From Theory to Practice: An Introduction to Implementation Science

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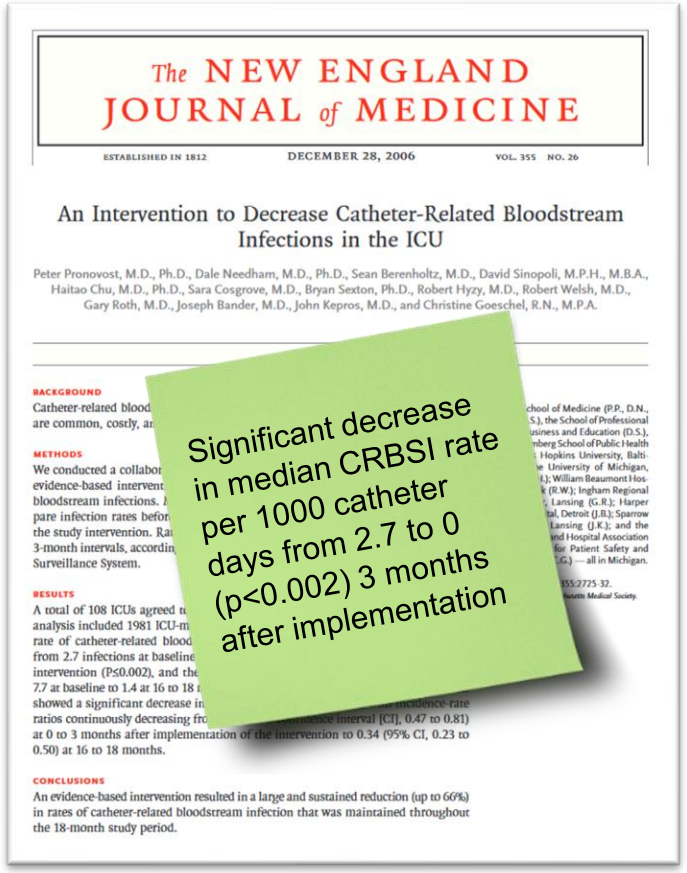
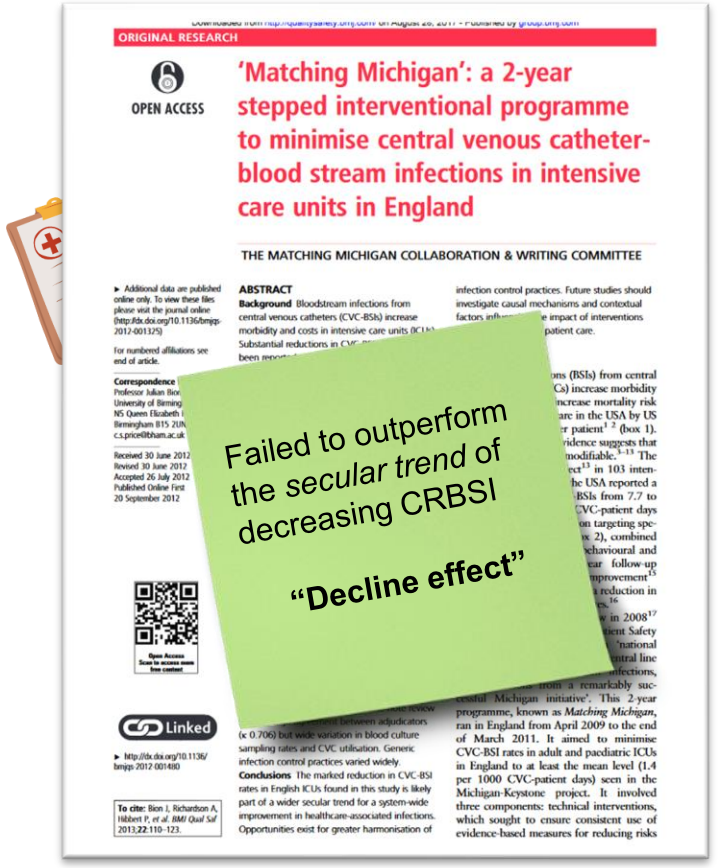


Pronovost et al. An intervention to decrease catheter-related bloodstream infections in the ICU. NEJM 2006. 355(26) 2725-32

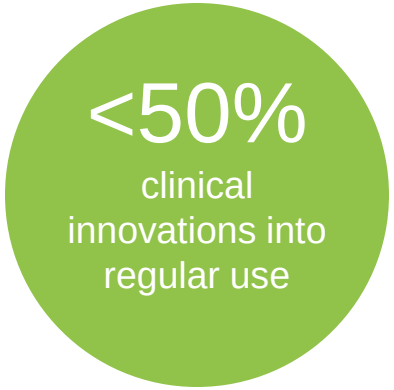


Bion et al. 'Matching Michigan': a 2-year stepped interventional programme to minimise central venous catheter-blood stream infections in intensive care units in England. BMJ Q&S 2013. 22(2) 110-23.

The know-do gap

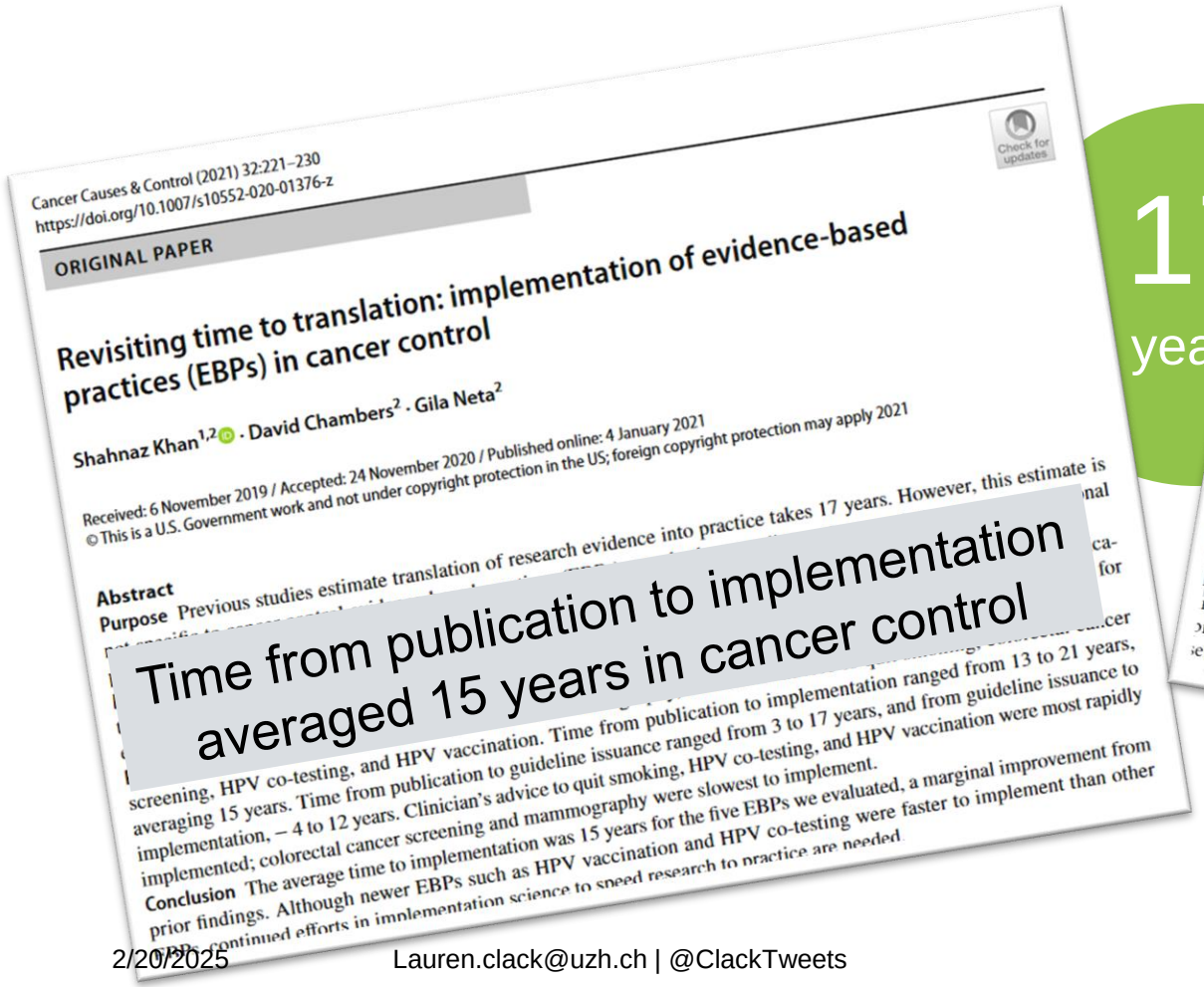
Research pipeline

Quantifying leaks in the pipeline



(Morris, Z.S., Wooding, S., Grant, J., 2011. The answer is 17 years. what is the question: understanding time lags in translational research. J. Roy. Soc. Med. 104, 510–520., Mosteller, F., 1981. Innovation and evaluation. Science 211, 881–886.)

Quantifying leaks in the pipeline



Cancer Causes & Control (2021) 32:221–230
https://doi.org/10.1007/s10552-020-01376-z

ORIGINAL PAPER

Revisiting time to translation: implementation of evidence-based practices (EBPs) in cancer control

Shahnaz Khan[1,2] · David Chambers[2] · Gila Neta[2]

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Abstract

Purpose Previous studies estimate translation of research evidence into practice takes 17 years. However, this estimate is

screening, HPV co-testing, and HPV vaccination. Time from publication to implementation ranged from 13 to 21 years, averaging 15 years. Time from publication to guideline issuance ranged from 3 to 17 years, and from guideline issuance to implementation, – 4 to 12 years. Clinician's advice to quit smoking, HPV co-testing, and HPV vaccination were most rapidly implemented; colorectal cancer screening and mammography were slowest to implement.

Conclusion The average time to implementation was 15 years for the five EBPs we evaluated, a marginal improvement from prior findings. Although newer EBPs such as HPV vaccination and HPV co-testing were faster to implement than other

continued efforts in implementation science to speed research to practice are needed.

Time from publication to implementation averaged 15 years in cancer control

17 yea

Infection Control & Hospital Epidemiology (2018), **39**, 1277–1295
doi:10.1017/ice.2018.183

Original Article

The preventable proportion of healthcare-associated infections 2005–2016: Systematic review and meta-analysis

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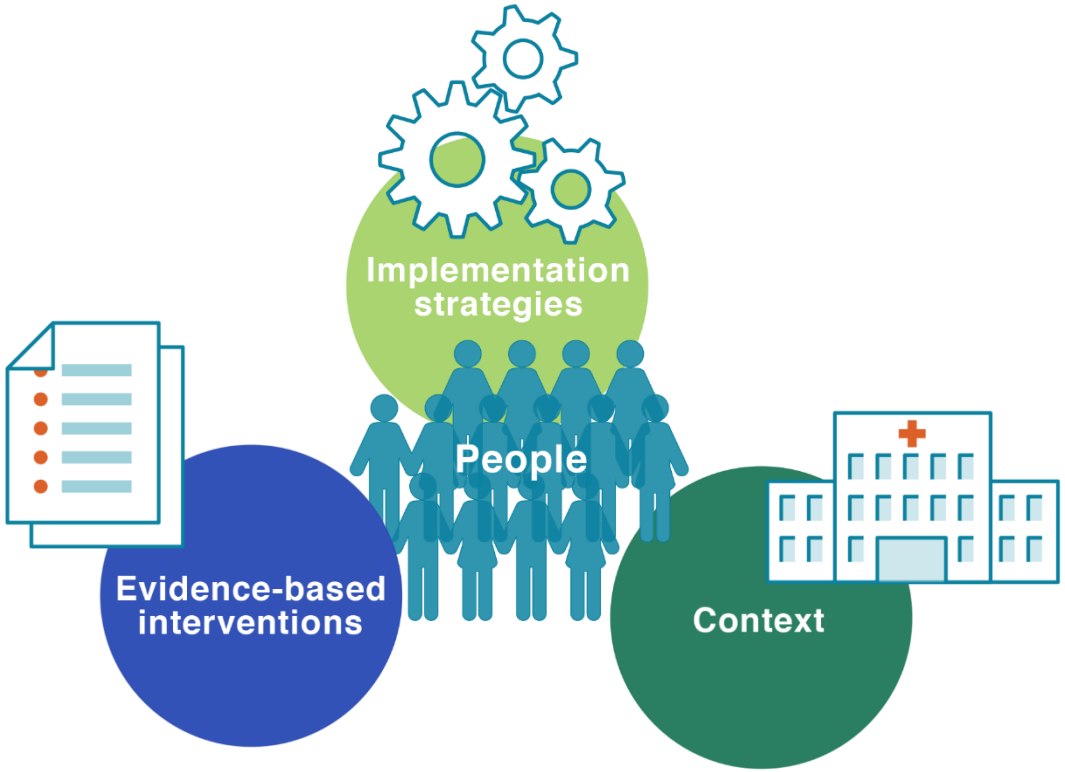
[1]Division of Infectious Diseases and Hospital Epidemiology, University and University Hospital of Zurich, Zurich, Switzerland and [2]Swissnoso, National Center for Infection Control, Bern, Switzerland

35%-55% of healthcare-associated infections are preventable

Understanding leaks in the research pipeline



ISLAGIATT approach to implementation

Prof. Martin Eccles, Implementation Researcher

What is implementation science?

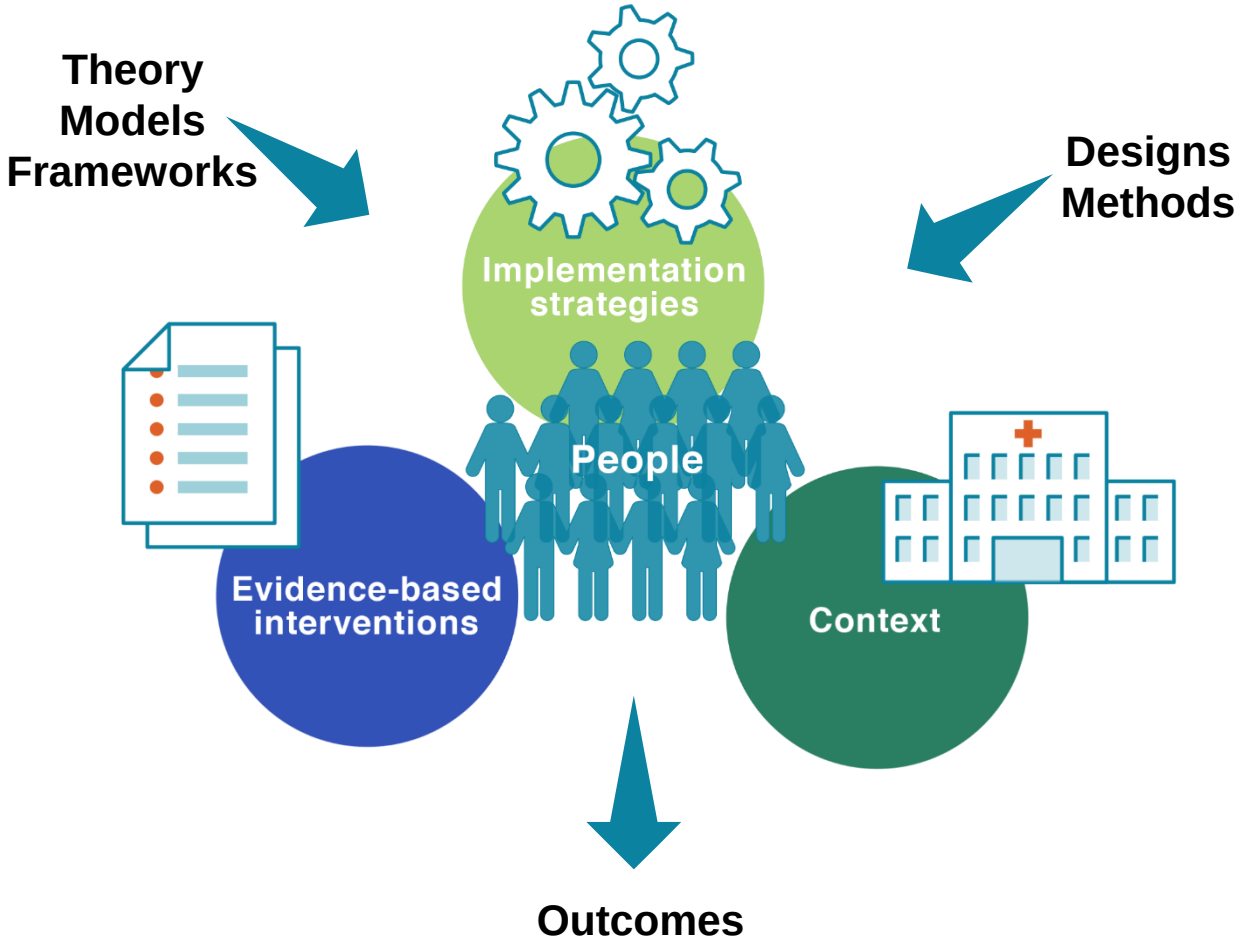
Implementation science definition

Implementation science is defined as the **scientific study of methods** to promote the **systematic integration** of **research findings and evidence based practices** into care delivery and the **de-integration of low value care**.

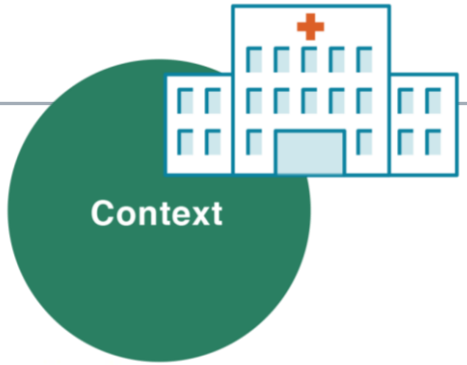
- Involves early and active engagement of practice partners and end users
- Draws from rich theoretical foundation for understanding, designing, and evaluating complex implementation processes and their multilevel contextual interactions

Intersection of research and practice

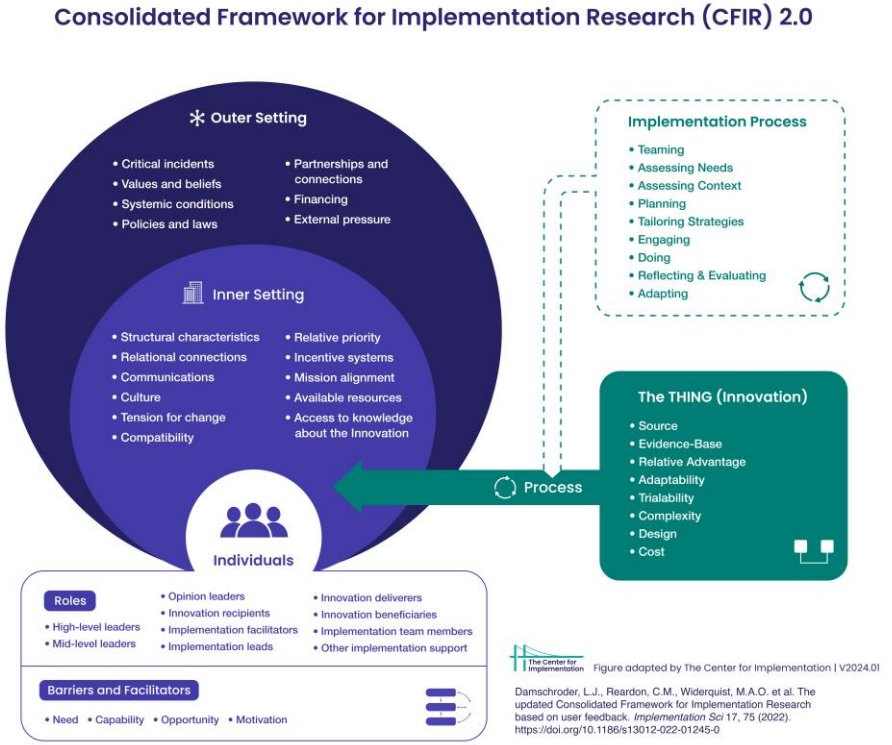
Implementation science ingredients



Context



- **Context:** the complex adaptive systems that form the dynamic environment(s) in which implementation processes are situated
- The **context and the intervention interact** and influence each other over time
- Understanding **context can inform design of tailored implementation** strategies and ultimately lead to better implementation outcomes



May, C. (2013). Towards a general theory of implementation. *Implementation Science, 8(1), 18.* https://doi.org/10.1186/1748-5908-8-18

Implementation strategies

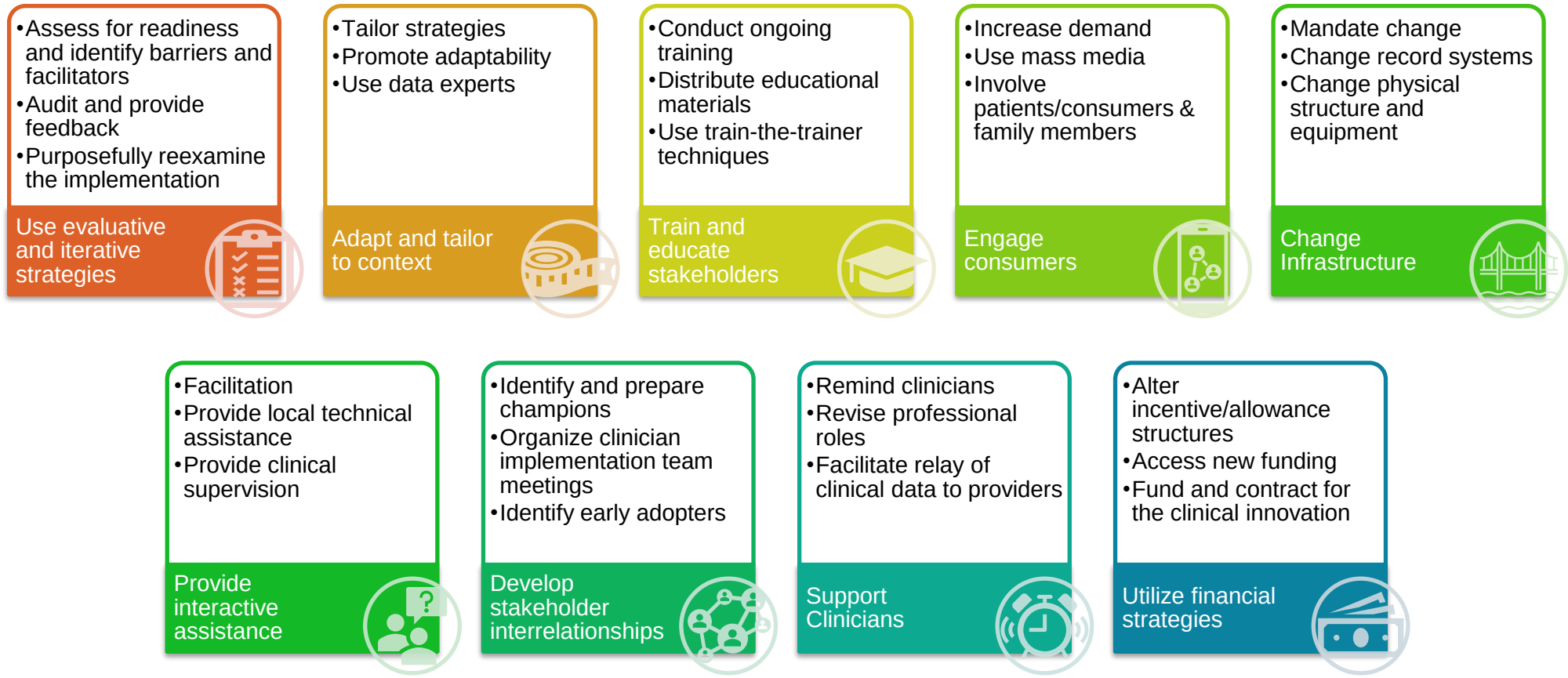
- “To a man with a hammer, everything looks like a nail.”
- Over-reliance on a familiar tool

- Training and education are necessary, yet insufficient to change behavior
- We must consider a broader range of implementation strategies addressing individual, organizational, and systems change

Clinical interventions vs. Implementation strategies

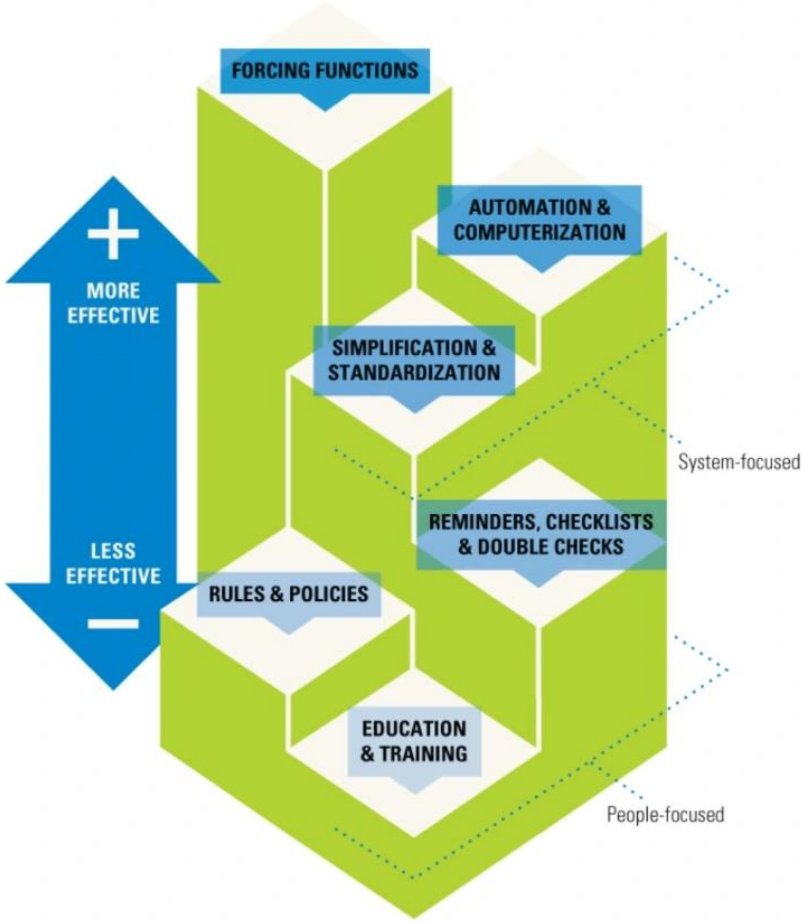
Clinical intervention
Hand hygiene
Removing unnecessary catheters

Expert recommendations for implementation change (ERIC) - Clusters



Source: Waltz, T.J., Powell, B.J., Matthieu, M.M. *et al.* Use of concept mapping to characterize relationships among implementation strategies and assess their feasibility and importance: results from the Expert Recommendations for Implementing Change (ERIC) study. *Implementation Sci* **10,** 109 (2015). https://doi.org/10.1186/s13012-015-0295-0

Implementation strategies



Powell, B.J., Waltz, T.J., Chinman, M.J. *et al.* A refined compilation of implementation strategies: results from the Expert Recommendations for Implementing Change (ERIC) project. *Implementation Sci* **10**, 21 (2015)
https://patientsafe.wordpress.com/the-hierarchy-of-intervention-effectiveness/

biology letters

Biol. Lett. (2006) 2, 412–414
doi:10.1098/rsbl.2006.0509
Published online 27 June 2006

Cues of being watched enhance cooperation in a real-world setting

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We examined the effect of an image of a pair of eyes on contributions to an honesty box used to collect money for drinks in a university coffee room. People paid nearly three times as much for their drinks when eyes were displayed rather than a control image. This finding provides the first evidence from a naturalistic setting of the importance of cues of being watched, and hence reputational concerns, on human cooperative behaviour.

Keywords: cooperative behaviour; altruism; reputation; eyespots

1. INTRODUCTION

People tend to be generous, even toward unrelated individuals (Fehr & Fischbacher 2003). This is true even in situations where there is no prospect of repeat interaction, and hence no potential for direct reciprocity (Gintis *et al.* 2003). A possible mechanism maintaining generosity, where direct reciprocity is absent, is the motivation to maintain a pro-social reputation (Alexander 1987; Roberts 1998). Theoretical models show that cooperation in sizeable groups can, in theory, be maintained where potential partners have information about a person's past behaviour and use it in making decisions about interaction (Nowak & Sigmund 1998; Panchanathan & Boyd 2004). In indirect reciprocity models of this kind, individuals with a history of non-cooperation are shunned and thus pay a long-term cost for their behaviour. Consistent with such models, laboratory experiments have shown that people increase their levels of cooperation when they know their behaviour is being observed by others, and also use reputational information in deciding how to interact with others (Milinski *et al.* 2002*a*,*b*; Wedekind & Braithwaite 2002; Barclay 2004).

Recent studies have shown that even when subjects are told they are anonymous, they respond to subtle cues of being watched, such as the presence of eye-like spots on the background of the computer on which they where people have the option of contributing or not, using their own money. Specifically, we test the hypothesis that participants will contribute more money to an honesty box (also known as an honour box) in the presence of an image of a pair of eyes than in the presence of a control image of flowers.

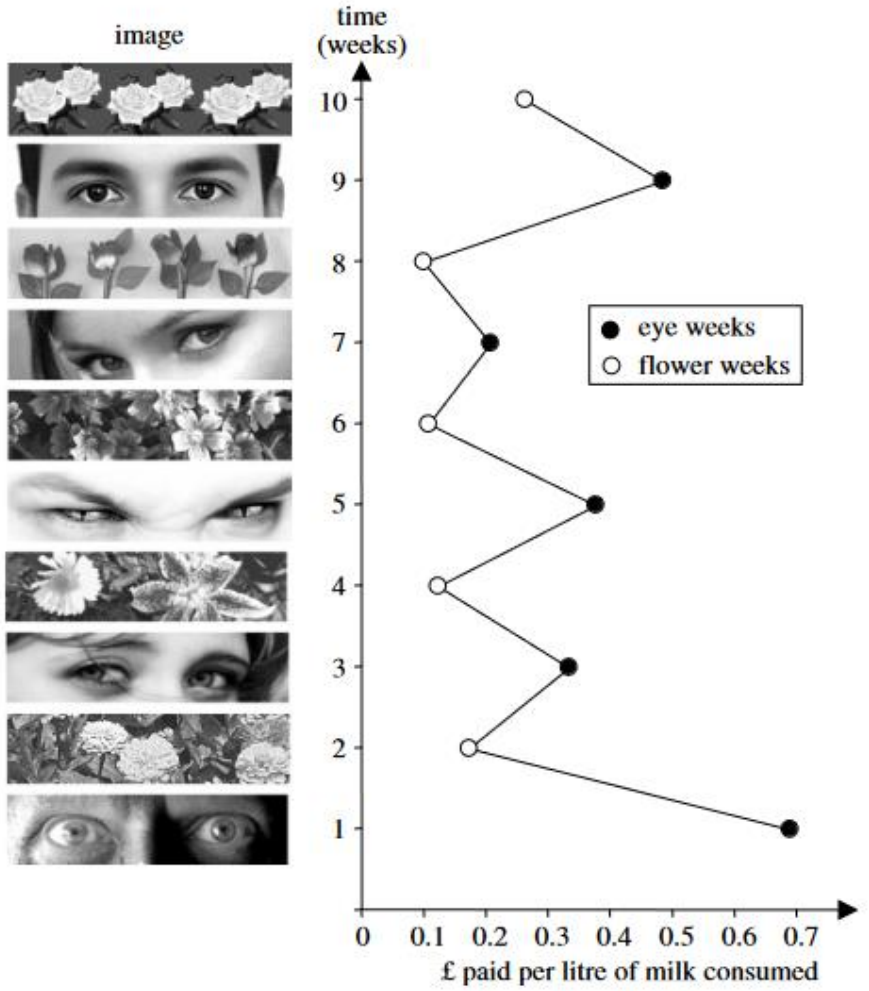
2. MATERIAL AND METHODS

Participants came from a population of 48 members (25 females and 23 males) of the Division of Psychology at the University of Newcastle, who had the option to pay for tea and coffee via an honesty box. This system of payment for drinks had been in place for several years prior to the commencement of the current study. Instructions for payment remained constant throughout the experiment, and were posted on a black and white A5-sized (148 mm high × 210 mm wide) notice. The notice was displayed at eye height on a cupboard door located above a counter on which was situated the honesty box and also the coffee and tea making equipment; the fridge containing the milk was below the same counter. The notice featured a 150 × 35 mm banner that alternated each week between an image of a pair of eyes and an image of flowers printed above the prices for tea, coffee and milk (30, 50 and 10 pence, respectively). A different image was used each week to control for any effects attributable to a single image. The images of eyes varied in the sex and head orientation, but were all chosen such that the eyes were looking directly at the observer. In addition to the notice, all members of the department were informed by email approximately every six months about the arrangements for payment for tea and coffee; the most recent reminder was sent approximately one month prior to the commencement of this study. From the perspective of the participants, the only change introduced at the start of the experiment was the inclusion of the image banner on the notice. Participants were naive to the purposes of the manipulation and none reported being aware of these. The layout of the coffee room is such that it is unlikely that anyone failing to pay would be observed. Hence, contributions were effectively anonymous, and participants could choose whether and how much to pay for their drinks.

Each week we recorded the total amount of money collected in the honesty box. Throughout the period of the study, supplies of tea, coffee and milk were maintained to keep up with demand, and each week, the volume of milk consumed was recorded as the best index available of total beverage consumption. We computed the ratio of money collected to the volume of milk consumed in each week to control for weekly variation in consumption.

3. RESULTS

The ratio of money collected to milk consumed for each of the 10 weeks is shown in figure 1, along with the image on the banner for that week. Contribution levels always increased with the transition from flowers to eyes, and decreased with the transition from eyes to flowers. A general linear model with factors image type (fixed) and week (covariate) fitted to log-transformed data explained 63.8% of the variance. There was a significant main effect of image type (eyes versus flowers: $F_{1,7}=11.551$, $p=0.011$) but not week ($F_{1,7}=0.074$, $p=0.794$). The interaction between image type and week was omitted from the model because it was not significant. On average, people paid 2.76 times as much in the weeks with eyes (mean ± s.e. = 0.417 ± 0.081 £ per litre) than with flowers (0.151 ± 0.030 £ per litre). There was no evidence that image type affected consumption.



Bateson M, Nettle D, Roberts G. Cues of being watched enhance cooperation in a real-world setting. Biol Lett. 2006 Sep 22;2(3):412-4. doi: 10.1098/rsbl.2006.0509. PMID: 17148417; PMCID: PMC1686213.

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WILEY Journal of Applied Social Psychology

ORIGINAL ARTICLE

A field study on watching eyes and hand hygiene compliance in a public restroom

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[2]University of Bonn

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Abstract
Humans modify their behavior in a socially desirable way when being watched by others. We applied this basic idea to hand hygiene compliance, a behavior that is crucial for preventing germ transmission and successive infections in many settings. Building on the assumption that hand hygiene behavior is socially desirable, we assume that individuals show stronger hand hygiene compliance when being watched. In a field study in a women's public restroom ($N = 354$), we exposed individuals to a message advising that hand-washing protects against the spread of pathogens. In the experimental condition, stylized human watching eyes were presented above the message. In the control condition, three stars were presented. Analysis revealed a significantly higher percentage of hand hygiene compliance in the watching eyes condition (83.3%) compared to the control condition (71.9%; odds ratio: 1.95, $p = .01$). The applied value for employers and public institutions is discussed.

1 | INTRODUCTION

All over the world, hand hygiene[1] is one of the most important means to prevent the transmission of pathogens and thereby reduce infections in professional contexts like the healthcare environment, as well as in home or community settings (e.g., Aiello & Larson, 2002; Bloomfield, Aiello, Cookson, O'Boyle, & Larson, 2007; Sax et al., 2007; World Health Organization, 2009). In developing countries, personal hand hygiene plays a crucial role in the prevention of life-threatening diseases such as diarrhea and is regarded as one of the most cost-effective preemptive measures (Bartram & Cairncross, 2010; Borghi, Guinness, Ouedraogo, & Curtis, 2002; World Health Organization, 2009). In wealthy countries, insufficient personal hand hygiene might be less life-threatening; nevertheless, it can contribute to elevated infection rates, particularly in pandemic situations (Aiello & Larson, 2002; Curtis & Cairncross, 2003). In this regard, hand hygiene can save more than a million people yearly from diarrheal diseases and can prevent viral infections like influenza (Curtis & Cairncross, 2003; Moyad & Robinson, 2008).

In addition to home and community settings, adequate hand hygiene is crucial and even legally regulated in several professional contexts such as the food processing industries and the healthcare sector (Allegranzi & Pittet, 2009; Kampf, Löffler, & Gastmeier, 2009; Medeiros, Cavalli, Salay, & Proença, 2011; Murphy, DiPietro, Kock, & Lee, 2011; World Health Organization, 2009). In hospitals, hand hygiene is particularly relevant with respect to patient safety, as it represents an effective way to prevent hospital-acquired infections among patients, a most vulnerable group of individuals, including infections with multi-drug resistant organisms such as MRSA (Allegranzi & Pittet, 2009; Backman, Zoutman, & Marck, 2008; Ducel, Fabry, & Nicolle, 2002; Kampf, Löffler, & Gastmeier, 2009; World Health Organization, 2009). Moreover, childcare centers and schools are receiving special attention given their double role as institutions that directly and indirectly interconnect a large number of people *and* as early-in-life providers of basic education on hand hygiene (Azor-Martinez et al., 2014; Meadows & Le Saux, 2004; Wang, Lapinski, Quilliam, Jaykus, &

[1]In the present contribution, hand hygiene is used to summarize different hand hygiene procedures, namely washing hands with plain soap and water as well as hand disinfection using antimicrobial agents such as alcohol hand

Hände verbreiten Krankheitserreger. Händewaschen schützt.

Hände verbreiten Krankheitserreger. Händewaschen schützt.

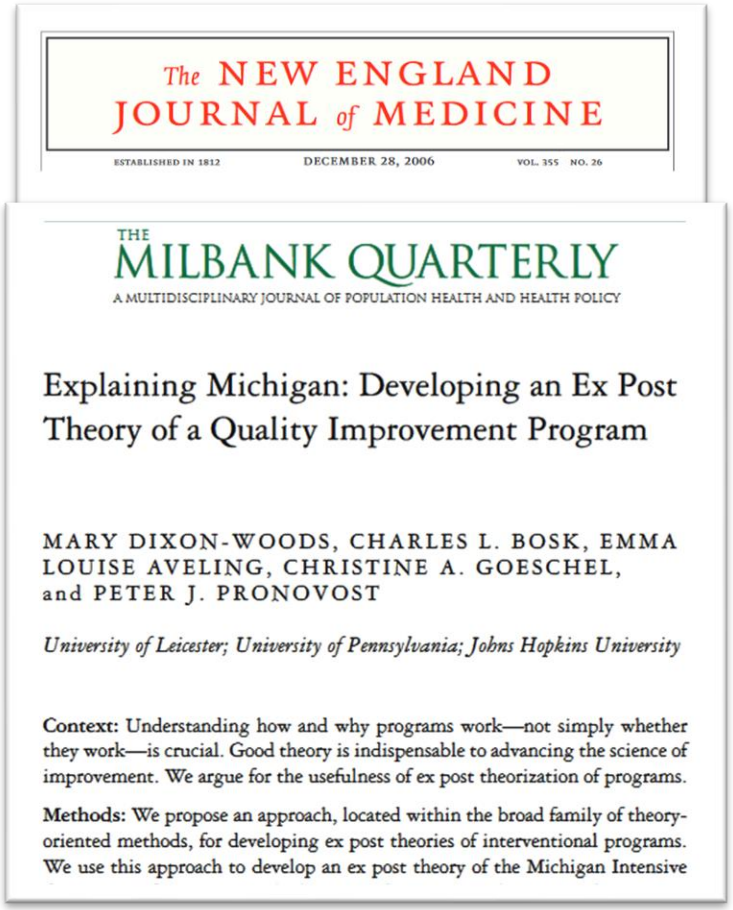
Pfattheicher, S, Strauch, C, Diefenbacher, S, Schnuerch, R. A field study on watching eyes and hand hygiene compliance in a public restroom. *J Appl Soc Psychol*. 2018; 48: 188– 194. https://doi.org/10.1111/jasp.12501

Sometimes, implementation fails before it has even started

- The intervention itself...
  - Is not compatible with the implementation context
  - Doesn't respond to a perceived clinical need
  - Was not designed in users in mind

- **Avoid this by:**
  - Engaging users early and often in the development of the intervention, and implementation planning
  - Planning for implementation early, it should not be an afterthought

What happened in "Matching Michigan"?



The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812 DECEMBER 28, 2006 VOL. 355 NO. 26

THE MILBANK QUARTERLY

A MULTIDISCIPLINARY JOURNAL OF POPULATION HEALTH AND HEALTH POLICY

Explaining Michigan: Developing an Ex Post Theory of a Quality Improvement Program

MARY DIXON-WOODS, CHARLES L. BOSK, EMMA LOUISE AVELING, CHRISTINE A. GOESCHEL, and PETER J. PRONOVOST

University of Leicester; University of Pennsylvania; Johns Hopkins University

Context: Understanding how and why programs work—not simply whether they work—is crucial. Good theory is indispensable to advancing the science of improvement. We argue for the usefulness of ex post theorization of programs.

Methods: We propose an approach, located within the broad family of theory-oriented methods, for developing ex post theories of interventional programs. We use this approach to develop an ex post theory of the Michigan Intensive

Dixon-Woods, Mary et al. "Explaining Michigan: developing an ex post theory of a quality improvement program." *The Milbank quarterly* vol. 89,2 (2011): 167-205.

ORIGINAL RESEARCH

OPEN ACCESS

'Matching Michigan': a 2-year stepped interventional programme to minimise central venous catheter-

Dixon-Woods *et al. Implementation Science* 2013, **8**:70
http://www.implementationscience.com/content/8/1/70

IMPLEMENTATION SCIENCE

RESEARCH Open Access

Explaining *Matching Michigan*: an ethnographic study of a patient safety program

Mary Dixon-Woods[1*], Myles Leslie[2], Carolyn Tarrant[1] and Julian Bion[3]

Abstract

Background: Quality and safety improvement initiatives in healthcare often display two disconcerting effects. The first is a failure to outperform the secular trend. The second is the decline effect, where an initially promising intervention appears not to deliver equally successful results when attempts are made to replicate it in new settings. *Matching Michigan*, a patient safety program aimed at decreasing central line infections in over 200 intensive care units (ICUs) in England, may be an example of both. We aimed to explain why these apparent effects may have occurred.

Methods: We conducted interviews with 98 staff and non-participant observation on 19 ICUs; 17 of these units were participating in *Matching Michigan*. We undertook further telephone interviews with 29 staff who attended program training events and we analyzed relevant documents.

Results: One *Matching Michigan* unit transformed its practices and culture in response to the program; five boosted existing efforts, and 11 made little change. *Matching Michigan's* impact may have been limited by features of program design and execution; it was not an exact replica of the original project. Outer and inner contexts strongly modified the program's effects. The outer context included previous efforts to tackle central line infections superimposed on national infection control policies that were perceived by some as top-down and punitive. This undermined engagement in the program and made it difficult to persuade participants that the program was necessary. Individual ICUs' histories and local context were also highly consequential: their past experience of quality improvement, the extent to which they were able to develop high quality data collection and feedback systems, and the success of local leaders in developing consensus and coalition all influenced the program's impact on local practices.

Conclusions: Improved implementation of procedural good practice may occur through many different routes, of which program participation is only one. The 'phenotype' of compliance may therefore arise through different 'genotypes.' When designing and delivering interventions to improve quality and safety, risks of decline effects and difficulties in demonstrating added value over the secular trend might be averted by improved understanding of program mechanisms and contexts of implementation.

Keywords: Patient safety, Improvement programs, Context, Ethnography, Healthcare-acquired infections

Dixon-Woods, M., Leslie, M., Tarrant, C. *et al.* Explaining *Matching Michigan*: an ethnographic study of a patient safety program. *Implementation Sci* **8,** 70 (2013).

Table 1 Selected differences and similarities between the Keystone project and *Matching Michigan*

Keystone	*Matching Michigan*
1. One cohort	1. Four cohorts (97% of English ICUs), including one pilot
2. Kicked off with 6 weeks of 'immersion' weekly teleconferences	2. Kicked off with data collection training
3/Whole-state workshops every six months—1.5 or 2 days (overnight), gradually becoming participant-led	3. Each cohort attended two 'training events' (0.5 or 1 day)—data collection and intervention
4. Continuous contact via teleconferences with 100~200	4. Teleconferences only at the beginning; discontinued after poor attendance. Webinars continued, but generally not well attended.
5. 5/6 months getting started with data collection & implementing the comprehensive unit-based safety program and daily goals; then Ventilator Acquired Pneumonia (VAP) and CVC-BSI interventions.	5. Initial period (3-6months according to cohort) of data collection only, then all interventions in any order. No VAP intervention.
6. Interactive web-based data entry tool allowing comparison with others	6. Interactive web-based data entry tool allowing comparison with others
7. Program team asked for infection rates to be reported by infection control practitioners independent of the ICUs.	7. ICUs allowed to determine method of data collection and reporting for themselves. Detailed definitions and guidance provided.
8. Targeted adult ICUs primarily	8. Targeted both adult and paediatric ICUs
9. Led by collaboration between prestigious out of state university and the state hospital association	9. Led by government agency

- Isomorphic pressures, bottom-up change
- Sense of community
- Shared sense of purpose and motivation

- "just another" top-down government-led initiative, perceived by staff as "harsh and coercive"
- Local leaders failed to develop consensus and coalition

What can we learn from (Matching) Michigan?

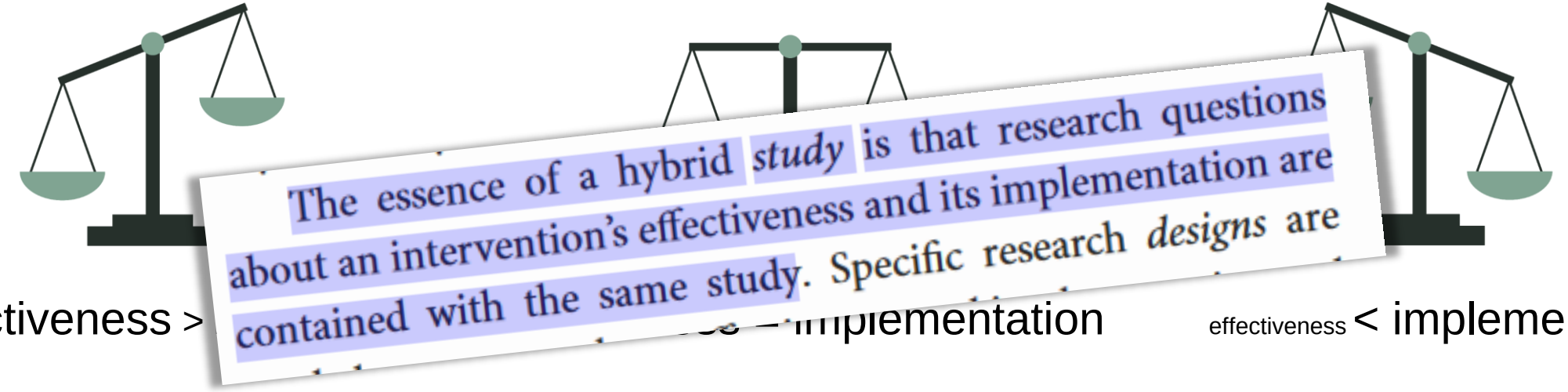
- **Context matters**
- **Clinical interventions** (e.g. care bundle of 5 prevention measures) as well as their **implementation strategies** (e.g. formation of professional networks, repeated education, monitoring and feedback) must be adequately reported and based on existing evidence
- **Underreporting** of **implementation strategies** and **mechanisms of change** leads to **poor reproducibility** of clinical interventions
- **Qualitative research methods** allow to understand the tacit «how» and «why», which are critical to understanding implementation dynamics

Opportunities for Implementation Science and Practice

Effectiveness research vs. implementation research

	Effectiveness research	Implementation research
Study aim: to evaluate a…	Clinical intervention	Implementation strategy
Typical intervention	Drug, procedure, therapy, product, evidence-based guidelines	Techniques used to enhance use of a clinical practice: involving clinician behavior or organizational practice change
Primary outcomes	Symptoms, health outcomes	Adoption, Appropriateness, Costs, Feasibility, Fidelity, Penetration, Sustainability
Typical unit of analysis, randomization	Patient	Clinician, team, organization

Hybrid effectiveness-implementation studies



effectiveness > implementation

effectiveness < implementation

Type I **Type II** **Type III**

Curran, Geoffrey M., et al. "Effectiveness-implementation hybrid designs: combining elements of clinical effectiveness and implementation research to enhance public health impact." *Medical care* 50.3 (2012): 217
Curran GM, Landes SJ, McBain SA, Pyne JM, Smith JD, Fernandez ME, Chambers DA and Mittman BS (2022) Reflections on 10 years of effectiveness-implementation hybrid studies. Front. Health Serv. 2:1053496.

Example: Hybrid type 2 effectiveness-implementation trial for reducing antibiotic resistance in high prevalence settings (REVERSE, H2020)

Setting

- 24 European hospitals in Italy, Greece, Spain, Romania

We aim to simultaneously test:

- Clinical interventions (infection prevention and antibiotic stewardship) → *Effectiveness*
- Standard vs. enhanced (multifaceted, tailored) implementation strategy → *Implementation*

Mixed-methods study design

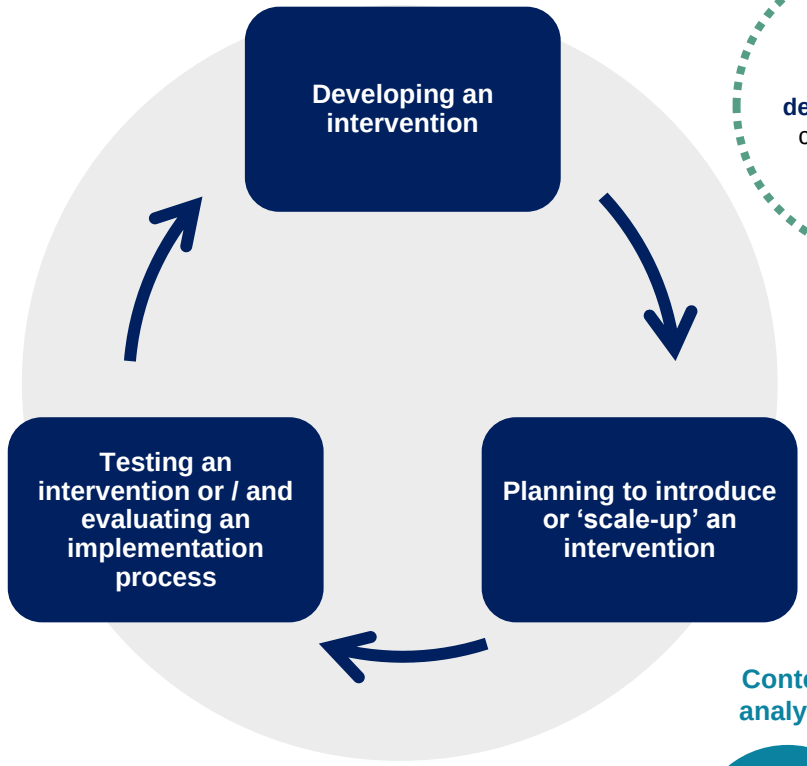
- Quantitative stepped-wedge trial → *Effectiveness*
- Longitudinal qualitative study and formative evaluation based on interviews, focus groups, and observations → *Implementation*

Theoretical frameworks

- Consolidated framework for implementation science (CFIR) (Damschroder, 2009)
- Exploration, preparation, implementation, and sustainment (EPIS) framework (Moullin, 2019)

www.reverseproject.eu

Typical implementation science study questions



Is the intervention and implementation approach successful with respect to **implementation outcomes?**

Qualitative & mixed methods

Which **contextual factors** actually influence implementation success?

Is the intervention & implementation strategy **cost-effective?**

Human-centered design methods

How can the **innovation be designed** to ensure compatibility with daily practice?

PPI activities

How can **stakeholders** be involved in this process?

Context analysis

What **contextual factors** are likely to influence the implementation process?

Implementation mapping

Which **implementation strategies** are likely to be most successful?

Wrap-up

Key messages

- Why is implementation science important?
  - Offers rigorous research methods, theories, models and frameworks to **accelerate and improve research translation**
  - Implementation science is a growing field with an extensive methodological toolbox, in particular a wide range of **implementation strategies**
  - Clinical research is not complete without implementation!
- At the **intersection of research and practice**, implementation science is well positioned
  - to improve the quality and effectiveness of health care, and
  - to shape future research priorities.

Thank you for your attention!

Thank you!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The Institute for Implementation Science in Health Care (IfIS) contributes to the optimization of health care, digital innovation, and improved translation of evidence into practice. Our implementation science teaching, research and training aims to accelerate the integration of research findings into health care and embed them in a sustainable way, as well as removing low-value practices from health care. Our digital health teaching, research and training aims to optimize digital innovation in clinics and create digital interventions to improve community health and well-being.
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