Royal College of Surgeons of England

SURGICAL TRIALS CENTRE

HSRU

Promoting Excellence in Health Services Research

Evaluating innovative and evolving healthcare technology – concepts and considerations

Marion K Campbell, Trialist and Methodologist

@MarionKCampbell

HSRU is core funded by the Chief Scientist Office of the Scottish Government Health and Social Care Directorates. The author accepts full responsibility for this talk.

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Disclosures

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- **Funding including NIHR, MRC, CIHR, Wellcome Trust & Intuitive Surgical European Research Board**
- **HSRU receives core funding from the Scottish Government Health Directorates**
- **In the context of this talk ..**
  - Member of the IDEAL Collaboration Council
  - Member of the RCSEng Robotic and Digital Surgery Initiative (RADAR)
  - Co-director, RCSEng Aberdeen Surgical Trials Centre

Technology & innovation in healthcare

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Characteristics of device/technology development

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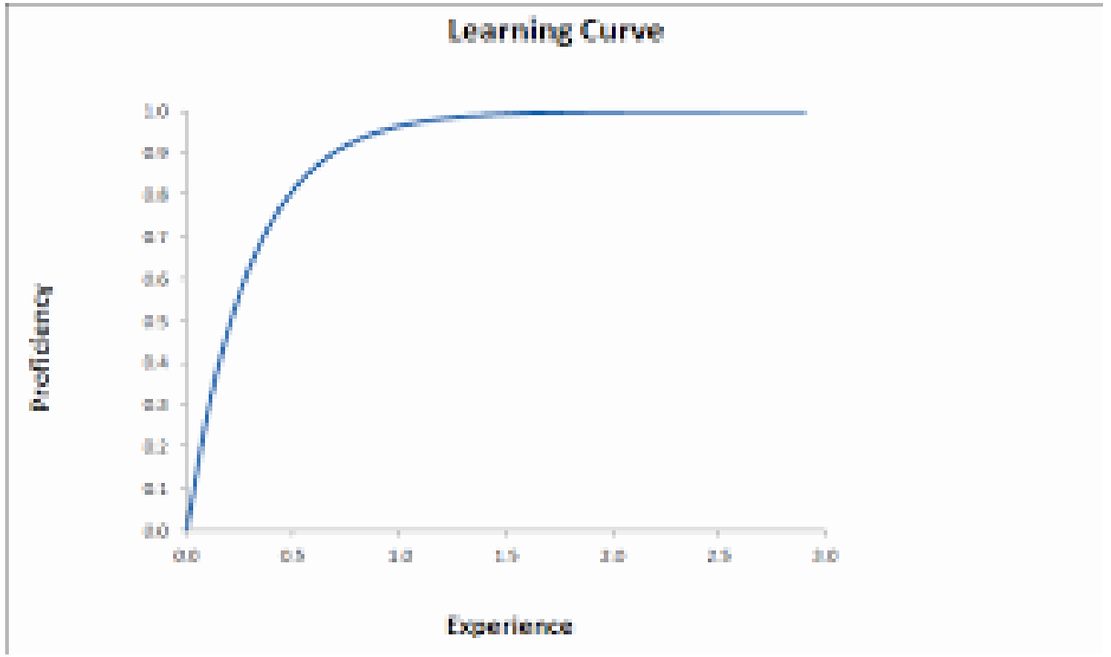
- Develops iteratively
- Technology goes through repeated refinement
- Change can be fast moving – lack of stability
- Learning curve issues
- Difficult to know when and how to evaluate
- Often has multiple components which can affect performance



Gartner's hype cycle

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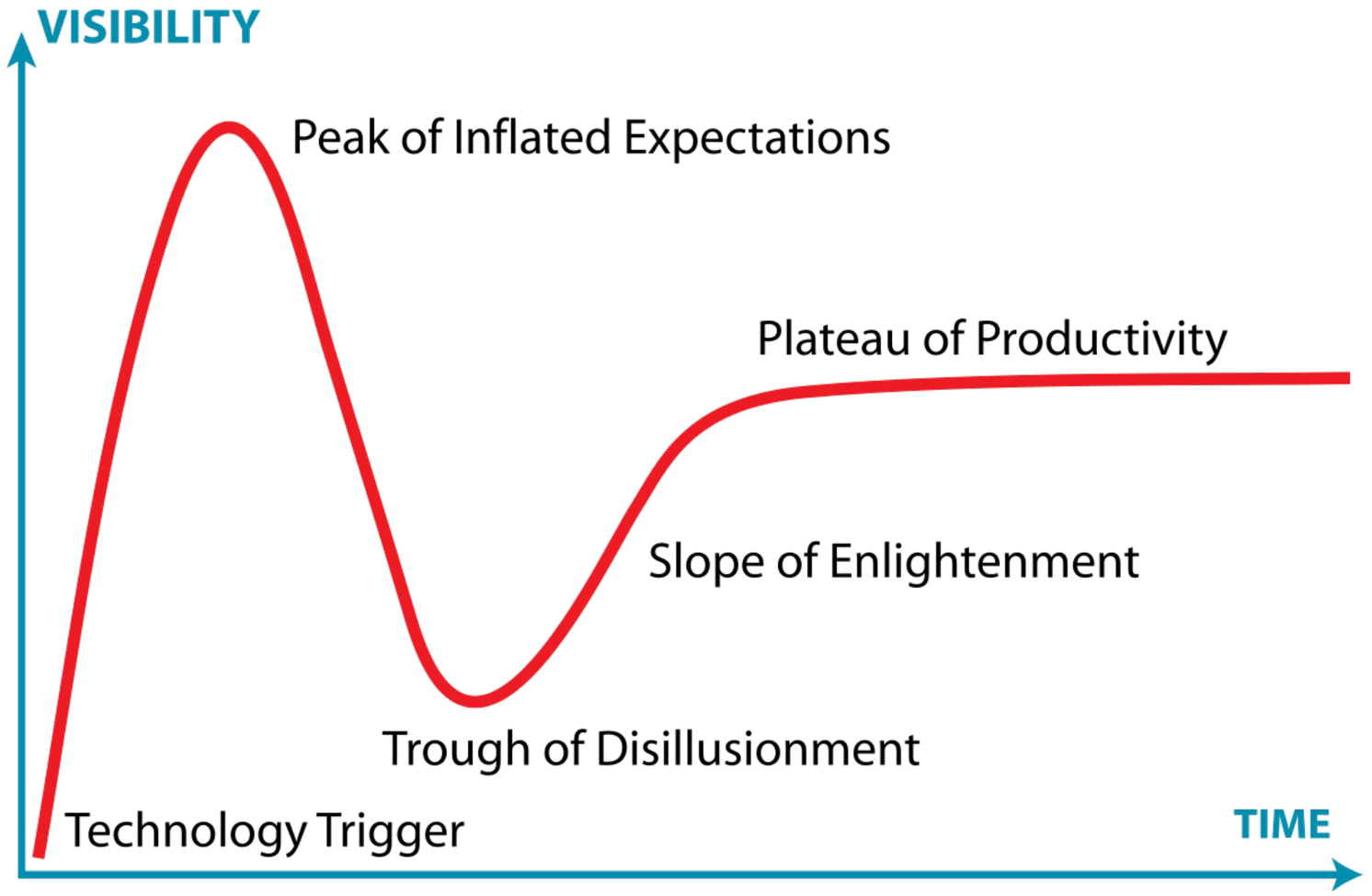

Evaluation of innovation in healthcare

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- No coordinated approach to evaluation
- New devices/technology often introduced without evaluation
- When evaluation is considered:
  - unclear whether RCT
  - difficulties of learning curves
  - tech still evolving etc

When to evaluate?

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Buxton's Law:

"It is always too early for rigorous evaluation (of a new technique) until, unfortunately, it is suddenly too late"

Martin Buxton, 1987

Evaluate across the lifecycle

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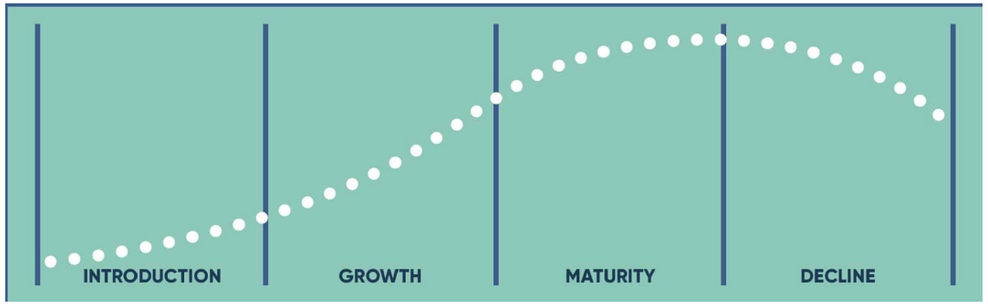
General considerations:

- Single point evaluation difficult
- Evaluate across the cycle
- Tailor to the stage of development
  - Designs will vary by stage of development
- Evaluation should not slow down innovation



IDEAL evaluation framework

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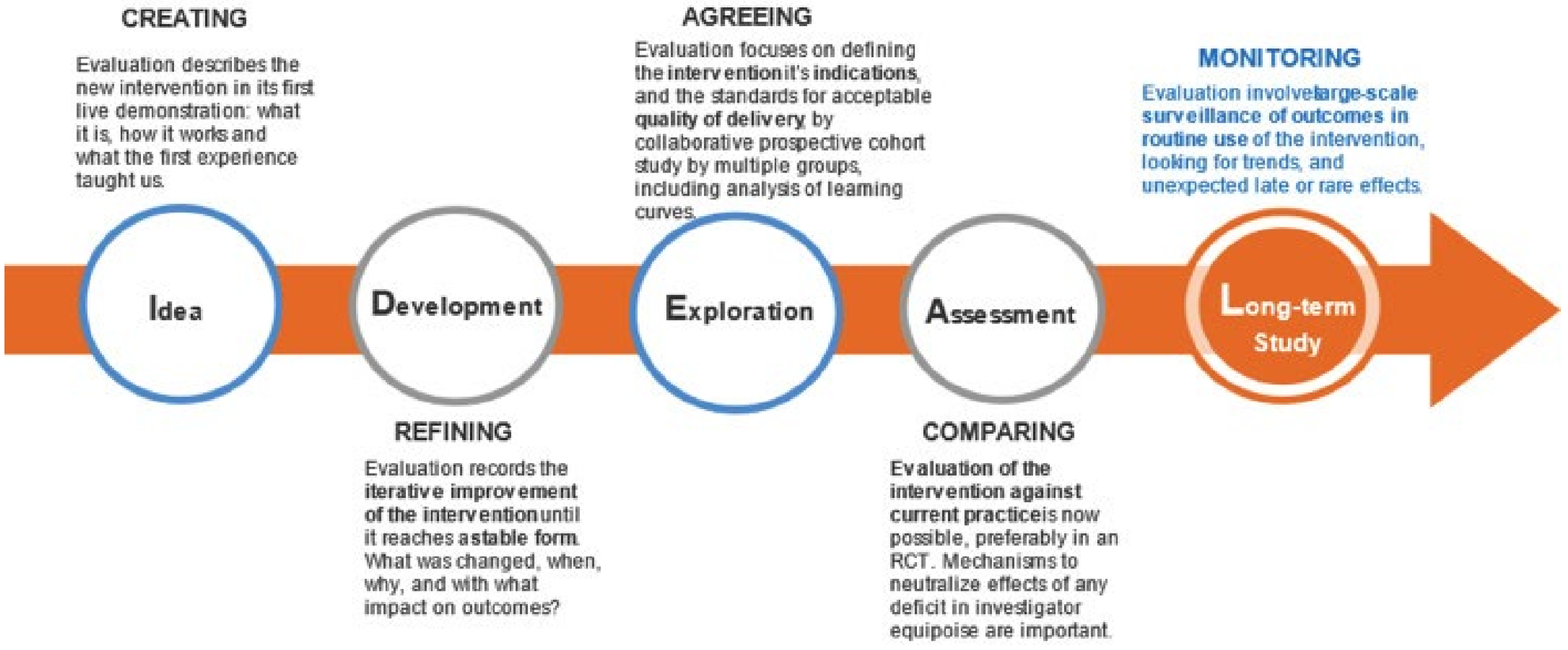
- Framework devised by surgeons and methodologists
- Proposed evaluative designs vary by stage of development
- 5 main stages

- *https://www.ideal-collaboration.net/*

The IDEAL evaluation pathway

defines the types of evaluation which are appropriate at successive stages in the life cycle of complex interventions



McCulloch et al. Lancet 2009; 374: 105–12;
Hirst et al. Ann Surg 2019;269:211–220

IDEAL framework

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	1 Idea	2a Development	2b Exploration	3 Assessment	4 Long-term study
Purpose	Proof of concept	Development	Learning	Assessment	Surveillance
Number and types of patients	Single digit; highly selected	Few; selected	Many; may expand to mixed; broadening indication	Many; expanded indications (well defined)	All eligible
Number and types of surgeons	Very few; innovators	Few; innovators and some early adopters	Many; innovators, early adopters, early majority	Many; early majority	All eligible
Output	Description	Description	Measurement; comparison	Comparison; complete information for non-RCT participants	Description; audit, regional variation; quality assurance; risk adjustment
Intervention	Evolving; procedure inception	Evolving; procedure development	Evolving; procedure refinement; community learning	Stable	Stable
Method	Structured case reports	Prospective development studies	Research database; explanatory or feasibility RCT (efficacy trial); diseased based (diagnostic)	RCT with or without additions/ modifications; alternative designs	Registry; routine database (eg, SCOAP, STS, NSQIP); rare-case reports
Outcomes	Proof of concept; technical achievement; disasters; dramatic successes	Mainly safety; technical and procedural success	Safety; clinical outcomes (specific and graded); short-term outcomes; patient-centred (reported) outcomes; feasibility outcomes	Clinical outcomes (specific and graded); middle-term and long-term outcomes; patient-centred (reported) outcomes; cost-effectiveness	Rare events; long-term outcomes; quality assurance
Ethical approval	Sometimes	Yes	Yes	Yes	No
Examples	NOTES video[6]	Tissue engineered vessels[7]	Italian D2 gastrectomy study[8]	Swedish obese patients study[9]	UK national adult cardiac surgical database[10]

RCT=randomised controlled trial. SCOAP=Surgical Clinical Outcomes Assessment Programme. STS=Society of Thoracic Surgeons. NSQIP=National Surgical Quality Improvement Program. NOTES=natural orifice translumenal endoscopic surgery.

Table: **Stages of surgical innovation**

Extension to devices: IDEAL-D

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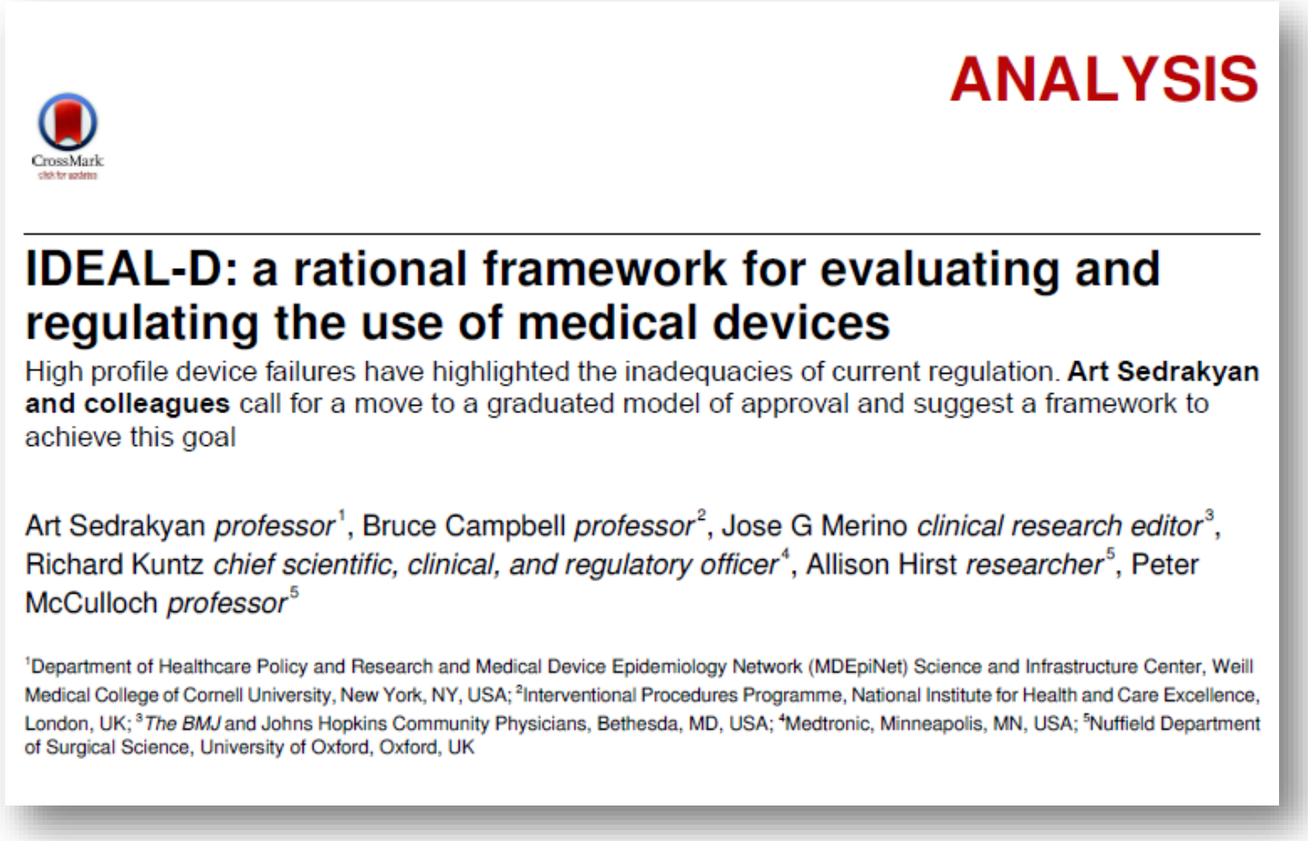
- Parallels with device development noted by IDEAL developers
- Translated the IDEAL framework to IDEAL-D for evaluation of devices



ANALYSIS

IDEAL-D: a rational framework for evaluating and regulating the use of medical devices

High profile device failures have highlighted the inadequacies of current regulation. **Art Sedrakyan and colleagues** call for a move to a graduated model of approval and suggest a framework to achieve this goal

Art Sedrakyan *professor*[1], Bruce Campbell *professor*[2], Jose G Merino *clinical research editor*[3], Richard Kuntz *chief scientific, clinical, and regulatory officer*[4], Allison Hirst *researcher*[5], Peter McCulloch *professor*[5]

[1]Department of Healthcare Policy and Research and Medical Device Epidemiology Network (MDEpiNet) Science and Infrastructure Center, Weill Medical College of Cornell University, New York, NY, USA; [2]Interventional Procedures Programme, National Institute for Health and Care Excellence, London, UK; [3]*The BMJ* and Johns Hopkins Community Physicians, Bethesda, MD, USA; [4]Medtronic, Minneapolis, MN, USA; [5]Nuffield Department of Surgical Science, University of Oxford, Oxford, UK

Sedrakyan et al BMJ 2016;353:i2372 doi: 10.1136/bmj.i2372

IDEAL-D

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- Same core 5-stage framework
- “Stage 0”:
  - preclinical development phase
  - main requirement – publish any safety risks;
- Compulsory reporting/registration of new clinical innovations at first-in-human stage
- Report failures as well as successes
- Refinement/development more concentrated in early phases – may imply direct stage 1-stage 3
- Registries and long-term surveillance to be enacted earlier in the life cycle

Incorporating outcomes

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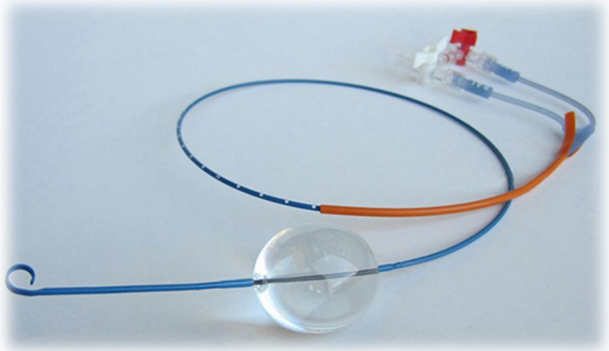
- **New innovations can impact on whole health system:**
  - patients,
  - health professionals,
  - health organisations
  - population



Incorporating outcomes

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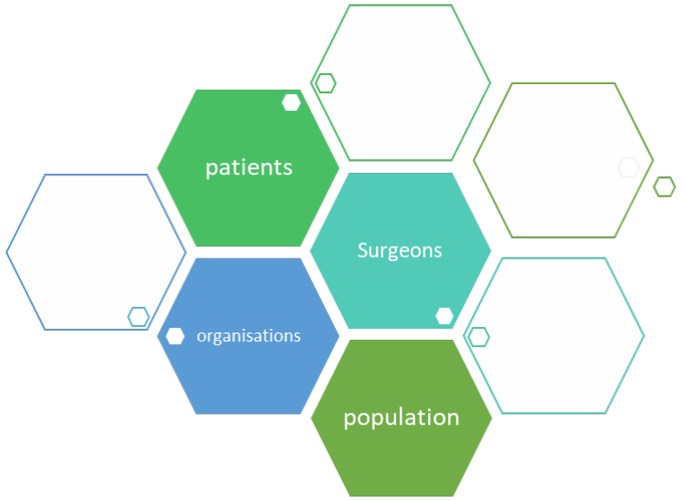
- Outcomes need to mirror the multiple levels
- Core outcome sets usually only patient/clinical outcomes
- Need for multi-level outcome sets
- Example:

RoboCOS



RoboCOS

Robot assisted surgery affects:

- Patients
- Surgeons
- Healthcare organisations
- Population

Outcome measures needed to reflect full system

RoboCOS core outcome set

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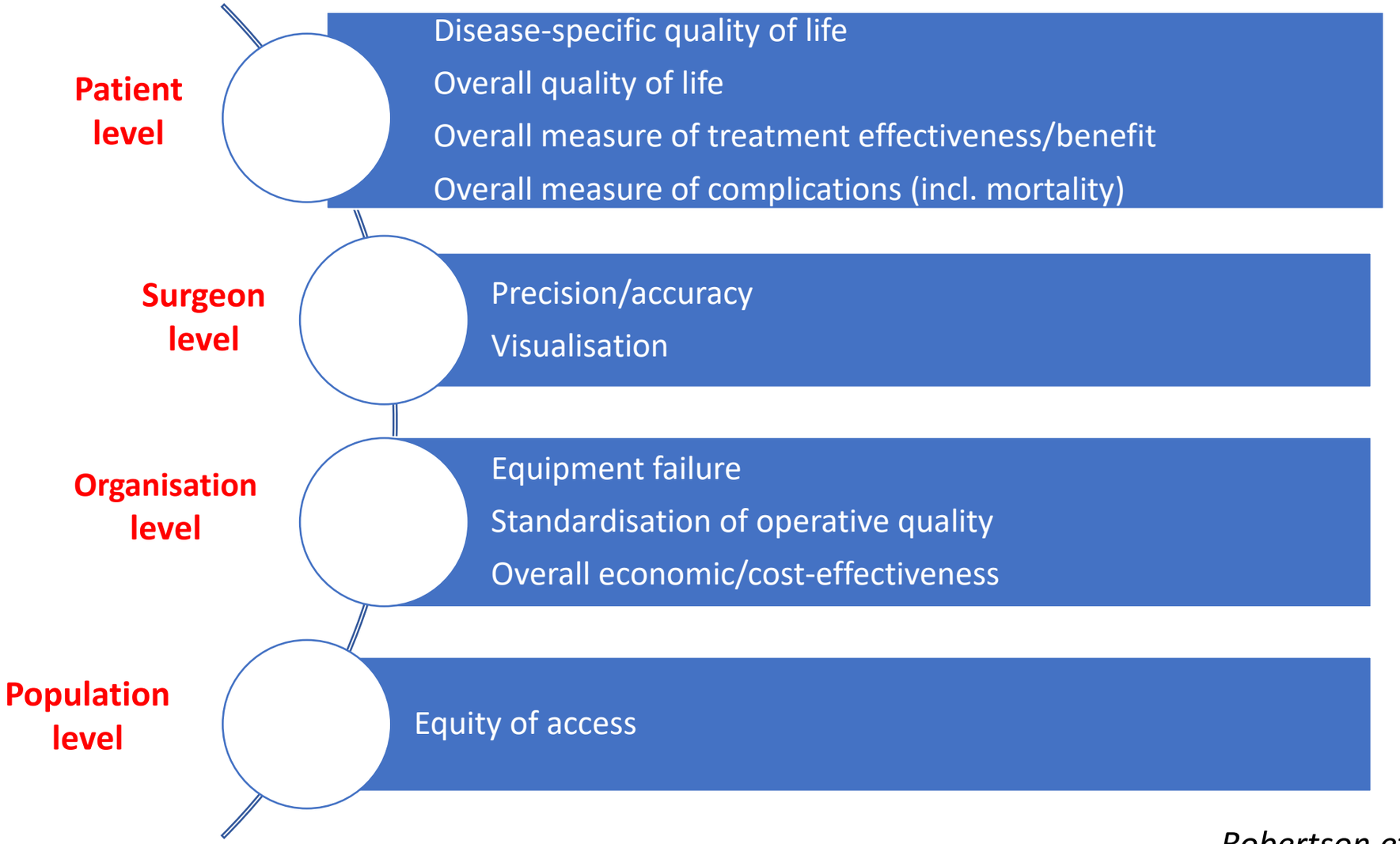

- 10 core outcomes
- Multi-level perspective built in
- More multi-level approaches to outcomes needed

Robertson et al. PLOS ONE 2023; 18(3): e0283000

Conclusions

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- Innovative and evolving technology can present difficulties for evaluation
- Evaluation must be planned across the life cycle
- Evaluation should not hamper continuing innovation
- IDEAL & IDEAL-D provide useful frameworks
- Outcomes need to reflect the impact on multiple levels

No innovation without evaluation!

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Thank you

If you have any further questions, please contact:

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@MarionKCampbell

WHEN AND HOW TO EVALUATE INNOVATIVE AND EVOLVING HEALTHCARE TECHNOLOGY

IN SURGERY & COMPLEX INTERVENTIONS

(USING THE EXAMPLE OF ROBOTIC SURGERY)

PROFESSOR DAVID BEARD

PROFESSOR OF MUSCULOSKELETAL AND SURGICAL SCIENCE, UNIVERSITY OF OXFORD

SURGICAL & COMPLEX INTERVENTION TRIALS PROGRAM LEAD, CTC UNIVERSITY OF SYDNEY

DIRECTOR/RCS CHAIR OF RCS SURGICAL TRIALS CENTRE (SITU), OXFORD

DISCLOSURES

- Institutional grants from;
  - NIHR HTA
  - NIHR RfBP
  - NIHR HS&DR
  - Versus Arthritis
  - Action Research
  - Royal College of Surgeons

- Director of Royal College of Surgeons Surgical Trials Unit
- NIHR Senior Investigator
- Professorial secondment to University of Sydney (Australia)
- ESP Swansea University Health Board, T&O/Physiotherapy
- Non Exec Director of PRO-MAPP Ltd (Oxford University Spin Out)

OUTLINE PLAN

- INTRO & GENERAL BACKDROP
  - Why evaluate? What is new technology?
  - Threats & Considerations
    - Importance of study design
    - Inhibition
    - Preference
    - Non scientific
  - Outcomes (MKC)

- ROBOTIC SURGERY
  - Example, including pitfalls

THE POINT OF EVALUATION (OF ANY INTERVENTION)

Generate evidence to guide DECISION MAKING

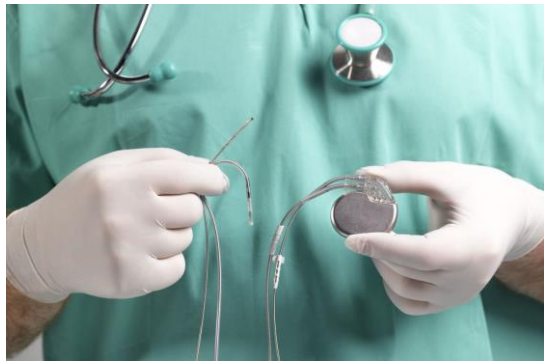
- Confirm that medical interventions are safe and provide benefit
- Restrict ineffective interventions
  - De-implementation
  - Prevent from becoming established
- Mechanism (along the way)

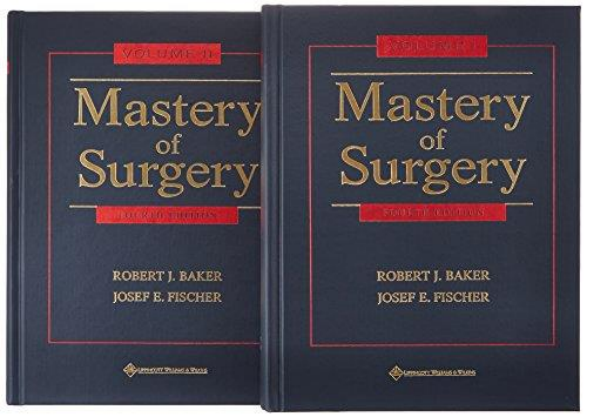
Does treatment work?

How well does it work?

How does it work?

Is something else better?





WHAT IS INNOVATION?
AND INNOVATION NOT ALWAYS A "SHINY NEW THING"

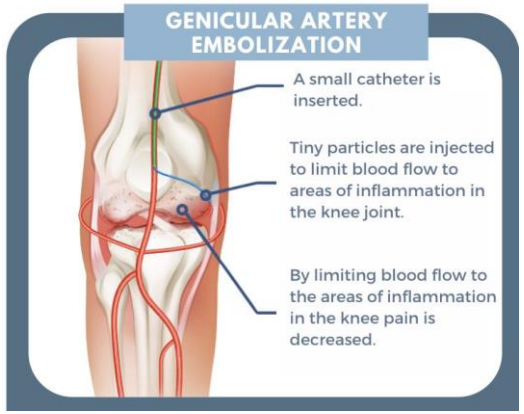
- Distinction between innovation and new tech
- Iteration?
- Testing device (hardware), procedure or both?

- Innovation - **Yes**
- New technology - **YES**

PASHiOn
Personalised Against Standard High tibial Osteotomy
A prospective multi-centre randomised control trial

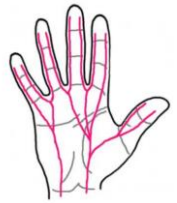
- Innovation - **Yes**
- New technology - **NO**

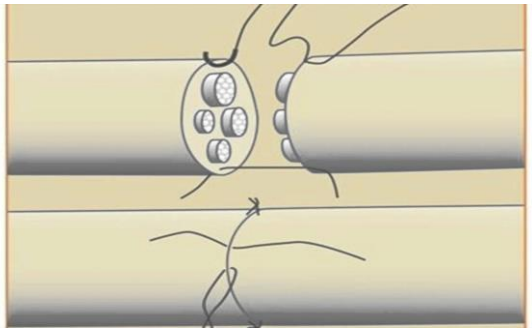
geko
Genicular Artery Embolisation Trial



- Innovation - **Yes**
- New technology - **NO**

NEON study

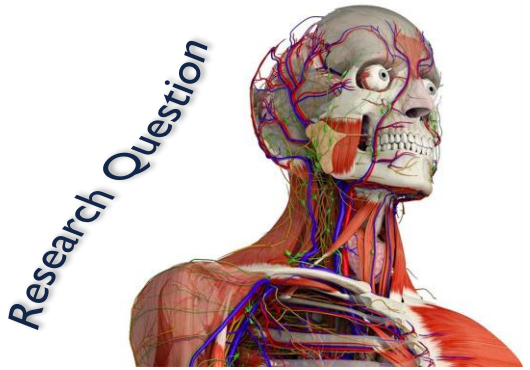




SCIENTIFIC CONSIDERATIONS

- Skill based
  - Expertise dependent
  - Experience dependent
  - Standardisation
  - Consensus
- Multi -modal
  - Identifying the active agent

Does it work?	Does it work & how?	Best Treatment?
Surgery v No Rx (no surgery) Rehab v No Rx (no rehab/OT)	Surgery/Rehab V Placebo	***Compare 2 or more treatments*** Surgery v Surgery? Rehab v Rehab? Surgery v Non Surg Mx



The IDEAL Collaboration
Idea, Development, Exploration, Assessment, Long-term follow-up

NON SCIENTIFIC CONSIDERATIONS FOR INNOVATION

- Professional Threat
- Commercial Interest / Drive
- Conflict of Interest
- Preference / Public opinion

INHIBITION - NOT TO STIFLE INNOVATION

- Falling in Love with the Existing Solution
- Unrealistic Expectations
- Using The Same Processes & Metrics for All Initiatives

Time (and cost) to Evaluate

Gabriel Mendoza
Co-Founder at Praxie

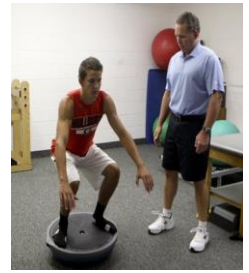
PREFERENCE / EQUIPOISE

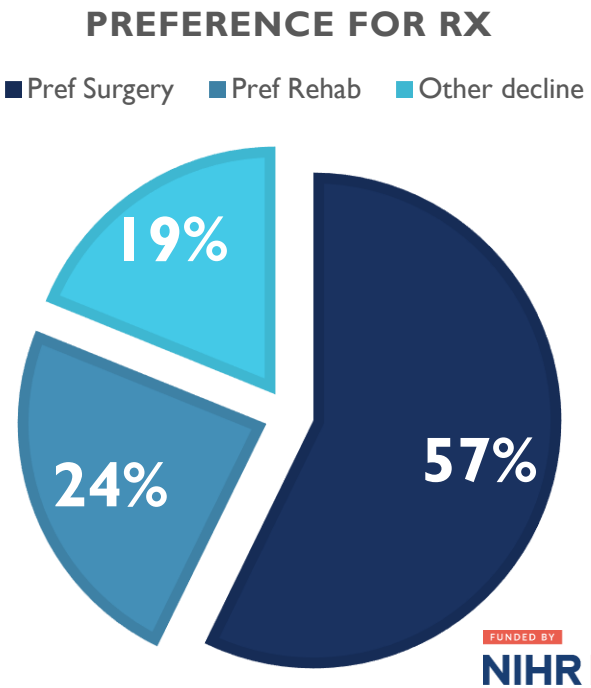
I have a very strong opinion on what I want

I have a strong opinion on what is right

Can be Challenging

Especially for innovation and new devices





aclsnnap
SURGERY NECESSITY IN NON-ACUTE PATIENTS

FUNDED BY NIHR | National Institute for Health and Care Research

OUTCOME MEASUREMENT

- Not always clear for evaluation of innovation
- Maybe new parameters, variables of interest
- Often chosen to suit purpose!

MKC

Royal College of Surgeons (Eng)
RADAR INITIATIVE
ROBOTIC And DIGITAL SURGERY

Funded by NHS National Institute for Health Research
Health Services & Delivery (HS&DR) Programme

NHS
Royal Devon and Exeter
NHS Foundation Trust

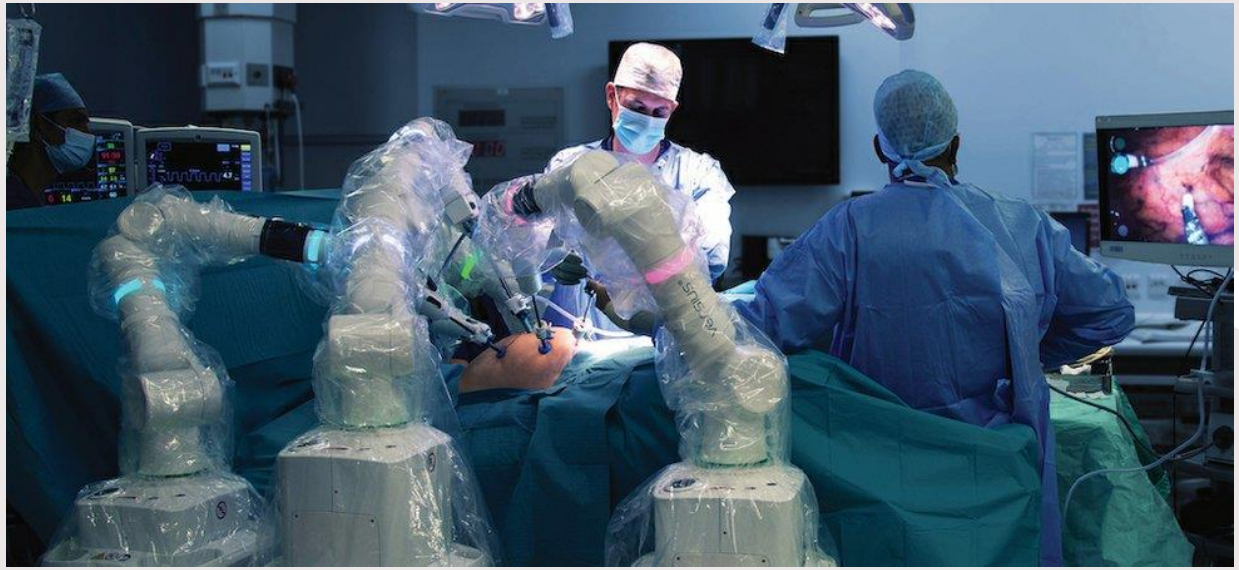
UNIVERSITY OF BIRMINGHAM

The University of Manchester

A REAL-WORLD, IN-SITU, EVALUATION OF THE INTRODUCTION AND SCALE-UP OF ROBOT-ASSISTED SURGICAL SERVICES ACROSS ENGLAND: EVALUATING ITS IMPACT ON CLINICAL AND SERVICE DELIVERY, EFFECTIVENESS AND COST

What are we talking about? The adoption

- Better visualisation?
- Faster discharge?
- Fewer complications?
- Better outcome?
- Ergonomics?
- Fatigue/endurance

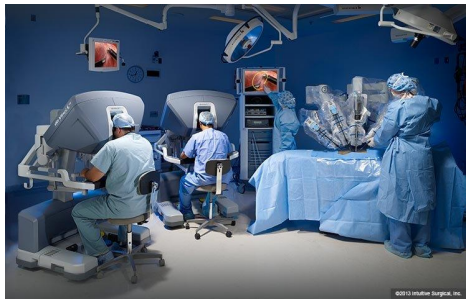


RADAR INITIATIVE

ROBOTIC And DIGITAL SURGERY

THE DIFFERENT STAGES – WHERE IS RAS? WHY EVALUATE?

- New technology – innovation
  - First in human?
  - Safety?
- Runaway train….
  - Implementation without evidence
- Questionable existing practice
  - Ethical issues
  - Change of practice



Robotic surgery is turning out to be an expensive fad

The rapid rise of robot-aided surgery ignores the fact that high-tech gadgets don't always improve treatment outcomes but do increase costs

TECHNOLOGY 12 June 2019

By Ruby Prosser Scully

NewScientist

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ROBOTIC ASSISTED SURGERY - THREATS TO EXISTING STATUS QUO…….

De-skill

£££

Cost (effectiveness)

Efficiency (Workforce)

ROBOTIC ASSISTED SURGERY - THREATS TO ADOPTION……

Obsolescence

People / Replaced?

Device

EXPLORE, ASSESS & MITIGATE

Purpose/Use

Machine Failure

KNOW THE AREA OF THE INNOVATION , KNOW WHAT PEOPLE THINK (STANDARD R&D)

RESEARCH ARTICLE

Barriers and enablers to the effective implementation of robotic assisted surgery

Louisa Lawrie[1]*, Katie Gillies[1], Eilidh Duncan[1], Loretta Davies[2], David Beard[2], Marion K. Campbell[1]

1 Health Services Research Unit, Institute of Applied Health Sciences, School of Medicine, Medical Sciences and Nutrition, University of Aberdeen, Aberdeen, Scotland, United Kingdom, **2** RCS Surgical Interventional Trials Unit (SITU), Nuffield Dept Orthopaedics, Rheumatology and Musculo-skeletal Sciences, University of Oxford, Oxford, United Kingdom

* louisa.lawrie1@abdn.ac.uk

Health services research
Original research

Current issues and future considerations for the wider implementation of robotic-assisted surgery: a qualitative study

Louisa Lawrie [1], Katie Gillies [1], Loretta Davies [2], Jared Torkington [3], John McGrath [4], Richard Kerr [5], Arul Immanuel [6], Marion Campbell [1], David Beard [2]

Correspondence to Dr Louisa Lawrie; louisa.lawrie1@abdn.ac.uk

IMPLEMENTATION SCIENCE

- **Pre –**
  - Cost
  - Poor evidence for efficacy
  - Champion model & relationship with procurement process
  - Prejudice in opinion of benefit
  - Acceptance it is the future
- **Early –**
  - Role changes in theatre
  - Reliance on industry
  - Change in skill set and attentional processes in theatre
  - Scheduling issues
- **Late –**
  - Maintenance costs
  - Institutional promotion
  - Ergonomic benefits

KG

WP1

REINFORCE
Real-World Evaluation of Robot-Assisted Surgical Services

PLOS ONE
A peer-reviewed, open access journal

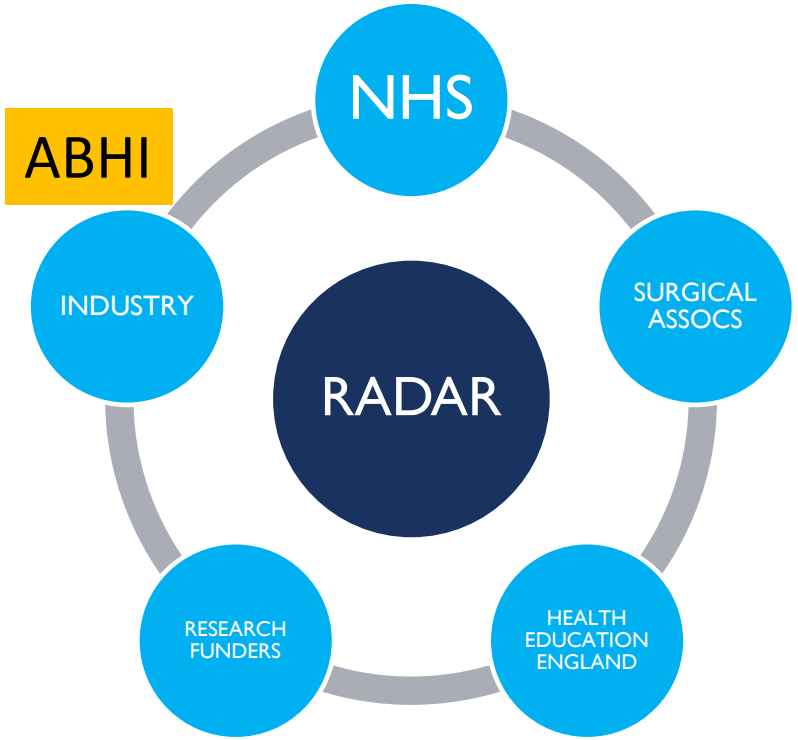
BMJ Journals
BMJ Open

RCS SURGICAL TRIALS CENTRE

UNIVERSITY OF OXFORD

UNIVERSITY OF ABERDEEN

NEED TO EMBED (NEW TECH) IN ECOSYSTEM
RCS (ENG) RADAR - TOUCHPOINT FOR KEY RAS STAKEHOLDERS



IS HELPFUL

COMMISSION FOR THE FUTURE OF SURGERY 2019

KEY THEMES: Minimally Invasive Surgery, immersive technologies, data & data analysis

Integrated Programme of Research …(Aberdeen/Oxford/RCS/Birmingham)

Soomro, Vale, Bach, Kerr,
Hutchinson, Gillies, Lawrie, Davies

NIHR | National Institute for Health Research

Complete
Published BJS Open

Systematic review what do we know?
Garfjeld Roberts/
Beard et al

Complete
Paper accept

RoboCOS
what should we measure?
Shaikh/Campbell/
Beard/Gillies et al

Complete
accepted

In SET UP

REINFORCE
WP1 optimise implementation
Campbell/Gillies/
Beard/Lawrie

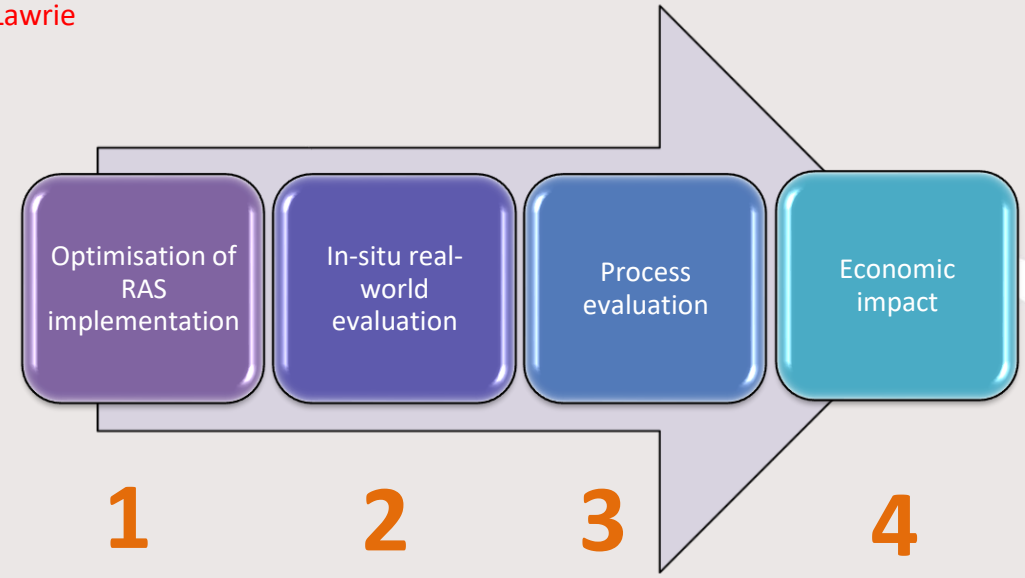
REINFORCE
Full scale evaluation
Beard/Campbell
/Vale/Davies

QUALITY OF RESEARCH & OUTCOMES – ROOM FOR IMPROVEMENT!

RADAR
INITIATIVE

ROBOTIC And
DIGITAL
SURGERY

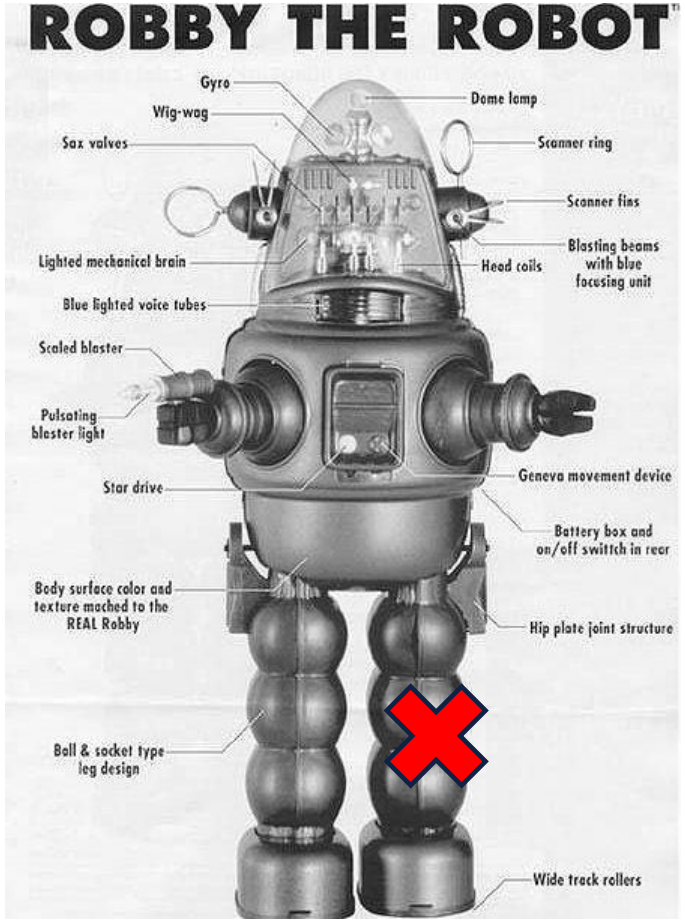
IS HELPFUL



MASTERY

Measuring the qu**A**lity of **S**urgical care and setting benchmarks for training using In**T**uitive data record**ER** technolog**Y**

PATIENT PREFERENCE
UNDERSTANDING OF THE TECHNOLOGY



Not autonomous

A TOOL!

Surgeon Driven (Haptic Technology)

Remote activator system

PAN-SURGICAL SYSTEMATIC REVIEW OF ROBOTIC ASSISTED INNOVATION LITERATURE: SAFETY, EFFICACY, AND OUTCOME

7142 studies
High-level evidence: systematic review of **183** randomised studies (76 unique populations)

- Research is not high quality
- Identified most popular outcomes

- No systems research
- No obvious threat or risk
- Uncertainty still exists

- Best evidence for sa

Out ate

43% no difference
24% superior
No Harm

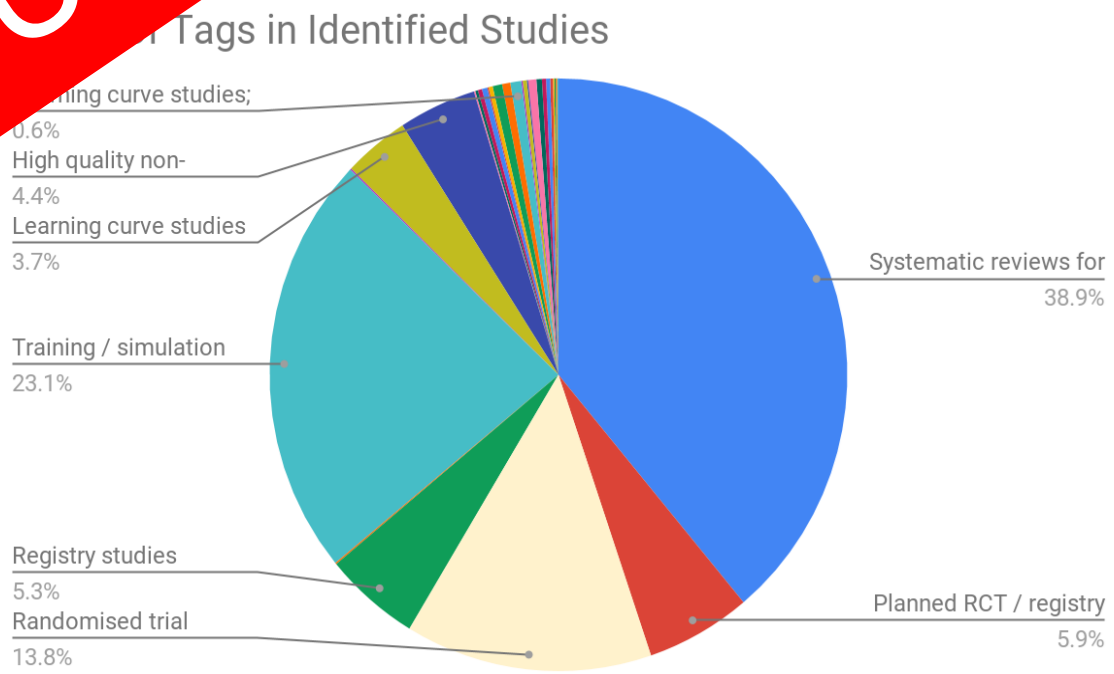
FEEL FOR MATURITY

Systematic review

BJS Open Open Access

search quality and transparency, outcome measurement and nce for safety and effectiveness in robot-assisted surgery: atic review

eld Roberts[1], J. C. Glasbey[3], S. Abram[1], D. Osei-Bordom[3], S. P. Bach[3,4,5] D. J. Beard[1,2,5]



OUTCOMES

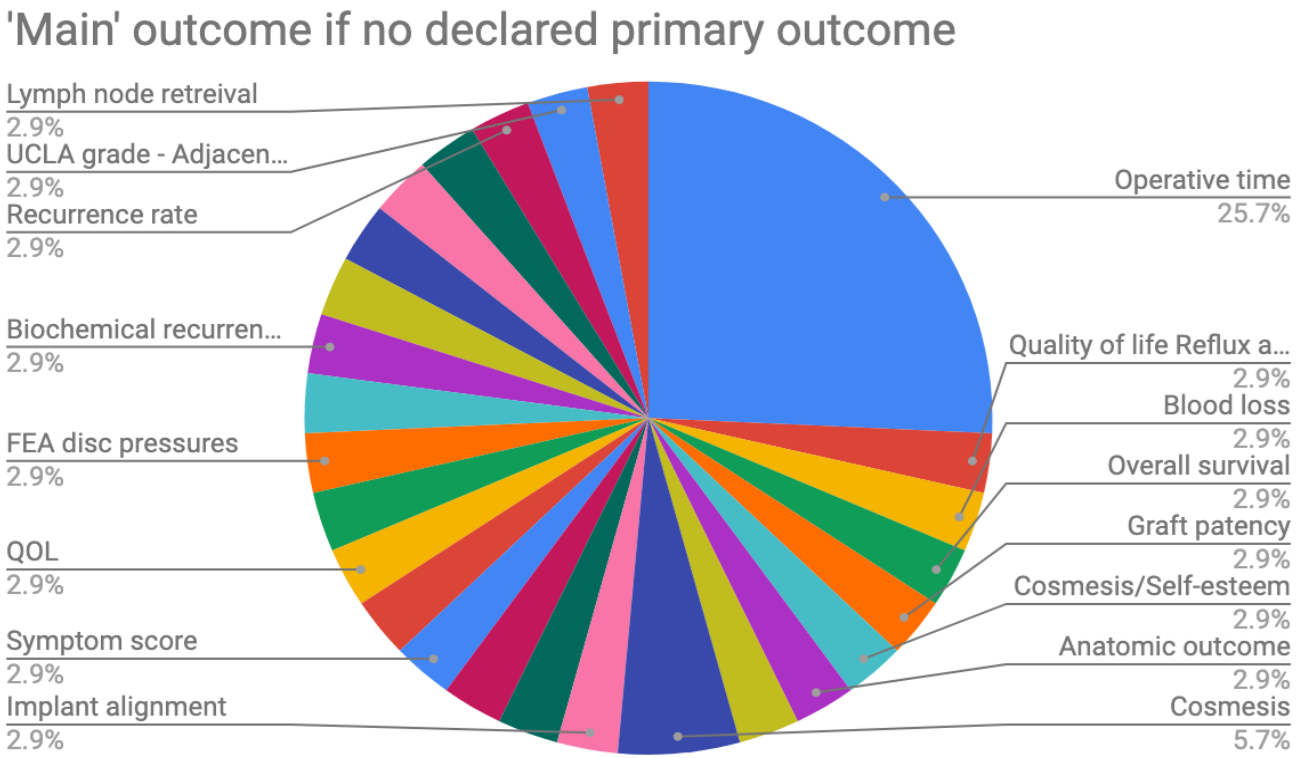
Systematic review

BJS Open Open Access

Research quality and transparency, outcome measurement and evidence for safety and effectiveness in robot-assisted surgery: systematic review

P. Garfjeld Roberts[1], J. C. Glasbey[3], S. Abram[1], D. Osei-Bordom[3], S. P. Bach[3,4,5] and D. J. Beard[1,2,5]

- 36% of studies no primary outcome



RoboCOS core outcome set

LEVEL	OUTCOME NAME
Patient level	Disease-specific quality of life
	Overall quality of life
	Overall measure of treatment effectiveness/benefit
	Overall-measure of complications inc. mortality
Surgeon level	Precision/accuracy
	Visualisation
Organisation level	Equipment failure
	Standardisation of operative quality
	Overall economic/cost-effectiveness
Population level	Equity of access

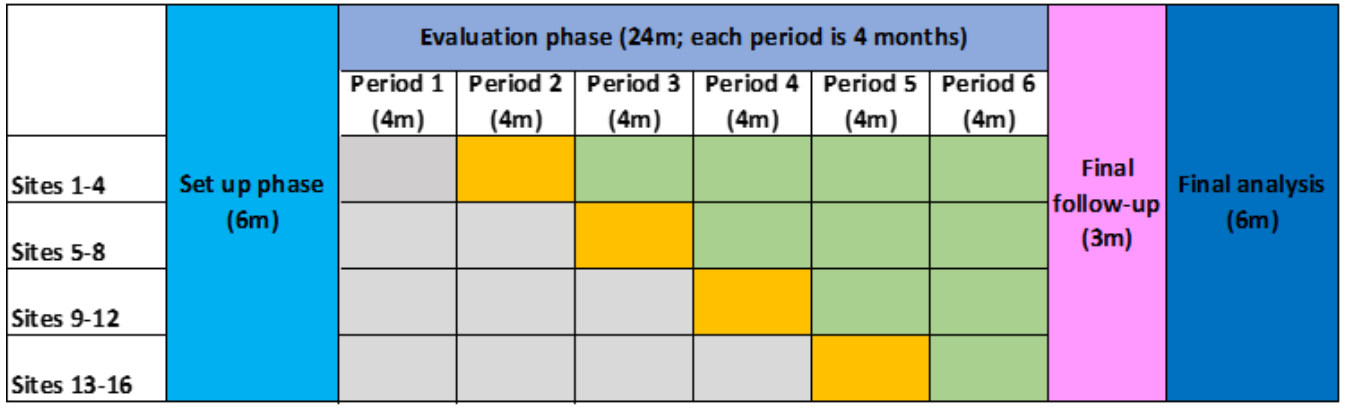
New when needed
Learn from existing – i.e. TLX assessment of task burden (from NASA)

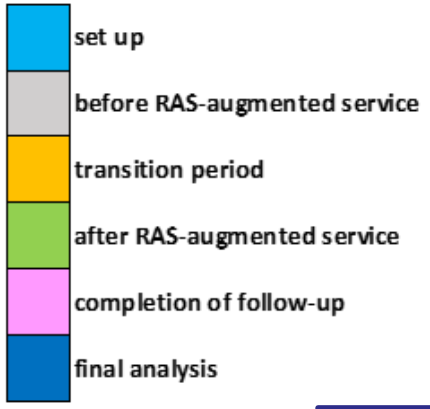
Design: Stepped wedge (or ITSD)
Allows evaluation whilst rolling out

REINFORCE
Real-World Evaluation of Robot-Assisted Surgical Services

NIHR | National Institute for Health Research

REINFORCE: Stepped wedge design and patient flow





2,560 procedures

3 types of transition

.

1. Change in Delivery (Naive sites - new to RAS)
2. Change in Specialty
3. Change in Procedure

Doesn't stifle innovation
Roll out model

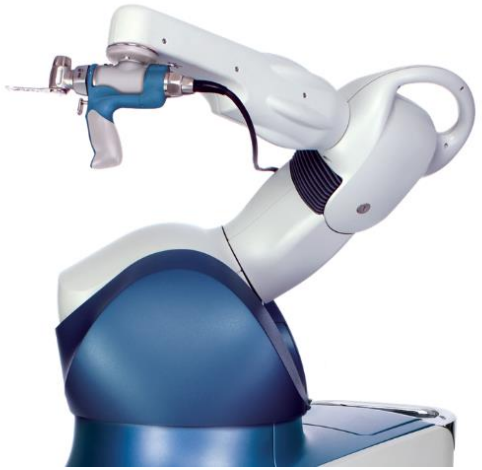
Each specialty represented?

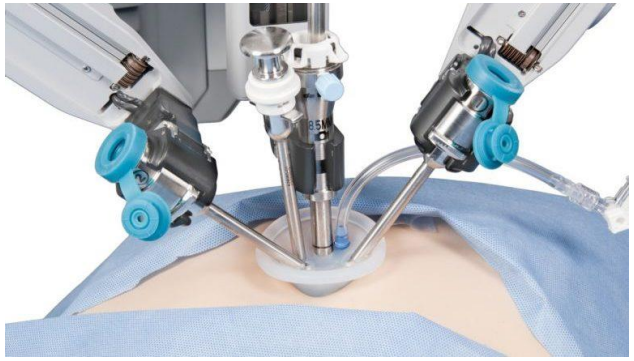
1. Urology
2. Colorectal
3. Thoracic
4. Gynaecology
5. Orthopaedics
6. Upper GI

(plus industry representation)

BEWARE

- Inter-specialty differences
- Upgrades and downgrades of product
- Time taken for MHRA & governance
- Trying to do too much
- Pressures from manufacturer

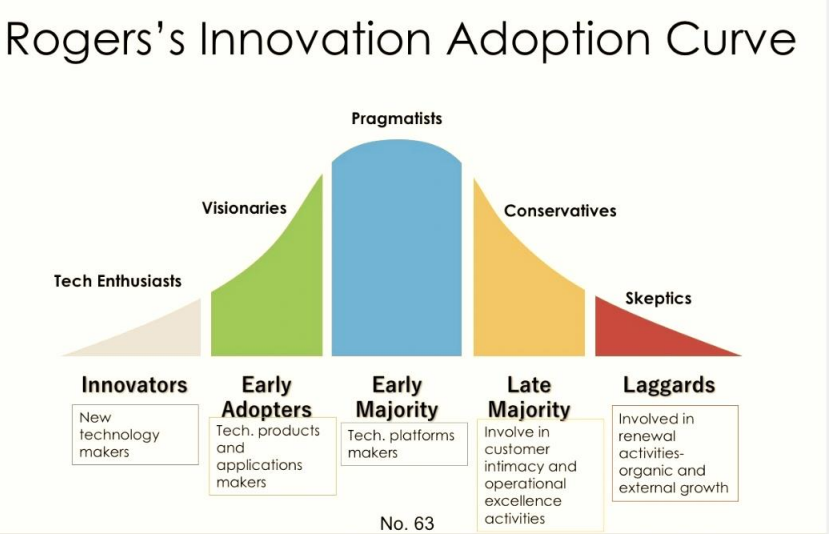




PASHiOn
Personalised Against Standard High tibial Osteotomy
A prospective multi-centre randomised control trial

SUMMARY

- Evaluation of technology – really no different to other health intervention evaluation
- But some nuances
  - Evaluate before too mature
  - Try not to stifle innovation
  - Important to evaluate properly (avoid mistakes of the past)
  - Important to evaluate as a whole system change



Three Cliffs Bay, Gower, Wales

South Barrule, Isle of Man

Radcliffe Camera, Oxford University

- *Acknowledgements*
- *“Several hundred people”*

WHEN AND HOW TO EVALUATE INNOVATIVE AND EVOLVING HEALTHCARE TECHNOLOGY

NEW TECHNOLOGY AND SMALL POPULATIONS

Jan Jansen, MBBS PhD
Professor of Surgery
Director, Center for Injury Science
Associate Vice Chair for Clinical Trials, Department of Surgery
University of Alabama at Birmingham

UAB CENTER FOR INJURY SCIENCE
The University of Alabama at Birmingham

Disclosures

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Grants: NIH, DoD, NIHR

Industry funding: CSL Behring, Infrascan, RevMedX

Consulting: CSL Behring, Infrascan, Cellphire

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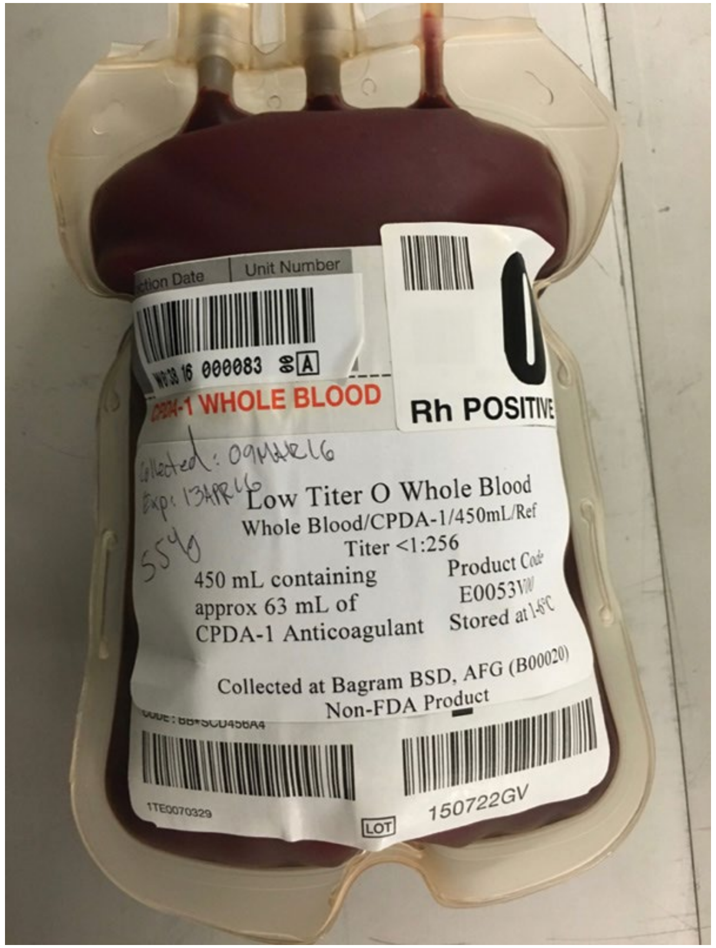
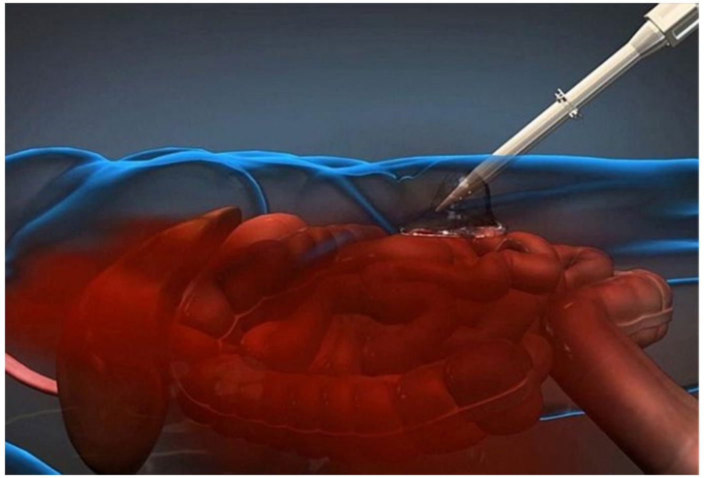
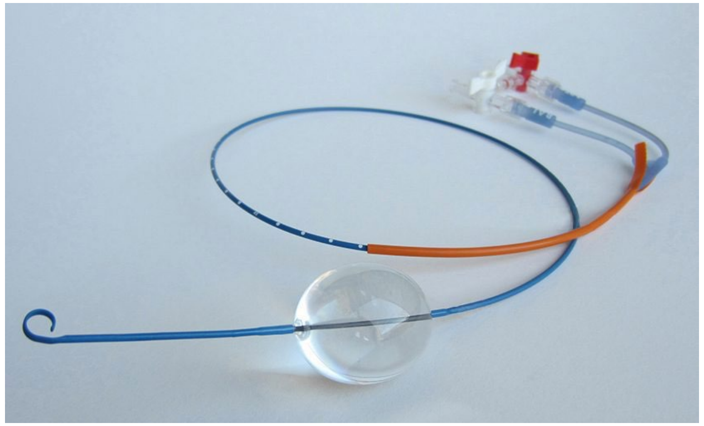
There’s a lot of “cool stuff” out there…







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	1 Idea	2a Development	2b Exploration	3 Assessment	4 Long-term study
Purpose	Proof of concept	Development	Learning	Assessment	Surveillance
Number and types of patients	Single digit; highly selected	Few; selected	Many; may expand to mixed; broadening indication	Many; expanded indications (well defined)	All eligible
Number and types of surgeons	Very few; innovators	Few; innovators and some early adopters	Many; innovators, early adopters, early majority	Many; early majority	All eligible
Output	Description	Description	Measurement; comparison	Comparison; complete information for non-RCT participants	Description; audit, regional variation; quality assurance; risk adjustment
Intervention	Evolving; procedure inception	Evolving; procedure development	Evolving; procedure refinement; community learning	Stable	Stable
Method	Structured case reports	Prospective development studies	Research database; explanatory or feasibility RCT (efficacy trial); diseased based (diagnostic)	RCT with or without additions/ modifications; alternative designs	Registry; routine database (eg, SCOAP, STS, NSQIP); rare-case reports
Outcomes	Proof of concept; technical achievement; disasters; dramatic successes	Mainly safety; technical and procedural success	Safety; clinical outcomes (specific and graded); short-term outcomes; patient-centred (reported) outcomes; feasibility outcomes	Clinical outcomes (specific and graded); middle-term and long-term outcomes; patient-centred (reported) outcomes; cost-effectiveness	Rare events; long-term outcomes; quality assurance
Ethical approval	Sometimes	Yes	Yes	Yes	No
Examples	NOTES video[6]	Tissue engineered vessels[7]	Italian D2 gastrectomy study[8]	Swedish obese patients study[9]	UK national adult cardiac surgical database[10]

RCT=randomised controlled trial. SCOAP=Surgical Clinical Outcomes Assessment Programme. STS=Society of Thoracic Surgeons. NSQIP=National Surgical Quality Improvement Program. NOTES=natural orifice translumenal endoscopic surgery.

Table: **Stages of surgical innovation**

n

Parmar *et al. BMC Medicine* (2016) 14:183
DOI 10.1186/s12916-016-0722-3

BMC Medicine

CORRESPONDENCE Open Access

How do you design randomised trials for smaller populations? A framework

Mahesh K. B. Parmar[1], Matthew R. Sydes[1] and Tim P. Morris[1,2*]

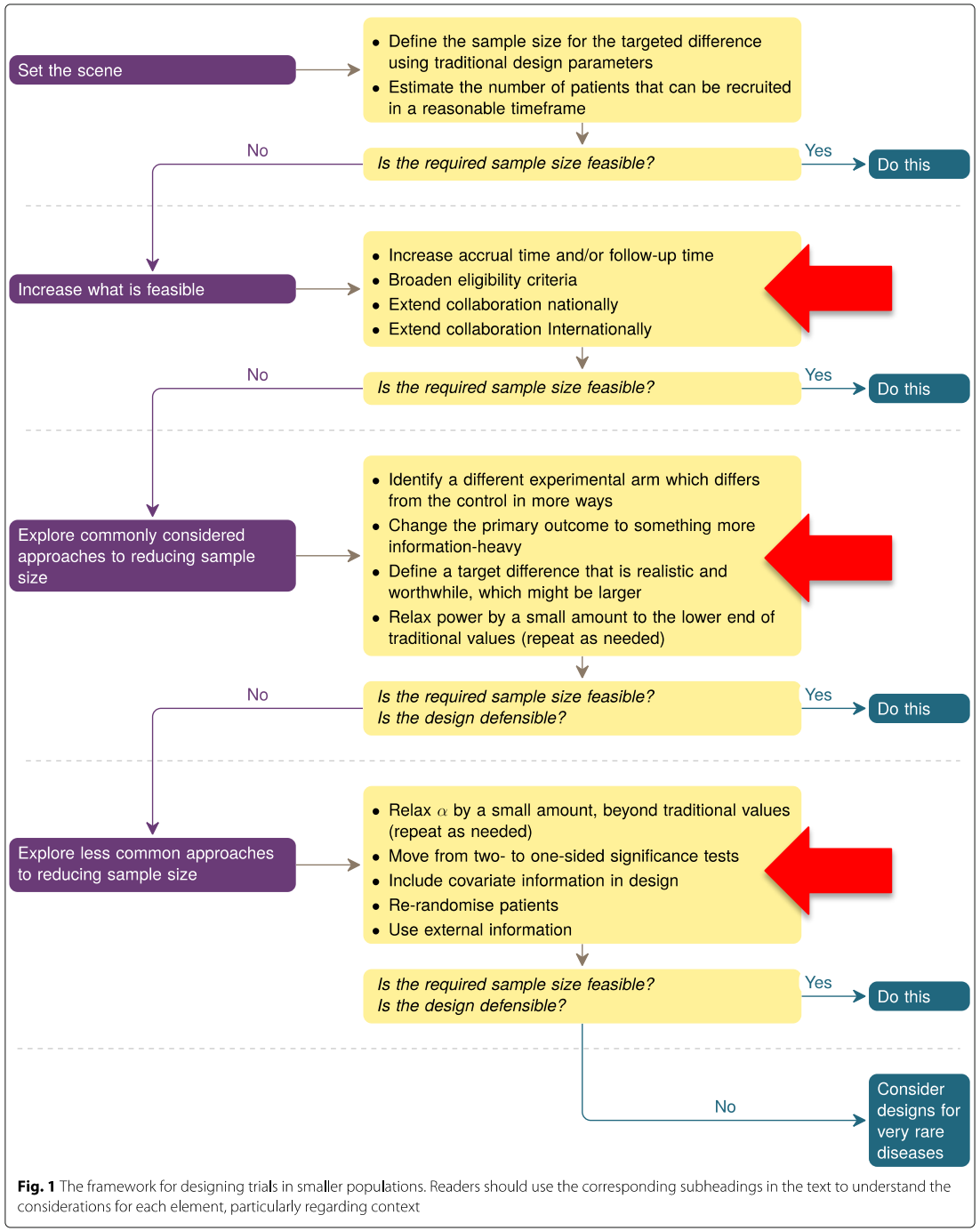

Fig. 1 The framework for designing trials in smaller populations. Readers should use the corresponding subheadings in the text to understand the considerations for each element, particularly regarding context

Bayesian Analytical Frameworks

No longer niche

Guidance
for Industry and FDA Staff

Guidance for the Use of Bayesian Statistics in Medical Device Clinical Trials

Document issued on: February 5, 2010

The draft of this document was issued on 5/23/2006

For questions regarding this document, contact Dr. Greg Campbell (CDRH) at 301-796-5750 or greg.campbell@fda.hhs.gov or the Office of Communication, Outreach and Development, (CBER) at 1-800-835-4709 or 301-827-1800.

U.S. Department of Health and Human Services
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Center for Biologics Evaluation and Research

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More meaningful and interpretable conclusions

Posterior probability is the *actual* probability (that it works, or not)

NOT the same as a p-value

Posterior probabilities (and credible intervals) may be lower than you would like…

…but that may be ok!

How much proof do you need to convince yourself, clinicians, or patients that something works, or doesn’t work?

What posterior probability *does* matter?

Choice of (primary) outcome

How much proof do you need to convince regulators that something works, or doesn't work?

Are you trying to convince regulators?

A lot of new technology have received (FDA) approval by other means

JAMA | Original Investigation

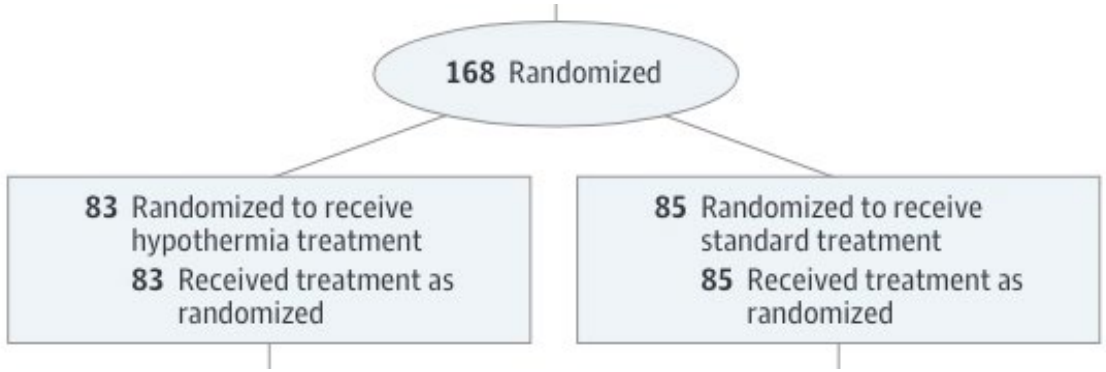
Effect of Therapeutic Hypothermia Initiated After 6 Hours of Age on Death or Disability Among Newborns With Hypoxic-Ischemic Encephalopathy

A Randomized Clinical Trial

Abbot R. Laptook, MD; Seetha Shankaran, MD; Jon E. Tyson, MD, MPH; Breda Munoz, PhD; Edward F. Bell, MD; Ronald N. Goldberg, MD; Nehal A. Parikh, DO, MS; Namasivayam Ambalavanan, MD; Claudia Pedroza, PhD; Athina Pappas, MD; Abhik Das, PhD; Aasma S. Chaudhary, BS, RRT; Richard A. Ehrenkranz, MD; Angelita M. Hensman, MS, RNC-NIC; Krisa P. Van Meurs, MD; Lina F. Chalak, MD, MSCS; Amir M. Khan, MD; Shannon E. G. Hamrick, MD; Gregory M. Sokol, MD; Michele C. Walsh, MD, MS; Brenda B. Poindexter, MD, MS; Roger G. Faix, MD; Kristi L. Watterberg, MD; Ivan D. Frantz III, MD; Ronnie Guillet, MD, PhD; Uday Devaskar, MD; William E. Truog, MD; Valerie Y. Chock, MD, MS-Epi; Myra H. Wyckoff, MD; Elisabeth C. McGowan, MD; David P. Carlton, MD; Heidi M. Harmon, MD, MS; Jane E. Brumbaugh, MD; C. Michael Cotten, MD, MHS; Pablo J. Sánchez, MD; Anna Maria Hibbs, MD; Rosemary D. Higgins, MD; for the Eunice Kennedy Shriver National Institute of Child Health and Human Development Neonatal Research Network

TRIAL REGISTRATION clinicaltrials.gov Identifier: NCT00614744

JAMA. 2017;318(16):1550-1560. doi:10.1001/jama.2017.14972
Corrected on March 13, 2018.



Complex intervention
Small available numbers
No “regulatory issue”

Table 3. Primary and Secondary Outcomes: aRRs and Posterior Probability of Treatment Effect[a]

Outcome	No. (%)		Enthusiastic Prior (RR, 0.72)		Neutral Prior (RR, 1.0)		Skeptical Prior (RR, 1.10)	
	Hypothermia (n = 78)	Noncooled (n = 79)	aRR (95% Credible Interval)	P-TB, %	aRR (95% Credible Interval)	P-TB, %	aRR (95% Credible Interval)	P-TB, %
Primary Outcome								
Death or moderate-severe disability	19 (24.4)	22 (27.9)	0.78 (0.52-1.15)	90	0.86 (0.58-1.29)	76	0.89 (0.60-1.32)	73

Conclusions

Among term infants with hypoxic-ischemic encephalopathy, hypothermia initiated at 6 to 24 hours after birth compared with noncooling resulted in a 76% probability of any reduction in death or disability, and a 64% probability of at least 2% less death or disability at 18 to 22 months. Hypothermia initiated at 6 to 24 hours after birth may have benefit but there is uncertainty in its effectiveness.

More helpful than a (“non-significant”) p-value

UK REBOA TRIAL

RESUSCITATIVE ENDOVASCULAR BALLOON OCCLUSION OF THE AORTA FOR TRAUMA

UAB MEDICINE TRAUMA
ALWAYS HERE ALWAYS READY

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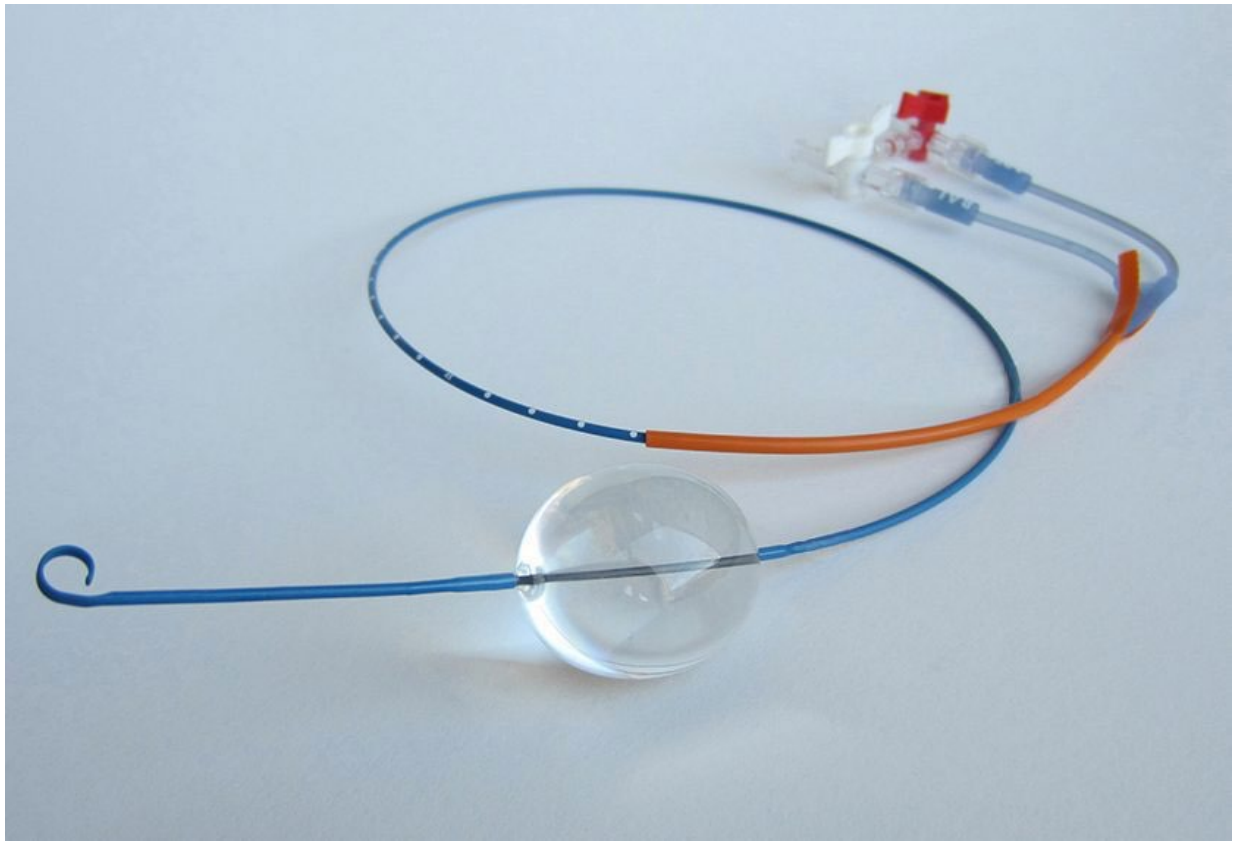
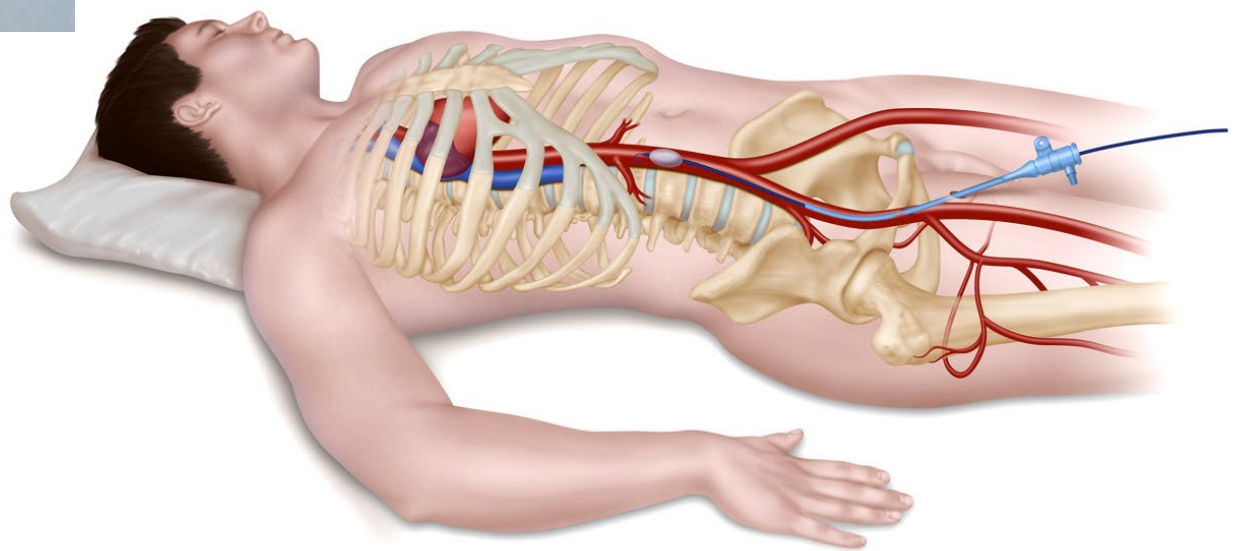
First (and only) randomized controlled trial of REBOA





Control hemorrhage
Increase cerebral/myocardial perfusion

Highly complex, sick/dying patients

Unable to give consent

Challenging clinical setting

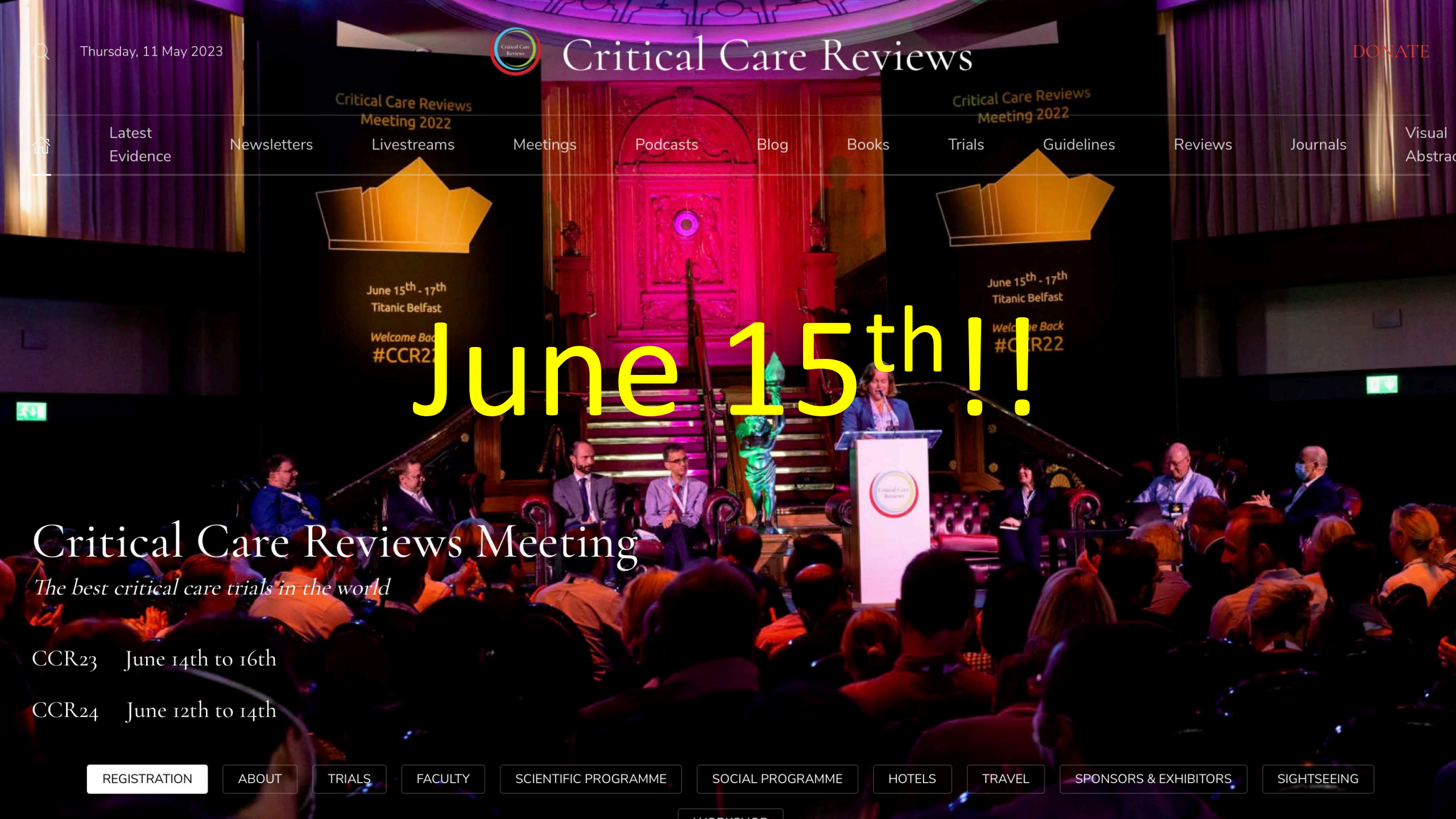
Technically difficult procedure

16 UK Major Trauma Centers

Small available “n”… 120 patients

Bayesian group-sequential design

Would not have been possible (and been much less informative) with a frequentist design


Thursday, 11 May 2023
Critical Care Reviews
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Livestreams
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Blog
Books
Trials
Guidelines
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Journals
Visual Abstrac
Critical Care Reviews Meeting 2022
June 15th - 17th
Titanic Belfast
#CCR22
June 15th!!
Critical Care Reviews Meeting
The best critical care trials in the world
CCR23 June 14th to 16th
CCR24 June 12th to 14th
REGISTRATION
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SIGHTSEEING

At some point, evaluation of innovative and evolving healthcare technology will probably involve a randomized clinical trial

Do all the “normal” things

Bayesian analytical frameworks have much to offer

jjansen@uabmc.edu

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Promoting Excellence in Health Services Research

Optimising the implementation of technology for evaluation – case study examples

Katie Gillies

@GilliesKatie

HSRU is core funded by the Chief Scientist Office of the Scottish Government Health and Social Care Directorates. The author accepts full responsibility for this talk.

CHIEF SCIENTIST OFFICE

1495 UNIVERSITY OF ABERDEEN

Disclosures

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NIHR | National Institute for Health and Care Research

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INTUITIVE SURGICAL®

Boehringer Ingelheim

Outline

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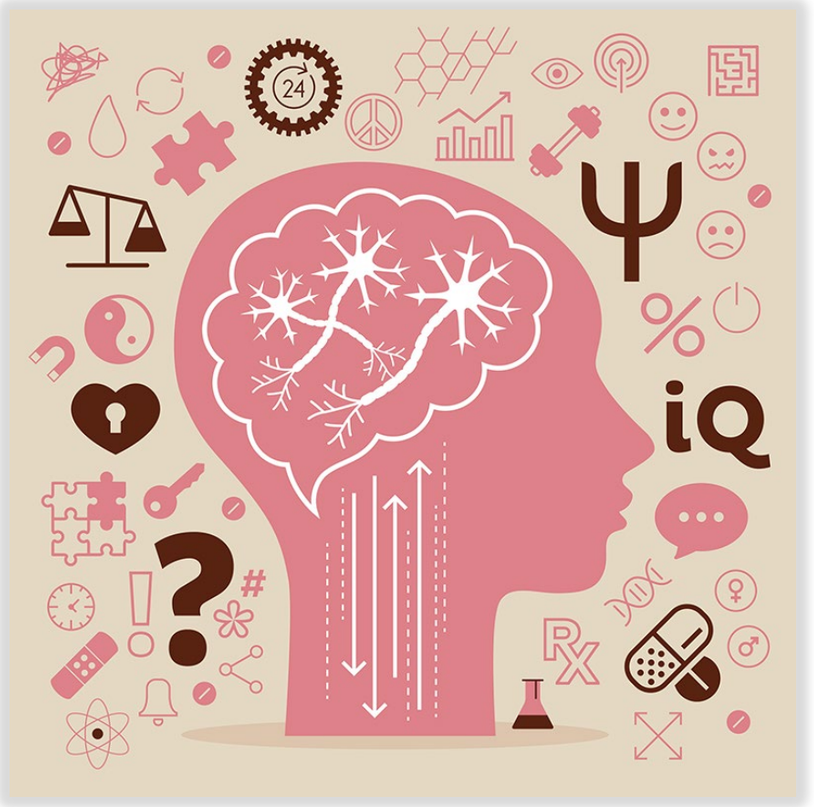
- Behaviour important for intervention optimisation
- Examples from our research
- Overarching learning



Behaviours in trials

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From specification to solution

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Behavioural specification

defining the problem

Behavioural investigation

diagnosing the problem

Behavioural solutions

treating the problem

Prospective optimisation of evaluation

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REINFORCE
Real-World Evaluation of Robot-Assisted Surgical Services

PLOS ONE

RESEARCH ARTICLE

Barriers and enablers to the effective implementation of robotic assisted surgery

Louisa Lawrie[1]*, Katie Gillies[1], Eilidh Duncan[1], Loretta Davies[2], David Beard[2], Marion K. Campbell[1]

1 Health Services Research Unit, Institute of Applied Health Sciences, School of Medicine, Medical Sciences and Nutrition, University of Aberdeen, Aberdeen, Scotland, United Kingdom, **2** RCS Surgical Interventional Trials Unit (SITU), Nuffield Dept Orthopaedics, Rheumatology and Musculo-skeletal Sciences, University of Oxford, Oxford, United Kingdom

* louisa.lawrie1@abdn.ac.uk

‘Diagnosis’ - What did we do?

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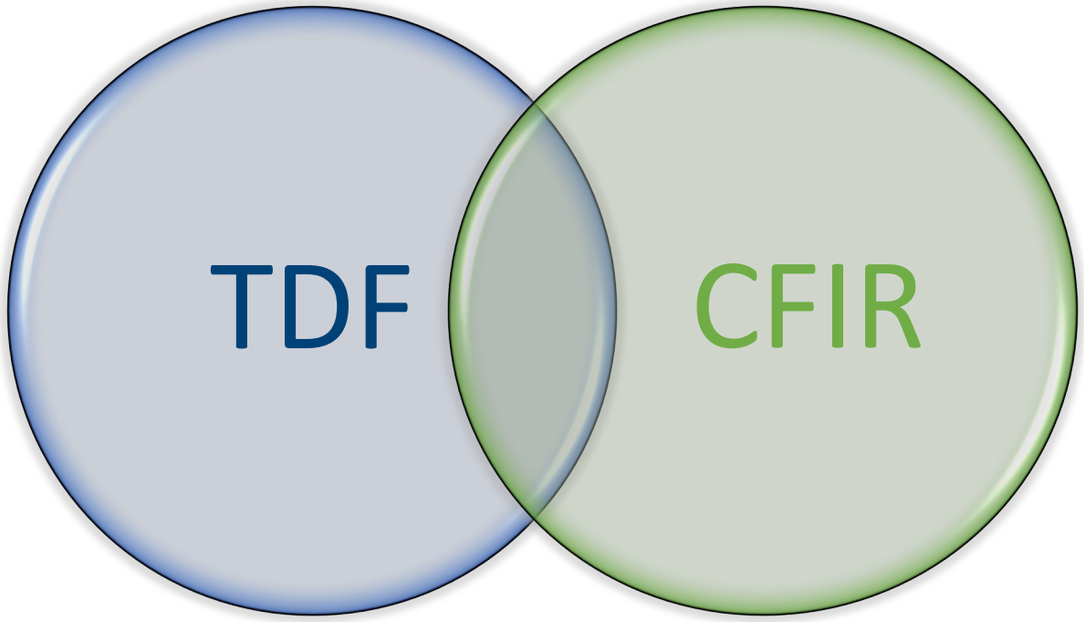

‘Diagnosis’ - What did we find?

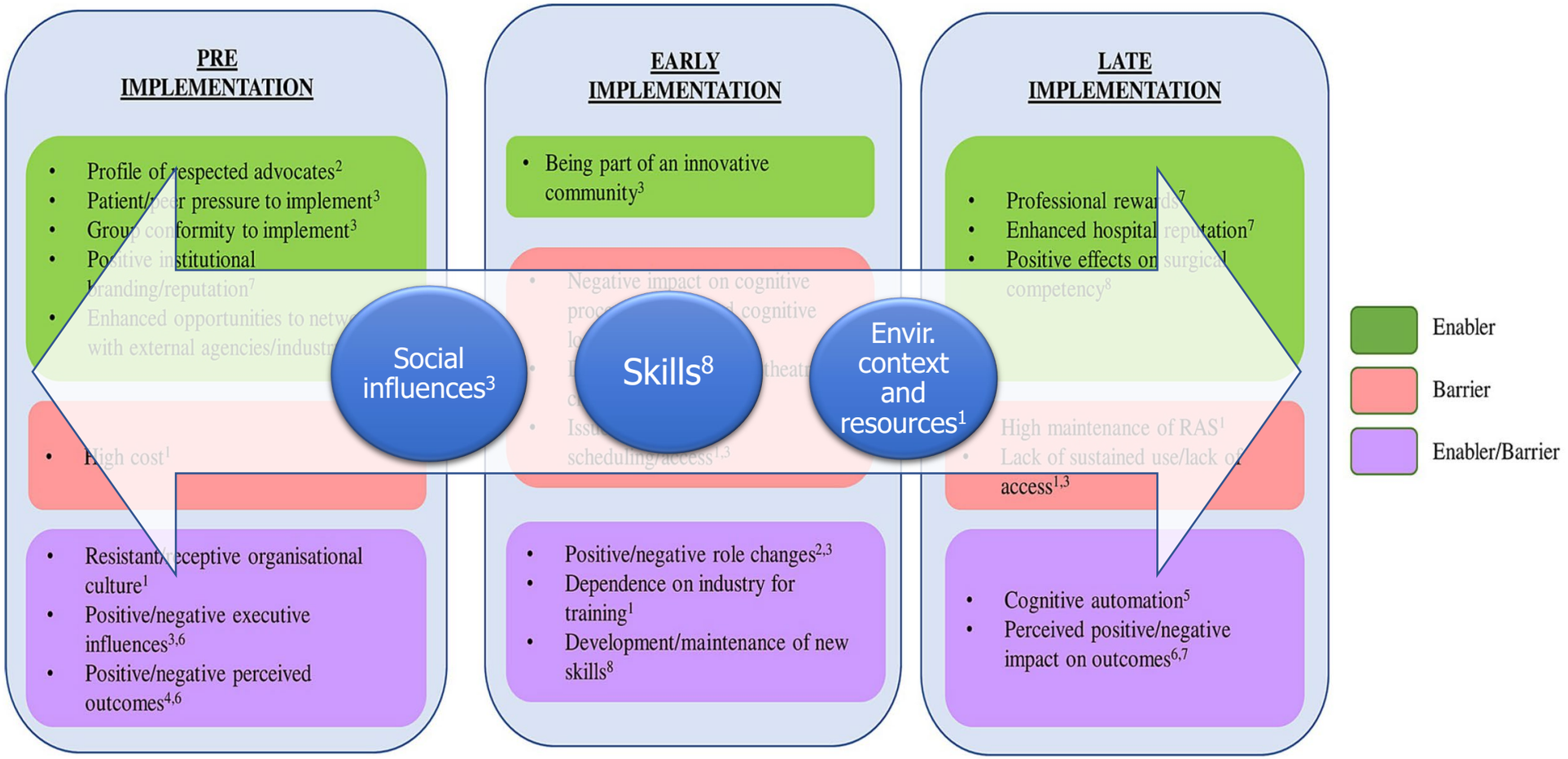

Fig 1. The barriers and enablers of implementation at each phase of adoption. TDF domains: [1]Environmental Context & Resources, [2]Social Professional Role & Identity, [3]Social Influences, [4]Beliefs about Consequences, [5]Memory Attention & Decision Processes, [6]Knowledge, [7]Reinforcement, [8]Skills.

https://doi.org/10.1371/journal.pone.0273696.g001

‘Treatment’ - What did we do?

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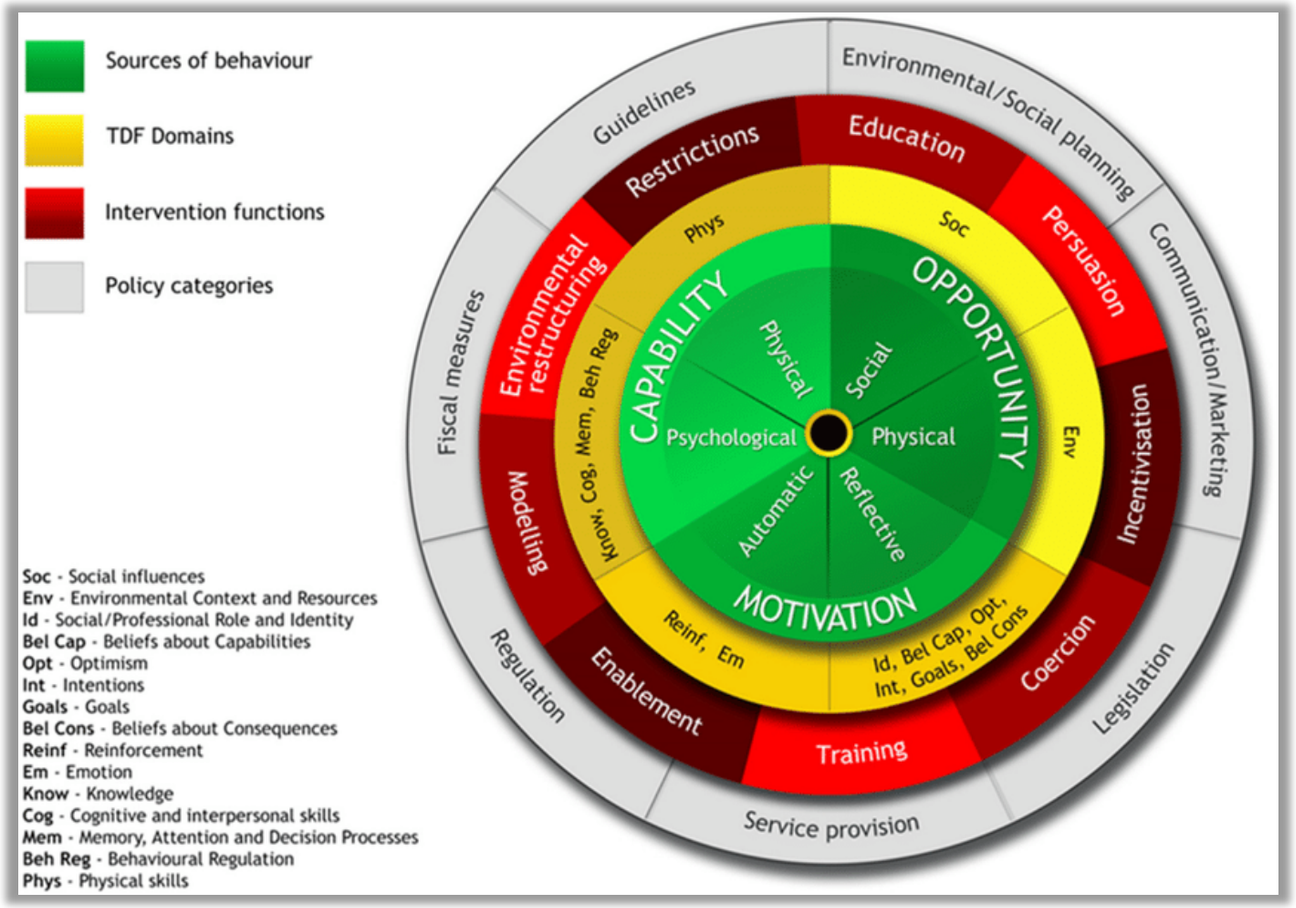

‘Treatment’ – What did we propose?

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Pre-Implementation

Theme(s)	Domain(s)	Intervention Function(s)	Proposed BCT(s)	Example
Social and Professional Roles: Impact on adoption	Social Professional Role & Identity Social Influences	Enablement	3.2. Social Support (Practical)	Enlist support of internal or external key opinion leaders (with academic backgrounds) at the outset to promote local implementation.
Patient/peer pressure Group conformity Competitiveness to innovate	Social Influences	Enablement	3.2. Social Support (Practical) 6.2. Social Comparison	Appoint clinical and patient champions to present the case for implementation. Draw attention to other hospitals with successful integrated RAS services to show benefit in comparison with existing service provision.
Managerial and executives influences	Social Influences Knowledge	Enablement Education	3.2. Social Support (Practical) 5.1. Information about health consequences 5.3. Information about social and environmental consequences	Appoint clinical and patient champions to present a favourable, albeit balanced, case for implementation to managers & commissioners Inform relevant stakeholders about the potential positive consequences of RAS implementation: expected improved patient outcomes and positive impact on staff retention/recruitment.

Implementation

Theme	Domain(s)	Intervention Function(s)	Proposed BCT(s)	Example
ocial and Pro[illegible]onal Roles: mpact on adoptio	Social Professional Role & Identity Social Influences	Enablement	3.2. Social Support (Practical)	Enlist support of internal or external key opinion leaders (with academic backgrounds) at the outset to promote local implementation.
atient/peer pressure roup conformity ompetitiveness to innovate	Social Influences	Enablement	3.2. Social Support (Practical) 6.2. Social Comparison	Appoint clinical and patient champions to present the case for implementation. Draw attention to other hospitals with successful integrated RAS services to show benefit in
anagerial and executives fluences	Soci Kno			
erceived Outcomes of RAS	Belief Cons Know			
nstitution Branding and Profiling	Reinf			
t-up/Early Implementation				
eme	Dom			
RA nfluences role modifications	Soci Role Soci			
Competen s required to conduct RAS	Skills			
Working in a R theatre: Impact on cognitive pro sses.	Mem and Proce			
Social and environm tal structures: Access to S	Soci Envi Cont			
Late Implementation				
Theme	Dom			
Working in a RAS theatre: Automatic cognitive processes during the conduct of RAS case	Mem Deci			
Social and environmental structures: Access to RAS, 'Dabbling and Stalling Surgeons'	Soci Envi Cont			
Perceived outcomes of RAS and consideration of economic viability	Be Con Knowledge		5.3. Information about social and environmental consequences	positive) impact on patient outcome. Present hospital data related to RAS process information to aid understanding of (expected beneficial) impact on efficiency.
Rewards associated with RAS implementation	Reinforcement	Incentivisation	10.6. Non-specific incentive	Identify monetary/non-monetary incentives to reward RAS activity.

https://doi.org/10.1371/journal.pone.0273696.t002

In situ optimisation of evaluation

Lawrie et al. Trials (2022) 23:398
https://doi.org/10.1186/s13063-022-06341-6

Trials

RESEARCH Open Access

Behavioural optimisation to address trial conduct challenges: case study in the UK-REBOA trial

Louisa Lawrie[1*], Eilidh M. Duncan[1], Jan O. Jansen[1,2], Marion K. Campbell[1], Dan Brunsdon[1], Zoë Skea[1], Taylor Coffey[1], Claire Cochran[1] and Katie Gillies[1]

- Recruitment of patients
- Delivery of the intervention

‘Diagnosis’ - What did we do?

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TDF

‘Diagnosis’ - What did we find?

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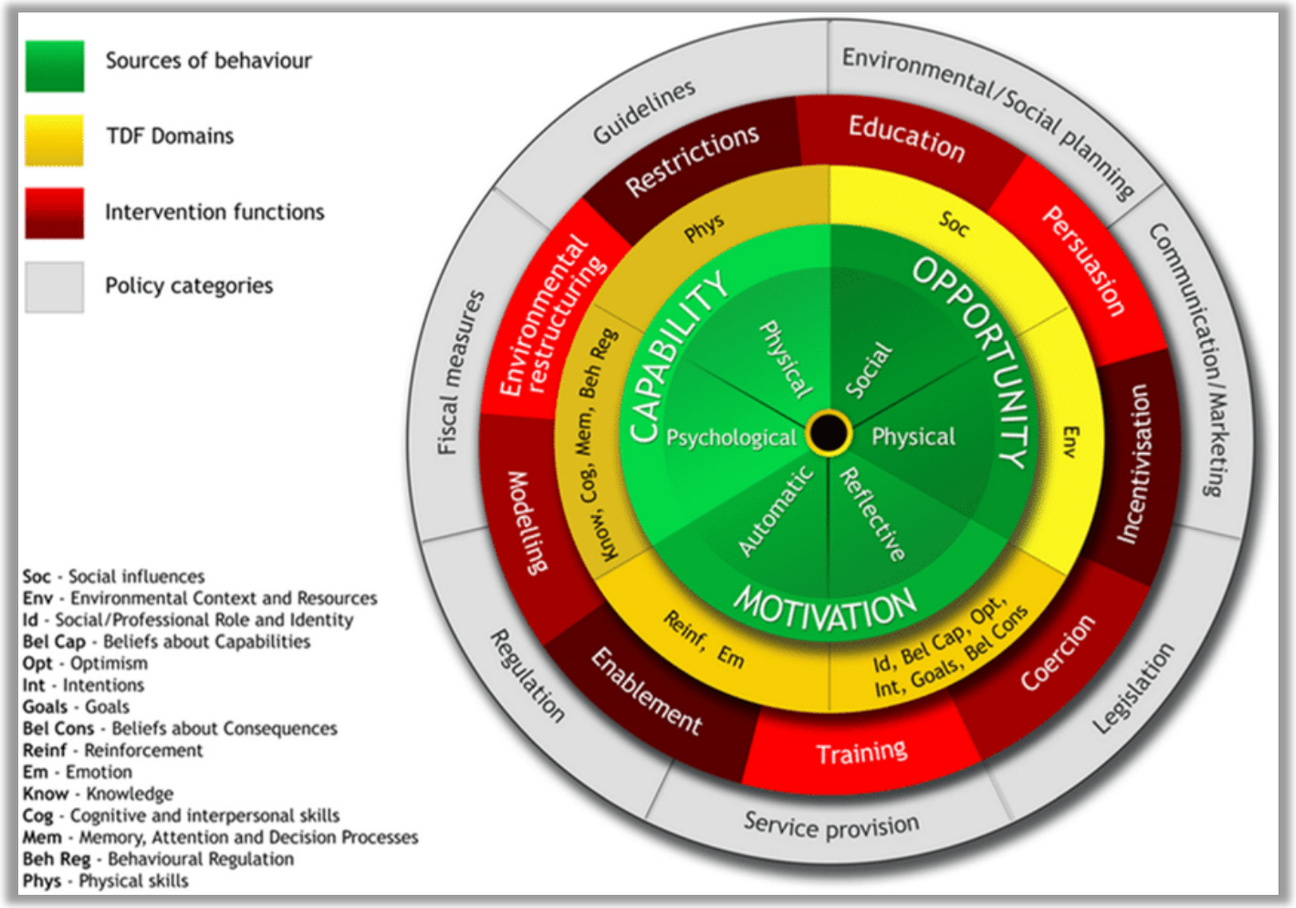
Skills	• Recognising eligible patients ▪ linked to definition of exsanguinating haemorrhage • Scarcity of cases vs maintenance of skills
Memory, Attention, Decision making	• Waiting to see if patients needs REBOA
Environment, context, resources	• So few patients require REBOA
Social influence	• Perception of individual and colleagues equipoise • Enthusiasm

‘Treatment’ - What did we do?

HSRU



‘Treatment’ – What did we propose?

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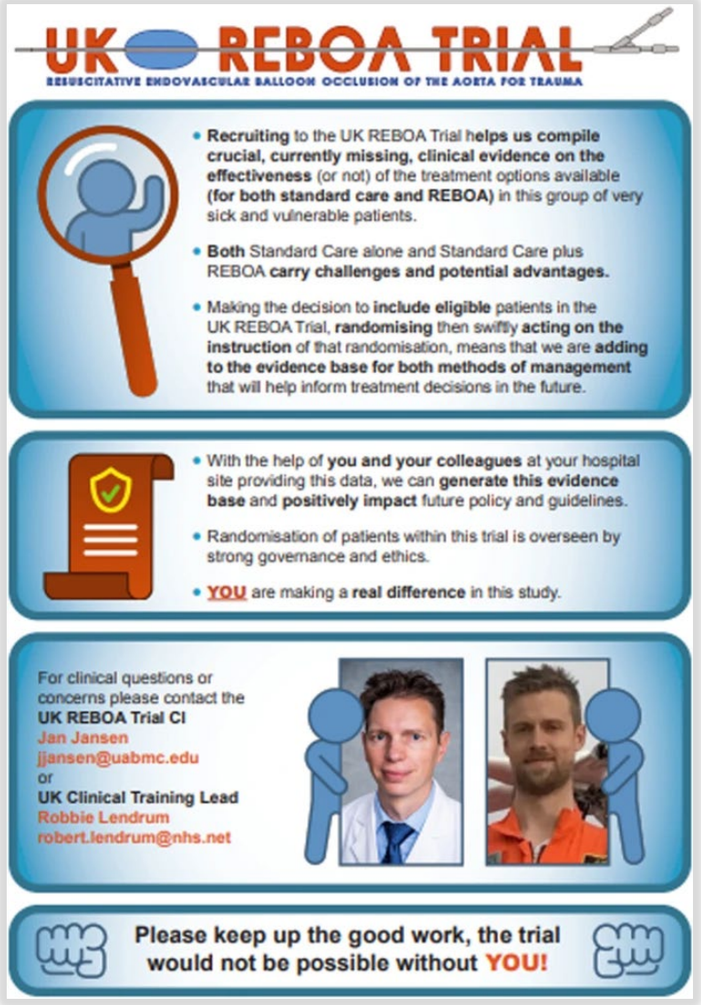
Proposed solution(s)	Proposed content	Selected BCT(s) (domain-relevant/supplementary)	Belief statements (salient barriers/enablers, linked to TDF domains)	Inclusion record (including APEASE criteria)
Training	Target altruistic emotions — express satisfaction of being part of a trial which will influence clinical practice Encourage reflection of the pros/cons to recruitment in the trial generally. Including advantages of knowing which clinical method is most effective. Highlight how the research will influence clinical practice. Remind staff about the potential benefits of REBOA to patients with traumatic injury, despite the associated risks. Also benefits of not doing REBOA — standard care. The purpose of the trial is to find out which method is best. Highlight that staff are contributing to valuable research which will also benefit the reputation of each institute. Present case studies of real-life examples where patients have been treated with REBOA and standard care, and highlight the valuable contribution of the trial Link the benefit of taking part in the trial to anticipated regrets of failing to recruit eligible patients. Remind staff of the scarcity of cases. Highlight the requirement to address the trial research question	5.6. Information about emotional consequences 9.2. Pros and cons 5.1. Information about health consequences 5.3. Information about social and environmental consequences 5.2. Salience of consequences 5.5. Anticipated regret	‘Reputational benefit for the institute associated with being able to recruit patients and deploy REBOA’ (TDF Beliefs about consequences) ‘REBOA may be beneficial’ (TDF Beliefs about consequences) ‘REBOA may cause complications’ (TDF Beliefs about consequences) ‘It can be difficult to define exsanguinating haemorrhage’ (TDF Beliefs about consequences)	**Include BCTs 5.6., 9.2., 3.2., 5.1., 5.2.:** All APEASE criteria met **Exclude BCT 5.5**: May not be acceptable. Many valid reasons for not recruiting eligible patients, external, out-with control. APEASE Acceptability, Equity and Side-Effects criteria not met
Persuasion Enablement	Local principal investigators (PIs) can actively persuade relevant staff members that they are capable of performing the REBOA intervention during conversations/meetings. Highlight transferable skills of trial recruitment — include the successful past experience of trial involvement Encourage staff to practice positive self-talk as a team: this could include discussing one’s own achievements/successes in a group setting. PIs to deliver	15.1. Verbal persuasion about capability 15.4. Self-talk	‘There is lots of nervousness around delivering REBOA related to personal abilities’ (TDF Beliefs about capabilities)	BCTs 15.3. and 15.1. can instead be incorporated via trial Training practices APEASE Effectiveness criteria not met APEASE Practicability criteria not met for BCT 15.4. Difficult to implement in a trauma care setting

‘Treatment’ – What did we propose?



- How did you identify patients eligible for REBOA?
- Can you provide step-by-step information regarding the procedures you followed before/after randomisation?
- What were the challenges you faced during this case?
- Which aspects of recruitment/intervention delivery went well? Why?
- Is there anything you would do differently if a similar case arose in the future? (can you think of any solutions?)

How did it help?

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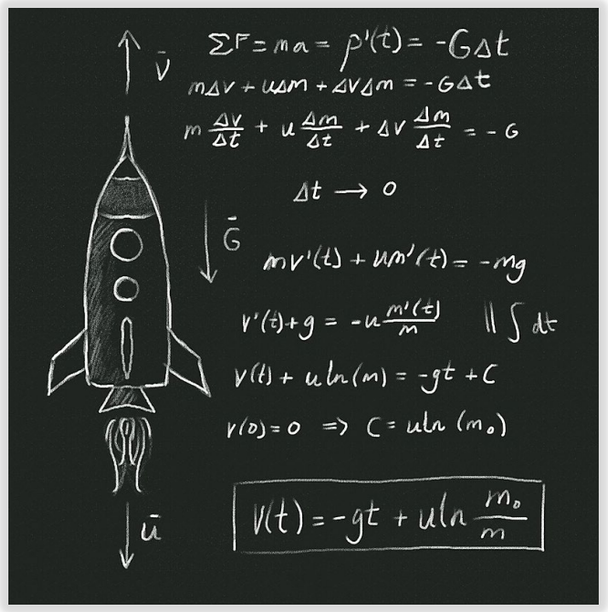

- ✓ **Evidence based plans to avoid or target implementation challenges**
- ✓ **Theory informed = ↑ replicability & transferability**
- ✓ **Provides mechanism of action/change**

DISCLAIMER! Needs to be tested

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Promoting Excellence in Health Services Research

Thank you

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Dr Taylor Coffey
Dr Eilidh Duncan
Prof Marion Campbell

Public Partner
Terry Mackie
Victoria Le Brec

University of Oxford
Prof David Beard
Dr Loretta Davies

University of Alabama at Birmingham
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