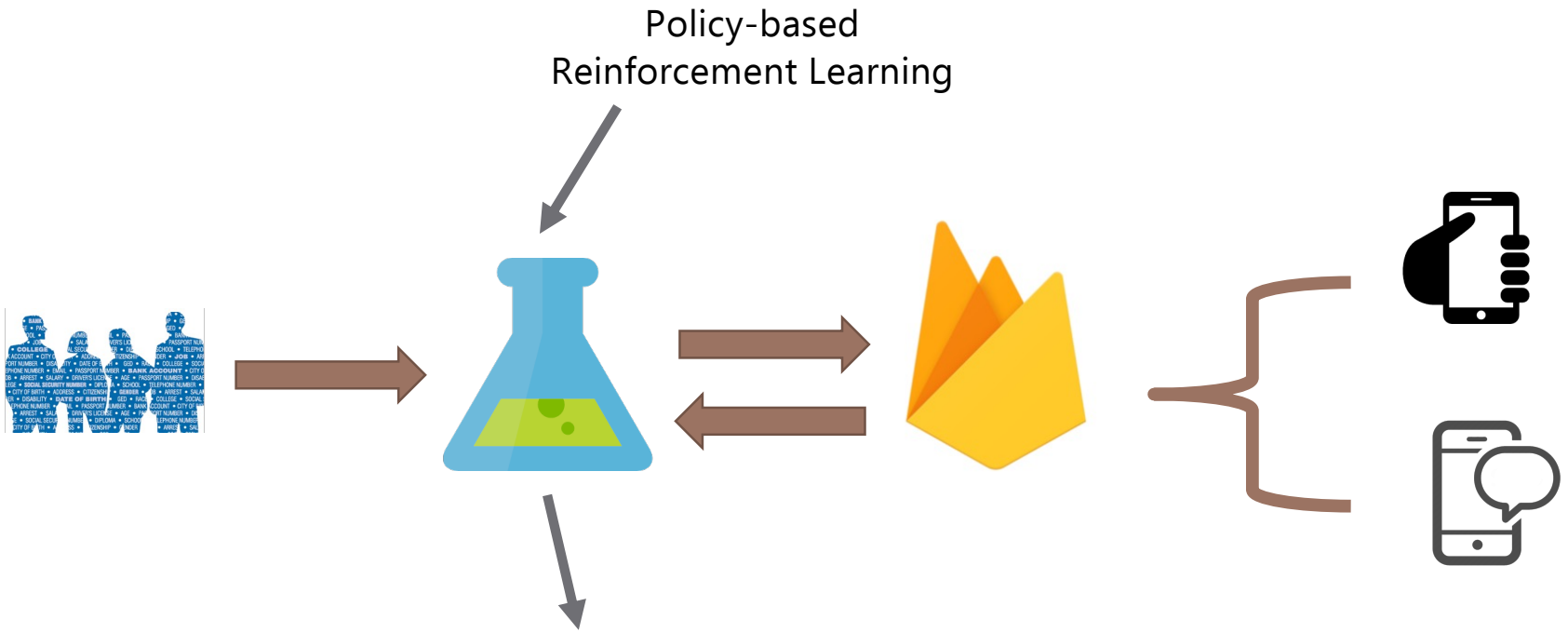


***InDEx* (v1) + Cohort**

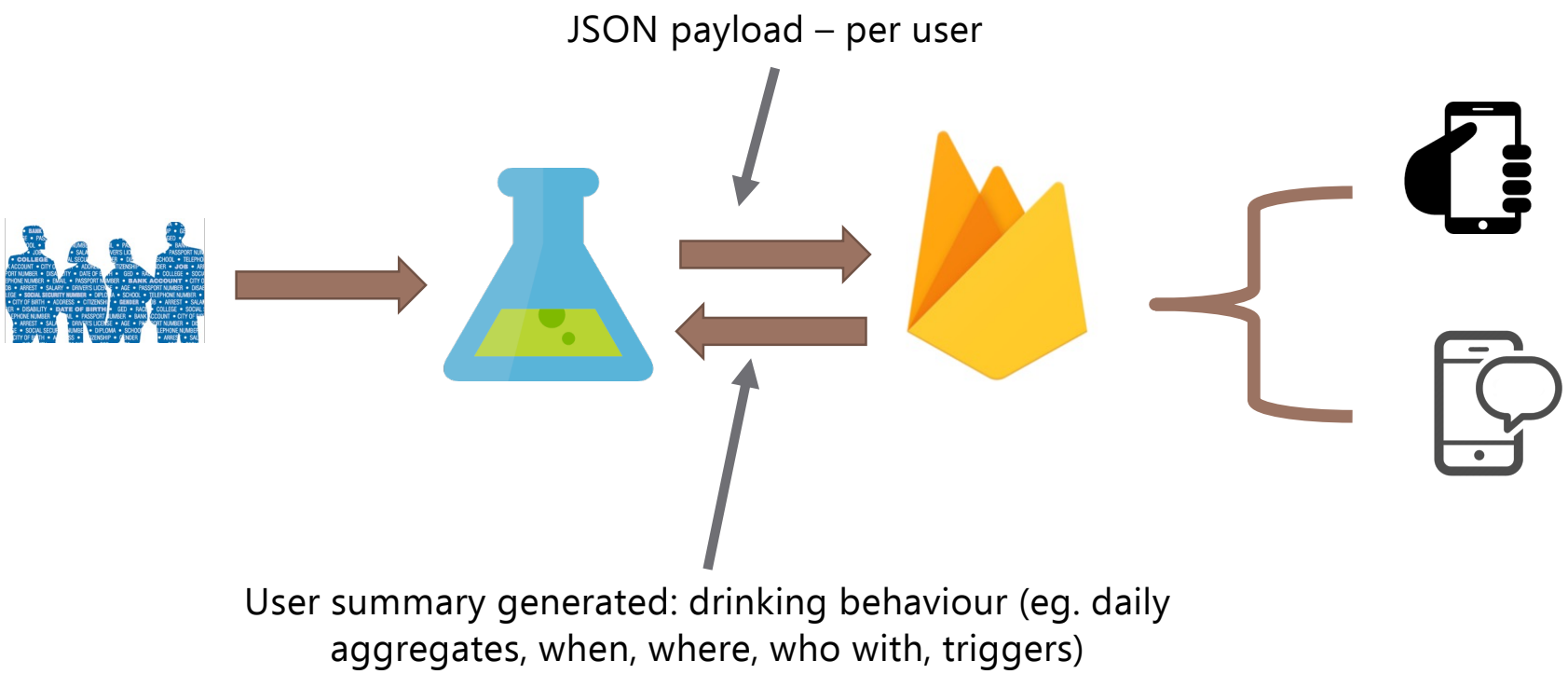
- Socio-demographic
- Alcohol-use
- Mental health
- Alcohol behaviours
- Message impact

Feature selection (predictive performance to outcome)

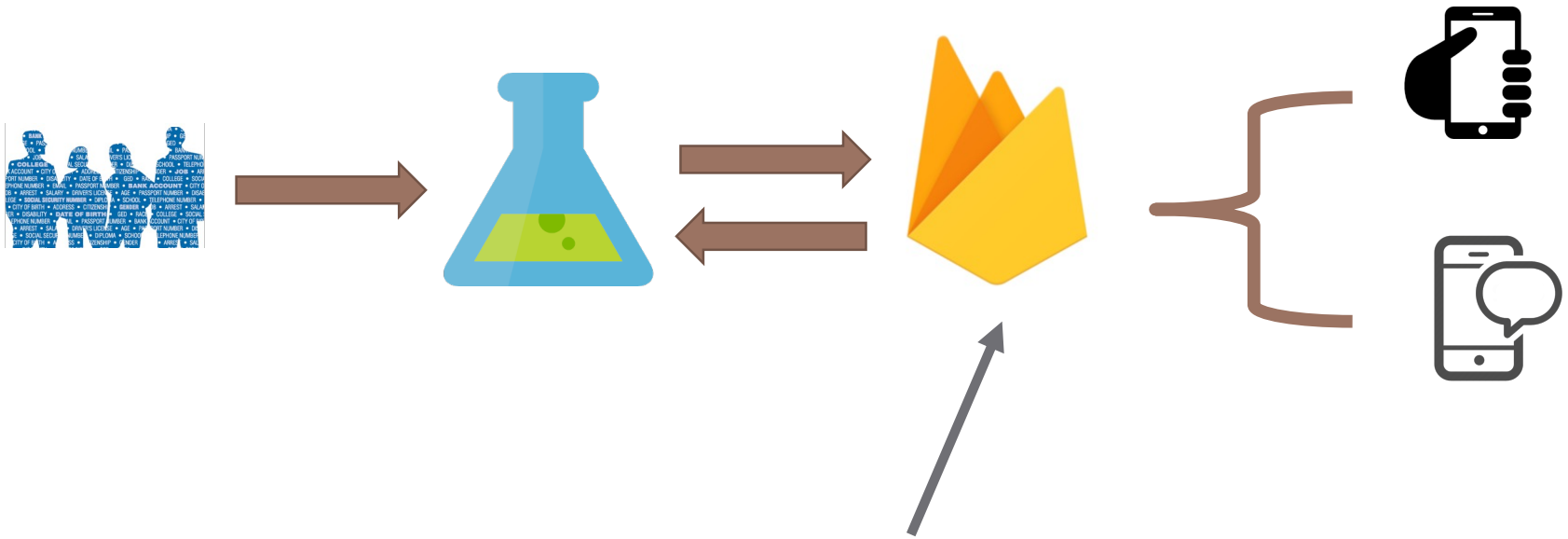
Personalising the ‘message’



Personalising the ‘message’



Personalising the ‘message’



Message constructed with personal greeting and message.
Determine when to send the message and channel

Personalising the ‘message’

Evening Dan, if you’re off out tonight – maybe you should think about singles instead of doubles? It would have saved you £16.70 last week.

Personalising the ‘message’

Past behaviour
(which day of week)

Evening Dan, if you’re off out tonight – maybe you should think about singles instead of doubles? It would have saved you £16.70 last week.

User generated goal
(to save money)

Behaviour change
(reduce consumption)

Using ANN via MLaaS constrained rules.

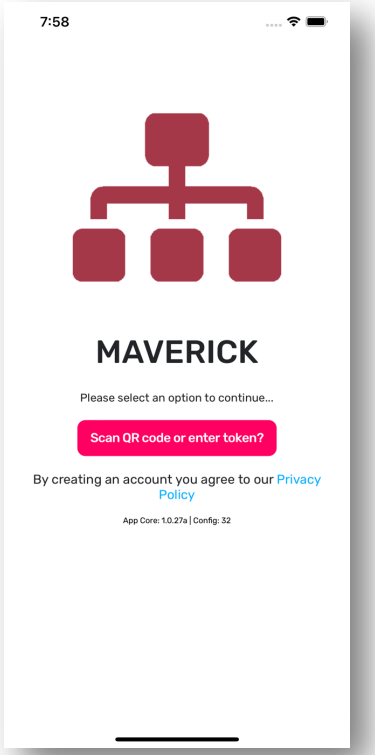
Does it actually work?

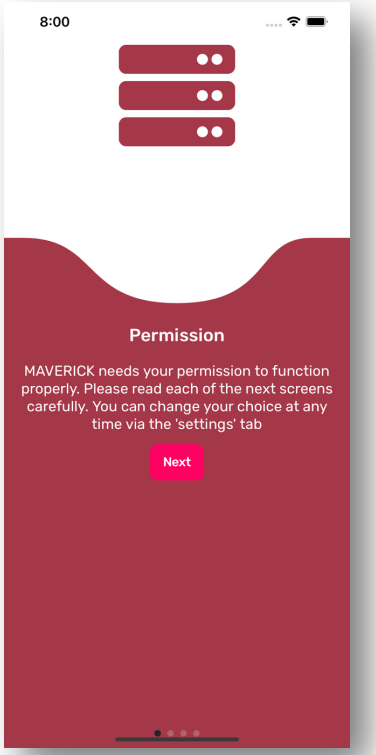
Previous study

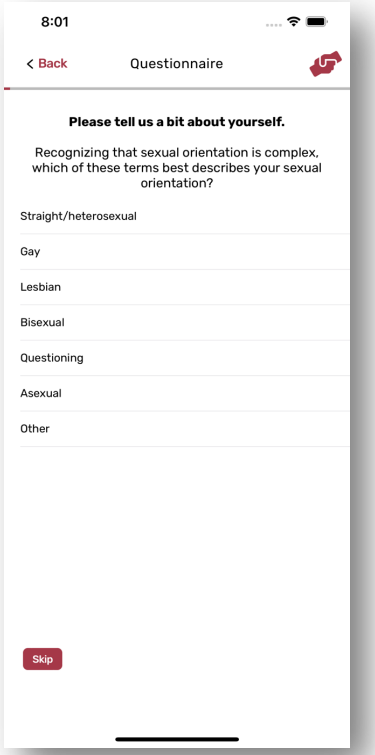
Reported alcohol consumption	Week 1	Week 2	Week 3	Week 4
Drinking days	4.0	3.0	3.0	3.0
Drink free days	3.0	4.0	4.0	4.0
Units per drinking day	5.6	6.5	4.54	4.7
Units consumed	22.9	20.4	18.1	15.9
Alcoholic drinks per drinking day	2.0	3.0	2.0	2.0
Binge drinking days per week	2.0	2.0	1.0	2.0

Median.

MAVERICK app







iOS

Google Play

Legalisation of cannabis in California

- Legal for medical use since 1996, and for recreational use since 2016.
  - Heavy taxation.
- Can be purchased from any recreational cannabis dispensary. ID required.
- Can purchase a maximum of 28.5 grams.
- You do not need to justify your use of cannabis.

MAVERICK study

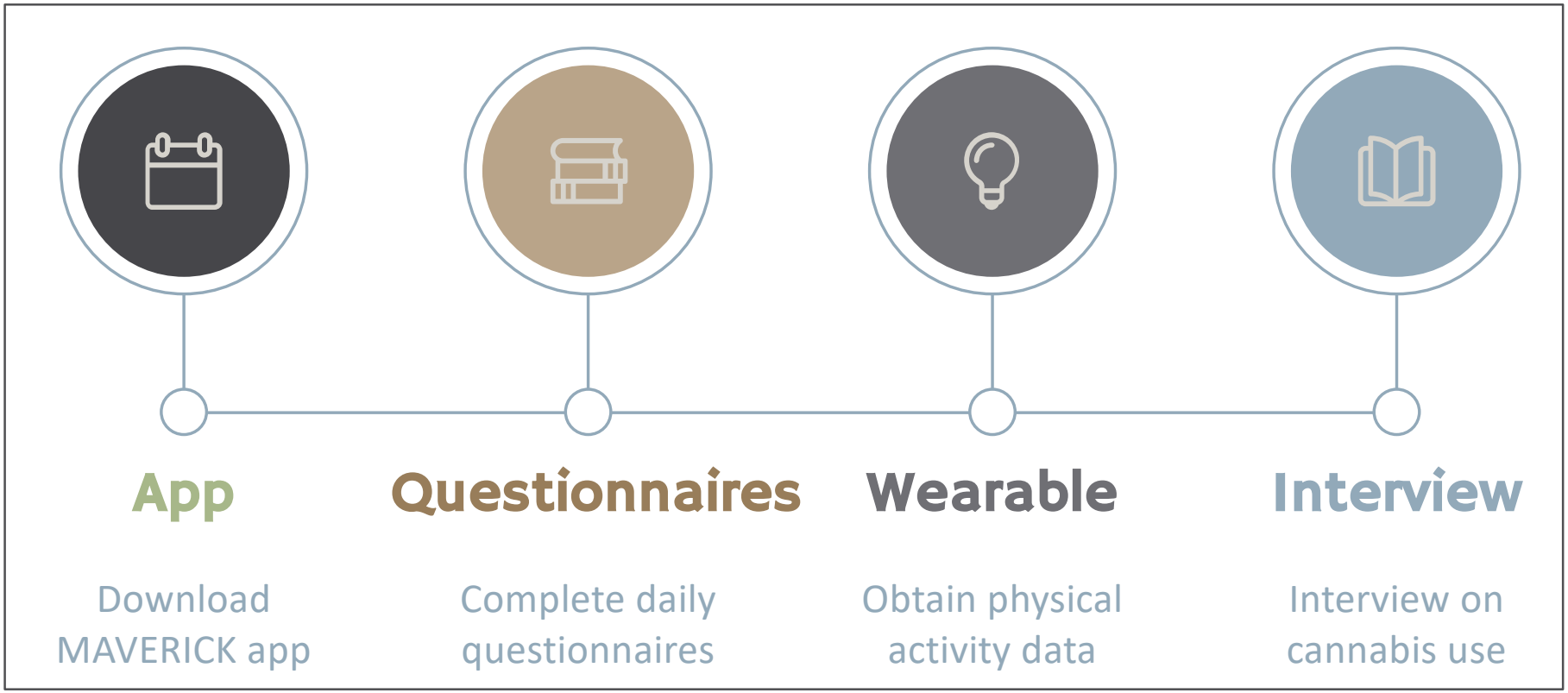
Focus: Recently discharged veterans with a history of PTSD and cannabis use who are not under treatment for either condition.

1. Use machine learning algorithms to determine whether passive data, alone and/or in conjunction with active data collection, can accurately predict clinically significant increases in PTSD symptoms and cannabis use.

2. Assess interplay between PTSD and problematic cannabis use.

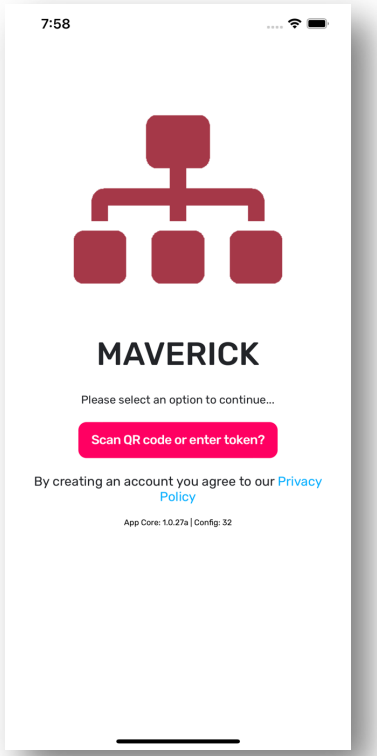
3. Understand the feasibility and acceptability of monitoring symptoms using passive vs. active data collection in clinical practice to non-treatment-seeking veterans.

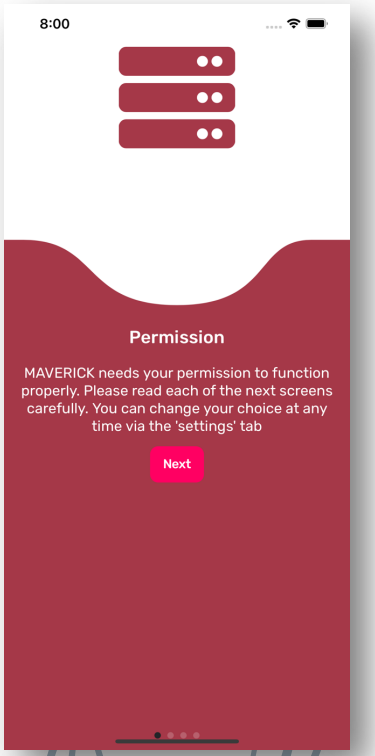
Participant journey

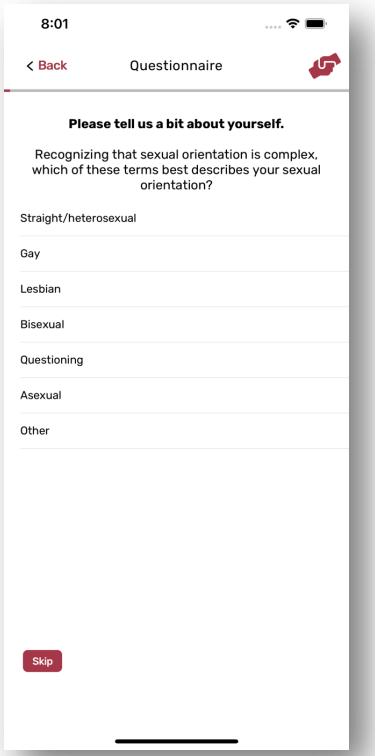


Participants take part for 84 days

MAVERICK app







iOS

Google Play

Thank You

Do you have any questions?

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