Lean Healthcare Research

SYMPOSIUM 2026

March 11, Houston

CLEAR

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Berkeley Public Health

CLEAR 2016-2026 TENTH ANNIVERSARY

Providing Evidence, Increasing Knowledge, Motivating Action for CONTINUOUS IMPROVEMENT OF HEALTHCARE DELIVERY

Stephen Shortell, PhD, Blue Cross of California Distinguished Professor of Health Policy and Management Emeritus and Co-founder CLEAR, UC-Berkeley and **Thomas Rundall**, Henry J. Kaiser Professor of Health Policy and Management Emeritus and co-founder CLEAR, UC-Berkeley

2026 CLEAR RESEARCH SYMPOSIUM
HOUSTON, TEXAS
MARCH 11, 2026

OUTLINE

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THE POOR PERFORMING

U.S. HEALTHCARE SYSTEM

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The US Healthcare System is Not Very Good

Exhibit 1: Health Care System Performance Rankings

Health Care System Performance Rankings

	AUS	CAN	FRA	GER	NETH	NZ	SWE	SWIZ	UK	US
Overall Ranking	**1**	**7**	**5**	**9**	**2**	**4**	**6**	**8**	**3**	**10**
Access to Care	9	7	6	3	1	5	4	8	2	10
Care Process	5	4	7	9	3	1	10	6	8	2
Administrative Efficiency	2	5	4	8	6	3	7	10	1	9
Equity	1	7	6	2	3	8	–	4	5	9
Health Outcomes	1	4	5	9	7	3	6	2	8	10

Note: SWE overall ranking calculation does not include Equity domain. See "How We Conducted This Study" for more detail.

Data: Commonwealth Fund analysis.

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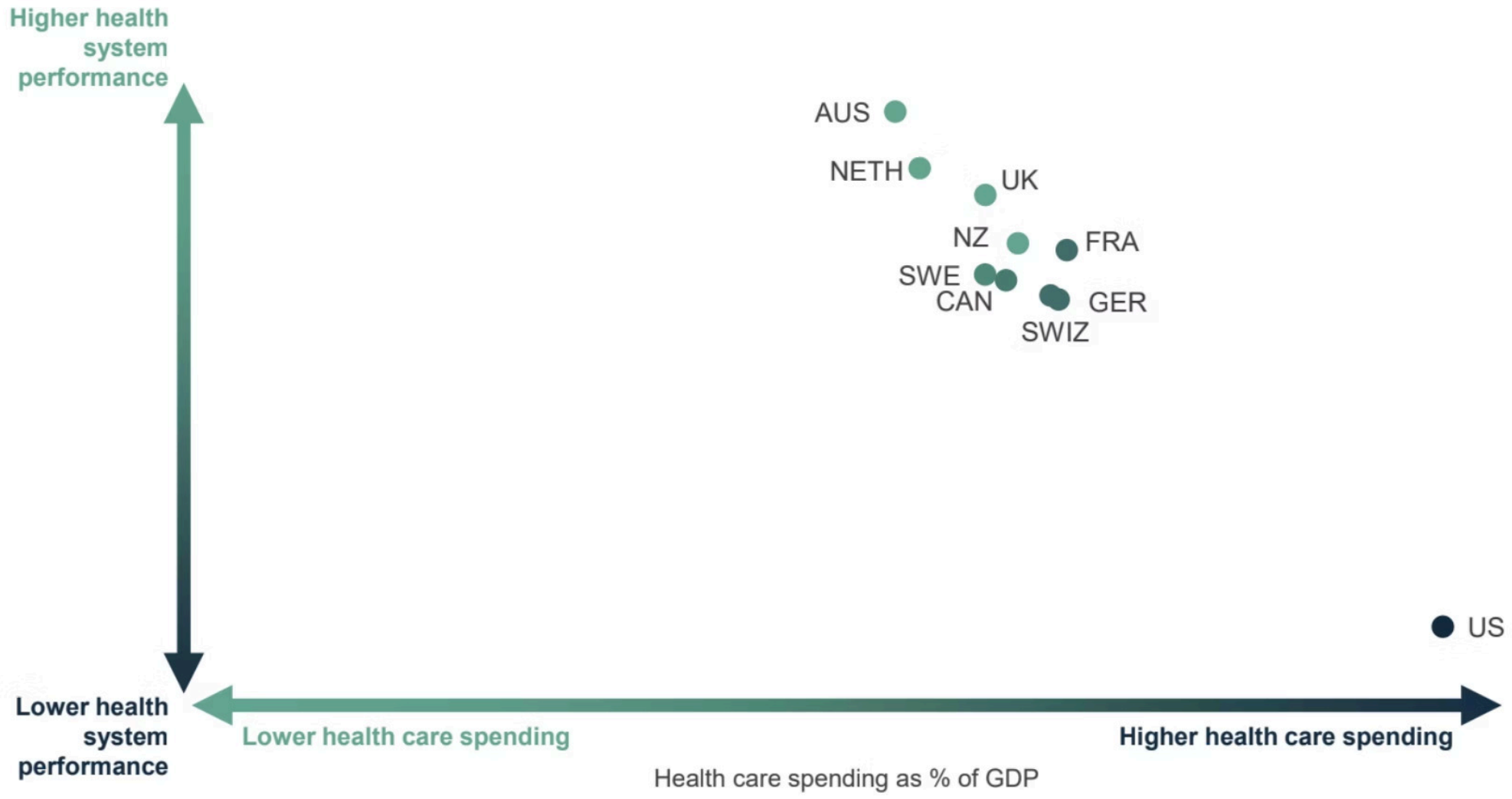
Exhibit 4. Performance vs. Spending

Health Care System Performance Compared to Spending



Notes: GDP = gross domestic product. Health care spending as a percentage of GDP. Performance scores are based on standard deviation calculated from the nine-country average that excludes the US. See "How We Conducted This Study" for more detail.

Data: Spending data are from OECD for the year 2022 and 2023 (updated in July 2024).

Exhibit 9. Health Outcomes

Americans live the shortest lives and have the most avoidable deaths

Note: To normalize performance scores across countries, each score is the calculated standard deviation from a nine-country average that excludes the US. See "How We Conducted This Study" for more detail.

Data: Commonwealth Fund analysis.

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More Bad News

25%

Admissions with adverse safety events

Approximately one-quarter of hospital admissions involve an adverse safety event, with a third of these being serious. (Bates et al., NEJM, 2023)

$900B

Annual Waste

Over $900 billion in wasteful, inefficient, and potentially harmful care is delivered annually in the US healthcare system. (Shrank et al., JAMA, 2019)

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MISSION STATEMENT

CLEAR's mission is to conduct timely, relevant, and actionable research on lean whole system transformation initiatives in healthcare.

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VISION STATEMENT

The vision of CLEAR is to transform healthcare delivery by providing knowledge to help organizations eliminate waste and create greater value, resulting in the continuous improvement of patient outcomes and experience of care, population health, provider well-being, and reduced growth in the cost of care.

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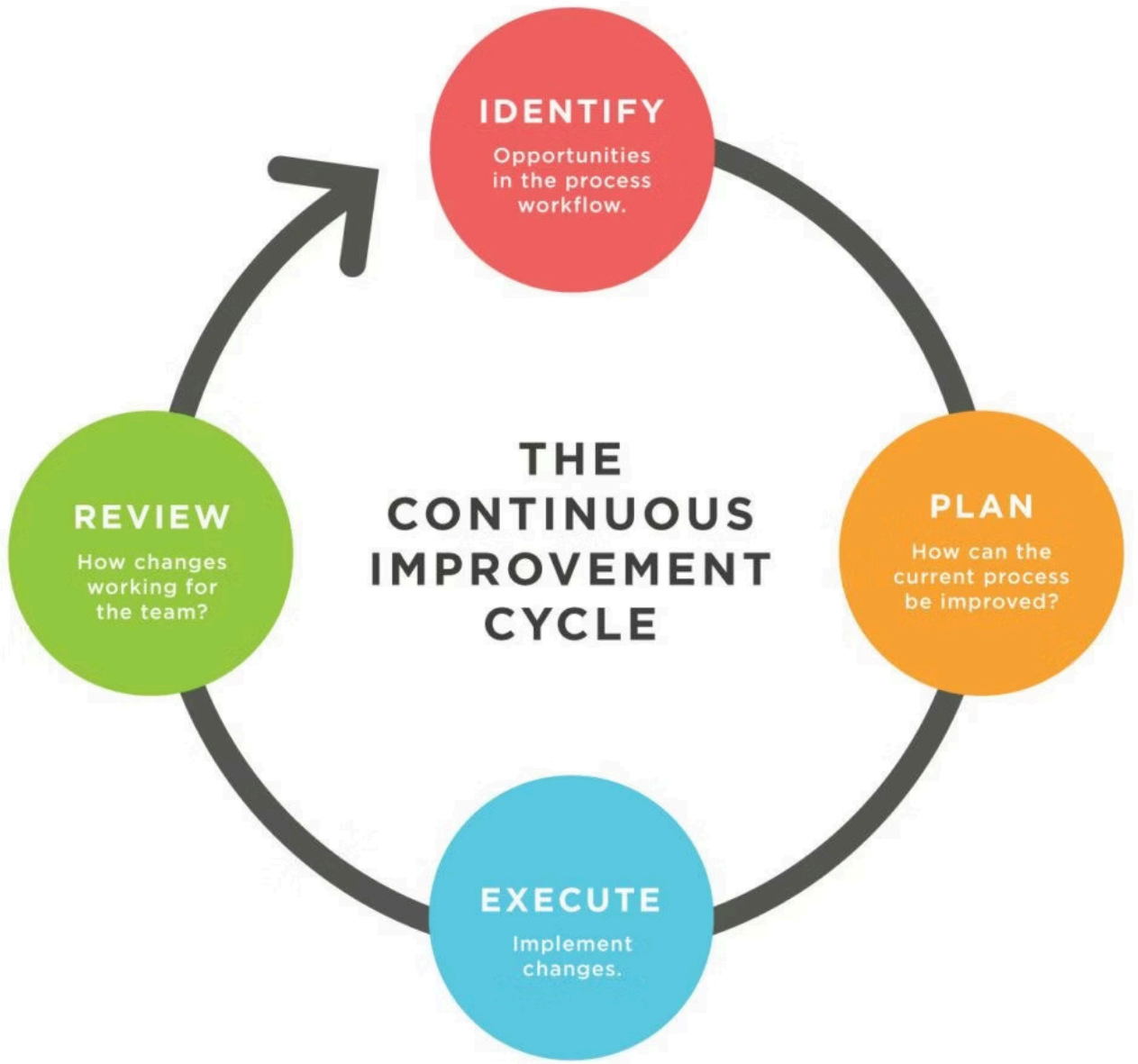
LEAN DEFINED

> "An overall operating and management system that creates value by eliminating waste and solving problems through daily application of the scientific method. The end result is improved quality and lower cost for the patient (increased value), and improved work experience leading to provider well-being."



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NOTE

> **"Not using re-engineering processes to improve care is...the most dysfunctional and perverse outcome for care delivery in this country that is created by the way we buy care"**

George Halvorson

Former President and CEO, Kaiser-Permanente

2018

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NOTE

> **"All other countries make re-engineering their basic processes a fundamental strategy, and all the well-run companies in other industries make process improvement and re-engineering a highly valuable organizational strength and capability"**

George Halvorson

Former President and CEO, Kaiser-Permanente

2018

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MAJOR INITIATIVES

Lean Literature Review Resources

Action Research Learning Lab with Health Systems

National Survey of Lean – AHA/HRET

Lean Implementation Self-Assessment Instrument (LHISI)

Peer-reviewed Publication Presentations

Annual Research Meetings - Catalysis and Lean Enterprise Institute (LEI)

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SOME SELECTED STUDIES

LEAN IMPLEMENTATION AND HOSPITAL PERFORMANCE

2017 National Survey

Survey Scope

- 1,222 hospitals
- 61.6 Percent reported doing some Lean or related quality improvement initiatives
- Only 12.6 percent reported organization-wide or enterprise-wide implementation
- Linked to publicly available performance data from AHRQ and CMS

Key Findings

- Degree of Lean implementation is significantly positively associated with higher patient experience scores
- Lower adjusted inpatient expense per admission
- Lower 30 day unplanned readmission rate
- Lower inappropriate use of imaging
- Two to Five years to reach "maturity"

Shortell et al., Joint Commission J. on Patient Safety and Quality, 2021

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LEAN MANAGEMENT AND QUALITY IMPROVEMENT CARE MANAGEMENT PROCESSES

223 hospitals linking the National Survey of Lean with the National Survey of Healthcare Organizations and Systems (NSHOS)

Number of years doing Lean was positively associated with:

1. Use of EHR based decision support
2. Quality-focused information management
3. Use of evidence-based guidelines
4. Support for care transitions

Tierney AA, Shortell SM, Rundall TG, Blodgett JC, Reponen E. Examining the Relationship Between the Lean Management System and Quality Improvement Care Management Processes. Qual Manag Health Care. 2022 Jan-Mar 01;31(1):1-6. doi: 10.1097/QMH.0000000000000318. Epub 2021 Aug 26. PMID: 34459445; PMCID: PMC8881543.

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DAILY MANAGEMENT SYSTEM FOR COVID RESPONSE AND RECOVERY

In-depth interviews with 47 executive leaders, clinical leaders and front line staff in four hospitals and health systems

Key Findings

1 **Tiered huddles facilitated rapid communication**

2 **Standard work helped with structure problem-solving**

3 **DMS visibility opened up new lines of communication among leadership, strengthened accountability, and empowered staff to develop solutions at the front line**

4 **Yielded lessons for meeting future unexpected events including expanding telehealth, reactivating incident command systems as needed, and efficiently obtaining and coordinating resources amid future shortages**

Hung, Dorothy Y. PhD; Rundall, Thomas G. PhD; Lee, Justin; Khandel, Negeen; Shortell, Stephen M. PhD. Managing Through a Pandemic: A Daily Management System for COVID-19 Response and Recovery. Journal of Healthcare Management 67(6):p 446-457, November/December 2022. | DOI: 10.1097/JHM-D-21-00319

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USING LEAN TO ADVANCE EQUITY

In-depth interviews with 67 leaders in four participating Action Learning Lab Health systems

Key Findings

1

Daily Management System provides the key platform for all initiatives

2

Humble Inquiry promotes understanding and discussions

3

Important to build equity into all strategic goals and their implementation

4

Need to create equity-focused data reporting systems

Hung DY, Levy LC, Rundall TG, Reponen E, Huen W, Shortell SM. Advancing Equity: Lean Leader Practices and a Path Forward. Milbank Q. 2025 Sep;103(3):918-939. doi: 10.1111/1468-0009.70037. Epub 2025 Aug 7. PMID: 40772572; PMCID: PMC12438453.

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LEAN AND POST-PANDEMIC OUTCOMES IN PRIMARY CARE

NSHOS II DATA – National sample of 1,245 Primary Care Practices

Lean adoption was positively associated with:

1. **Participation in an Incident Command System for Pandemic Response**
2. **Addressed clinician burnout**
3. **Had fewer staff layoffs or reduced work hours**
4. **Reported stronger financial performance**

Hung DA, Shortell SM, Morris E et al. “Lean Management of Crisis Response and Post-Pandemic Outcomes in U.S Primary Care Practices”, BMJ Health Services Research, 2026.

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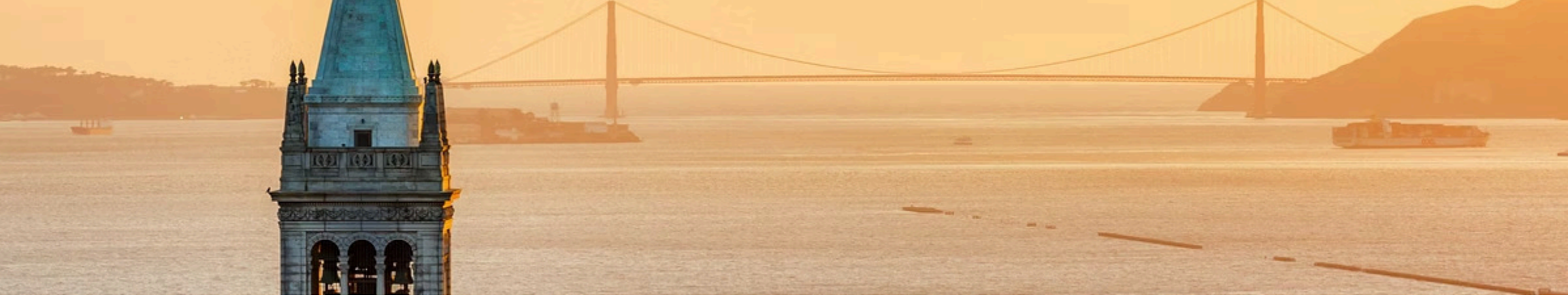
FUTURE RESEARCH CHALLENGES/OPPORTUNITIES

- Removing barriers to system-wide, organization-wide, enterprise-wide implementation
- Need for longitudinal follow-up studies - interrupted time series designs, multiple baselines, stepped wedge
- Implementing AI, new digital technologies and biomedical innovations
- Greater focus on primary care delivery/ambulatory care
- Greater use of mixed methods



CLEAR's Research Agenda

CLEAR's agenda for future research includes national studies using survey data from large samples of health organizations and studies of Lean implementation and its effects on organizational performance with members of our Lean Action Research Collaborative (LARLC)

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National Studies

Our research agenda includes multiple projects using data from the National Survey of Organizations and Health Systems II (NSOHS II), a 52-question survey of a nationally representative sample of non-federal adult primary care practices. The NSOHS was developed by researchers at Dartmouth College, Harvard University, and the University of California, Berkeley including CLEAR's co-founder Steve Shortell. The data have been analyzed extensively in prior research.

Team Innovation and Lean Implementation for Improving Primary Care Capabilities

Assessing the Associations Among Lean "Diagnostic" and "Implementation/Sustainment" of Practices and Clinician Performance

Examining the Relationships Among Use of Lean and Claims-based Performance Measures

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National Studies Continued

Use of Lean and Involvement of Non-physicians in Caring for Complex, High-need Patients

Institutionalizing Lean in Healthcare Organizations: How Is It Done and What are the Benefits

Explainable AI and Clinical Decision-Making in High Acuity Care

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We are currently seeking funding for several of these studies and would welcome opportunities to partner with interested organizations.

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Lean Action Research Learning Collaborative (LARLC) Studies

CLEAR's Lean Action Research Learning Collaborative (LARLC) brings together leading hospitals/health systems that aim to use lean as an overall operating system to culturally transform and continuously improve the value of care delivered to patients. The purpose of the LARLC is to support learning through objective evaluation of the uptake, spread, and/or effects of lean-based initiatives.

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This information is fed back to LARLC members for change initiation and change management or continuous improvement purposes. The ultimate goal is to produce and share actionable knowledge that will accelerate each organization's progress in achieving their strategic and operational goals.

Members of LARLC's first and second cohorts include:

- Stanford Children's Hospital
- Fairview Health
- Lancaster General Health
- Sutter Health
- Zuckerberg San Francisco General Hospital and Trauma Center
- John Muir Health
- Indiana University Health System
- St. Mary's General Hospital (Ontario, Canada)
- UCSF Health
- Legacy Health

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The Center team is currently developing two additional studies with LARLC Cohort 2 members:

1

Highlights and Hurdles of Lean Leadership

2

Catchball and Cross-level Trust

We are currently recruiting healthcare organizations to join LARLC Cohort 3. We welcome any interested organizations to contact us.

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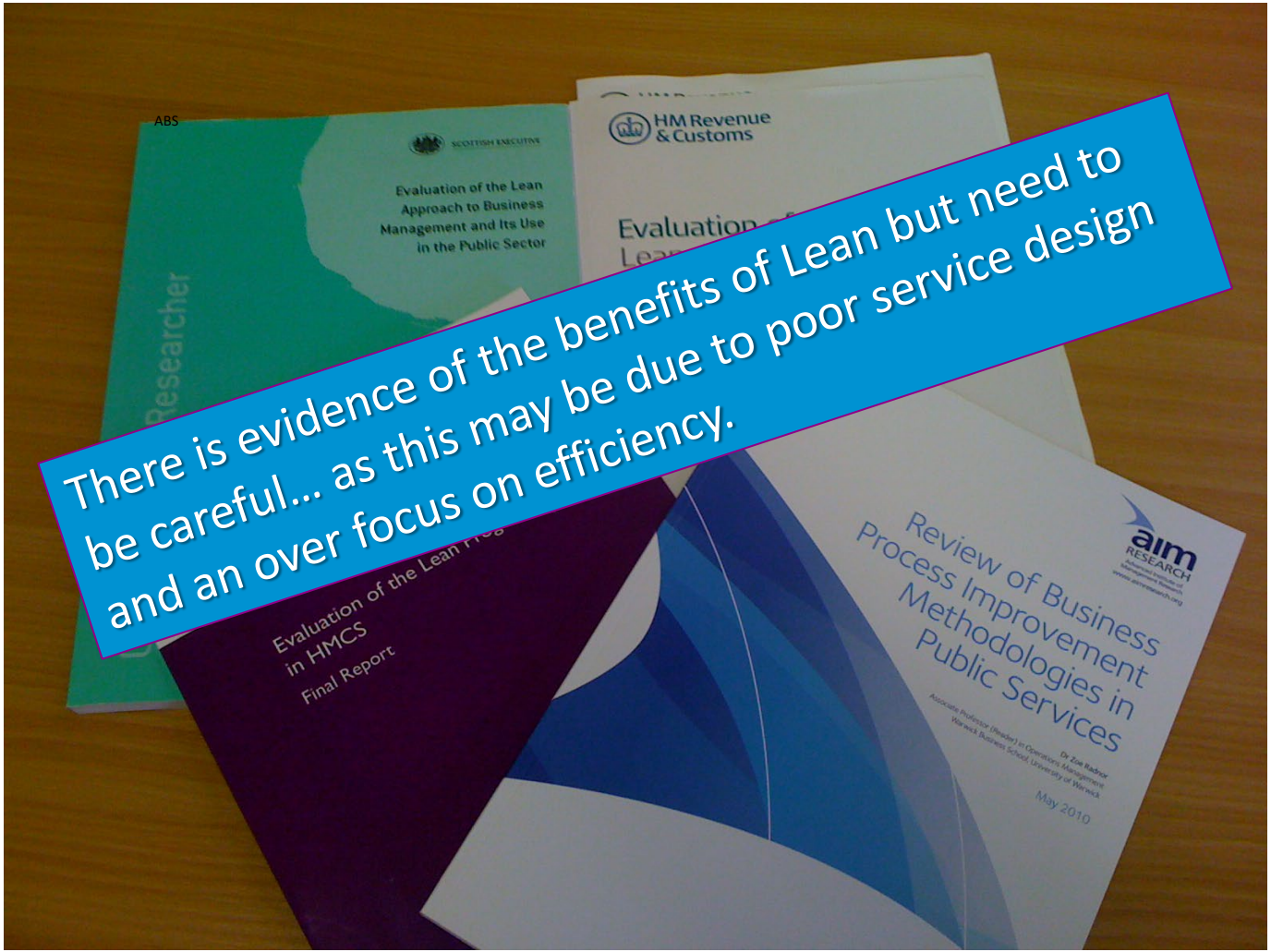
Lean in Healthcare: Reflecting on 25 years of Applied Research and Recommendations for Future Directions

Professor Zoe J Radnor
Professor of Service Operations Management
Deputy Vice-Chancellor (DVC), Aston University, Birmingham, UK


ABS
SCOTTISH EXECUTIVE
Evaluation of the Lean Approach to Business Management and Its Use in the Public Sector
HM Revenue & Customs
Evaluation of the Lean
in HMCS
Final Report
aim RESEARCH
Review of Business Process Improvement Methodologies in Public Services
May 2010
There is evidence of the benefits of Lean but need to be careful… as this may be due to poor service design and an over focus on efficiency.

Lean in Public Services: Power of 3

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BIRMINGHAM UK

3 Principles:

- Value, Flow and Reduction of Waste

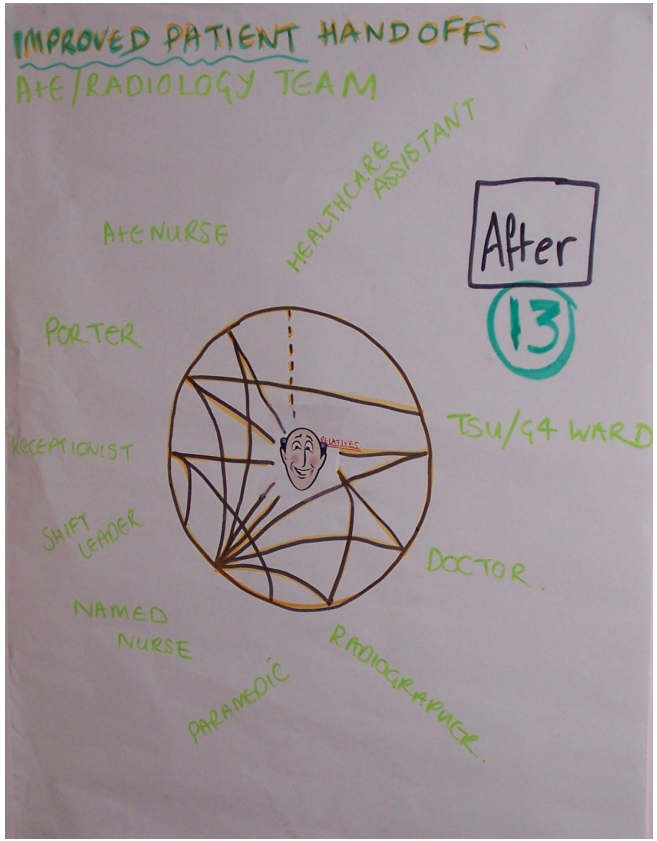
3 Types of tools:

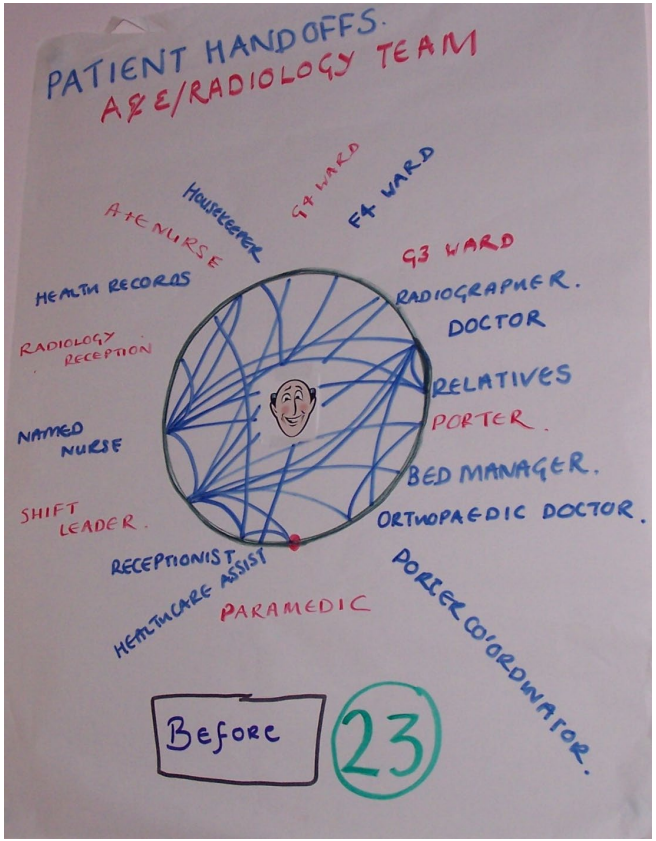
- Assessment, Monitoring and Improvement

3 Stages of the Lean journey:

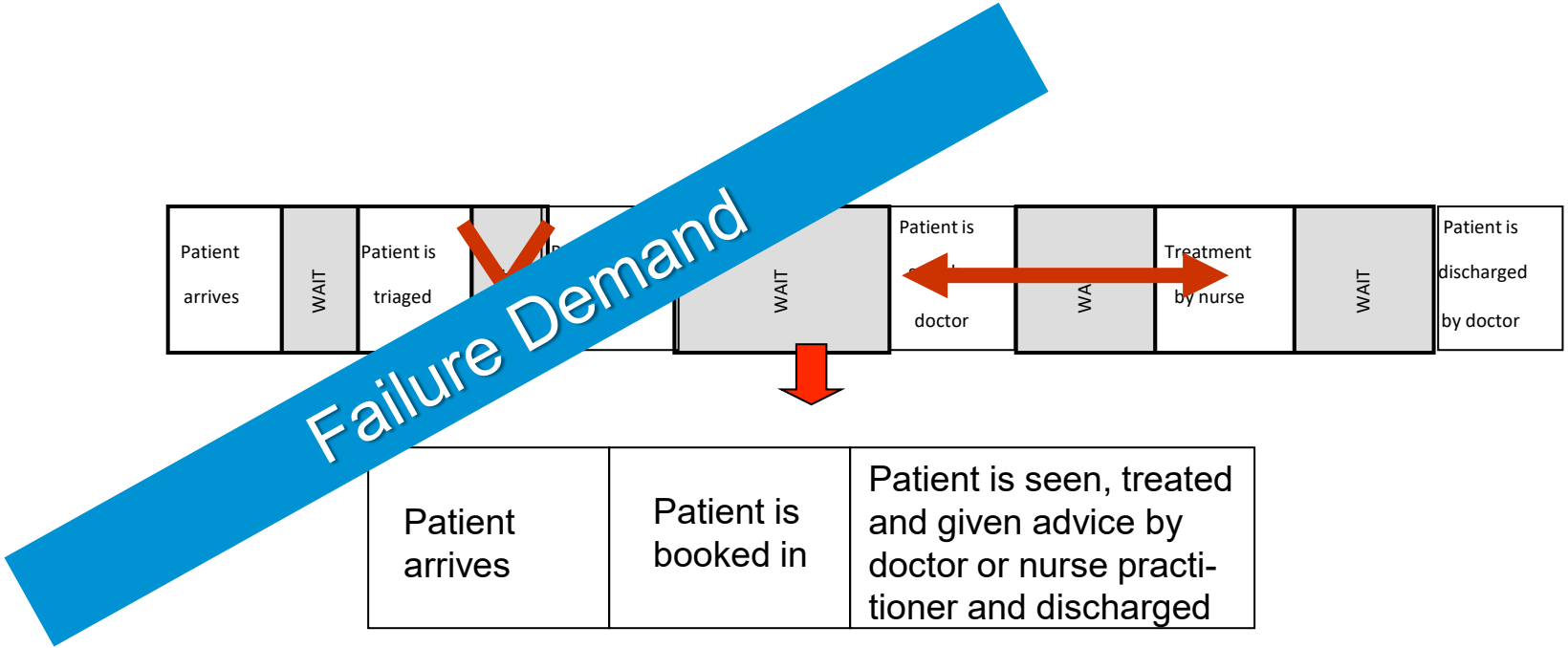
- Engage, establish and embed

Understand Value





Flow: Understanding and Managing Demand Types and Patterns



Reduction of Waste

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1

Over-production
- requesting unnecessary tests from pathology
- keeping investigation slots 'just in case'

2

Waiting - Patients, theatre, staff results, prescriptions and medicines
- doctors to discharge patients

3

Tran

ment stores
only used items

4

Over-processing
- **d**uplication o on
- asking ils
se

5

– excess
k in storerooms
- patients waiting to be discharged
- waiting lists

Rework
- readmission because of failed discharge
- repeating tests because correct information was not provided

7

Motion - unnecessary staff movement looking for paperwork
- not having basic equipment in every examination room

The 8th Waste … Untapped human potential

Use of Tools and Techniques within Lean in Public Services

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- Assessment:
  - To assess the processes at organisational level e.g. value stream mapping, process mapping
- Monitoring:
  - To measure and monitor the impact of the processes and their improvement e.g. control charts, visual management, benchmarking, work place audits
  - Measures in terms of quality, time, costs, satisfaction levels
- Improvement:
  - Tools implemented and used to support and improve processes e.g. RIEs, 5S, structured problem solving

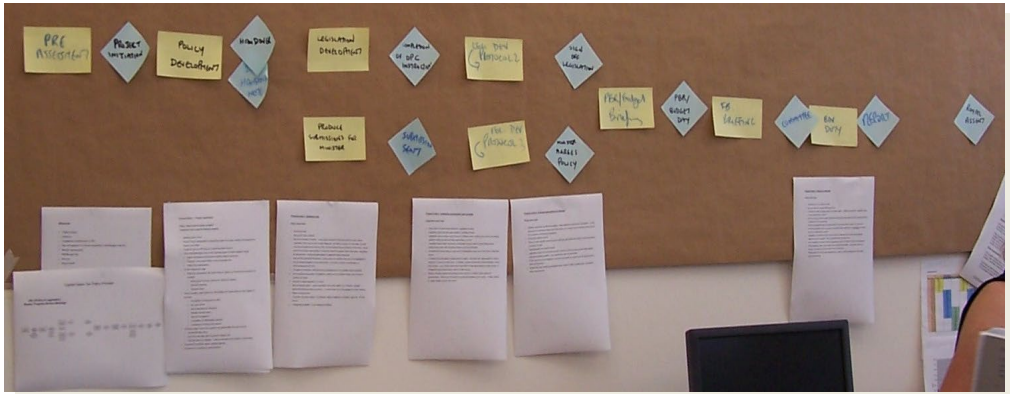
Assessment: Reviewing the work

From

Current State

to

Future State



Monitoring: Visual Management techniques

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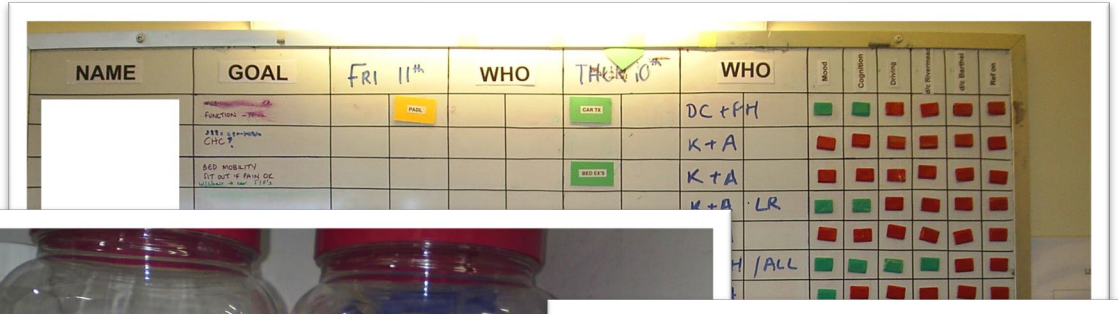
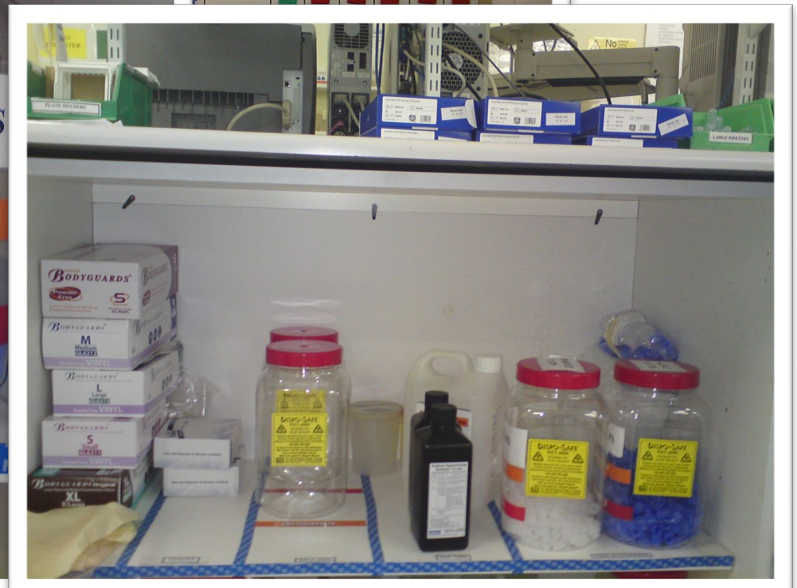
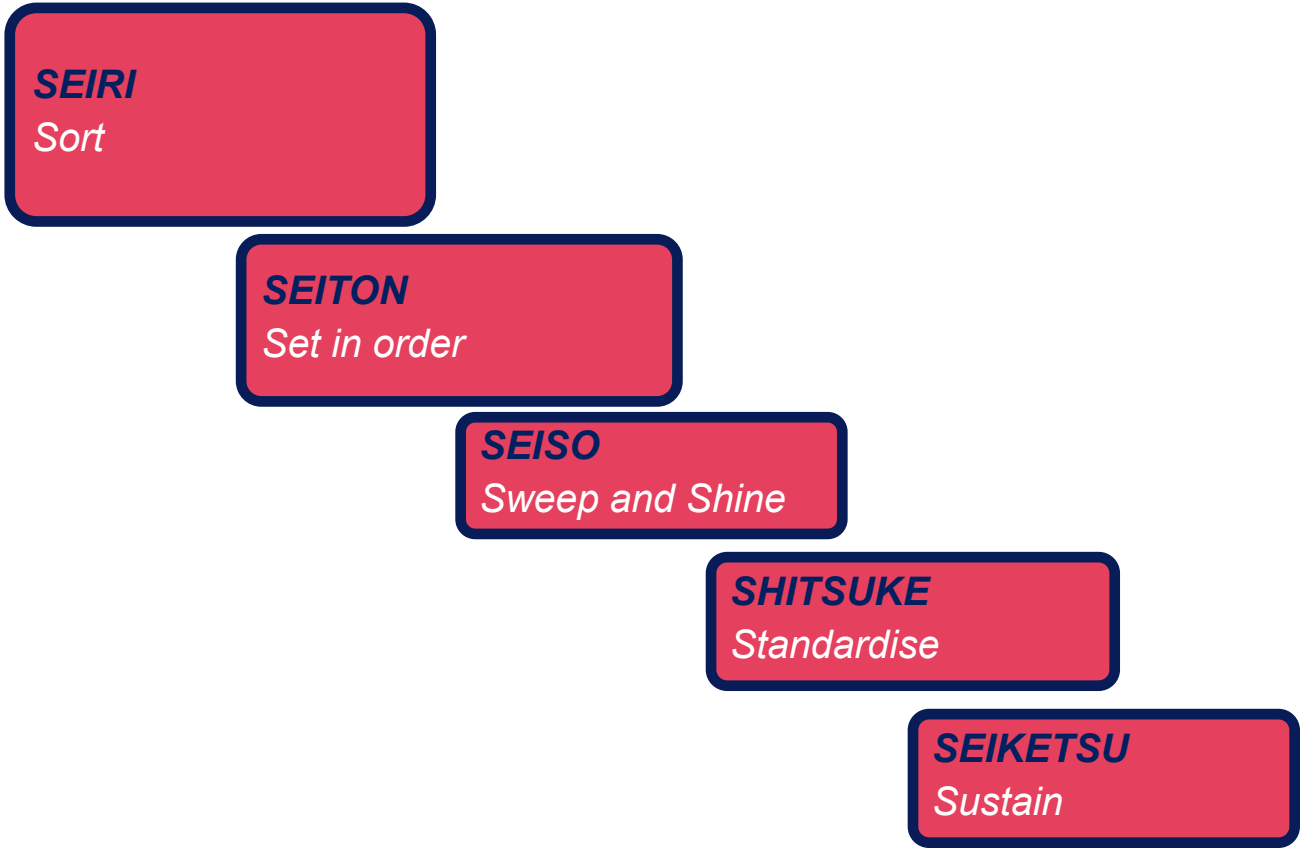
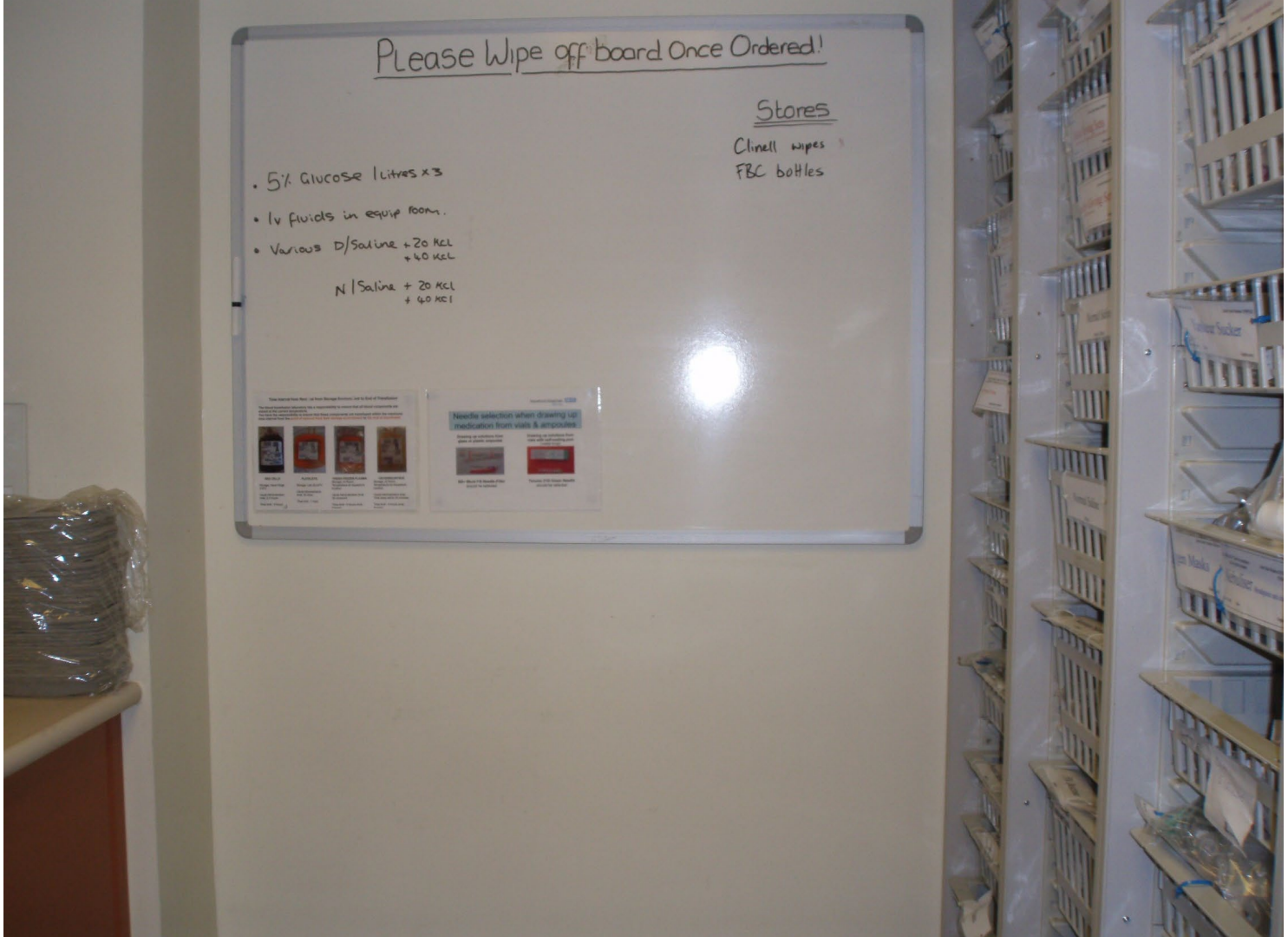




Improvement: The Five-Step Kaizen Movement




PLEASE WIPE OFF BOARD ONCE ORDERED.
STORES
Wound Assessment


Please Wipe off board Once Ordered!
Stores
Clinell wipes
FBC bottles
• 5% Glucose 1 Litres x 3
• Iv fluids in equip room.
• Various D/Saline + 20 KCL
+ 40 KCL
N/Saline + 20 KCl
+ 40 KCl
Needle selection when drawing up medication from vials & ampoules

Lean Transformation – A Two Pronged Attack

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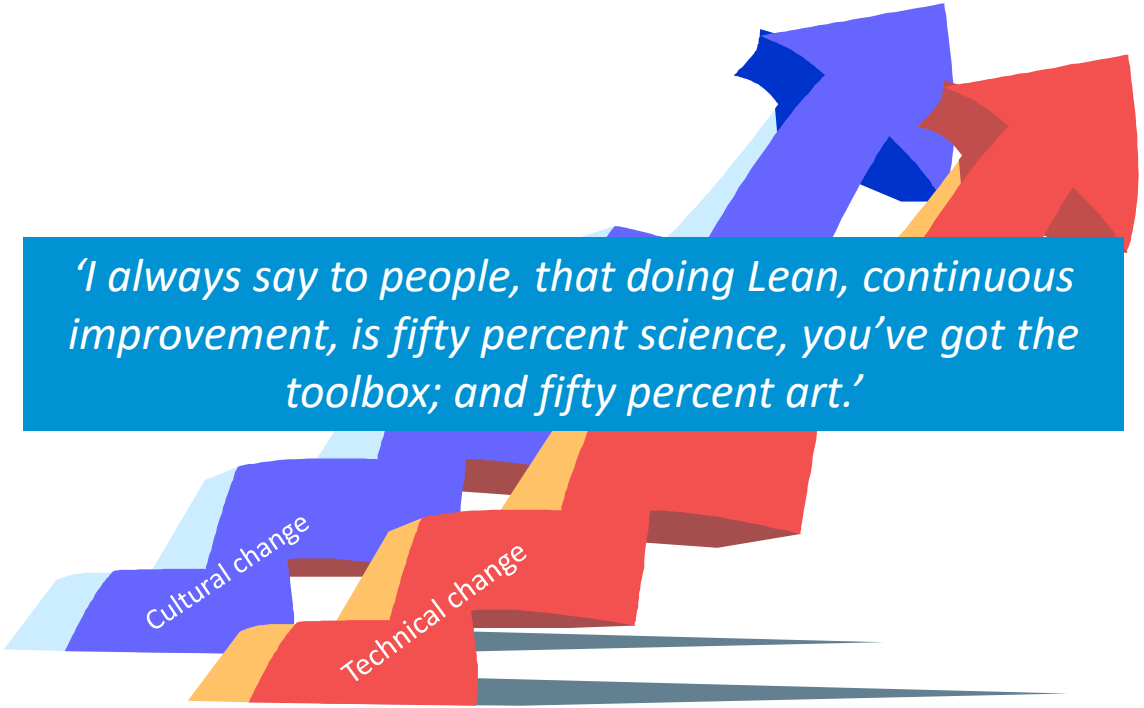

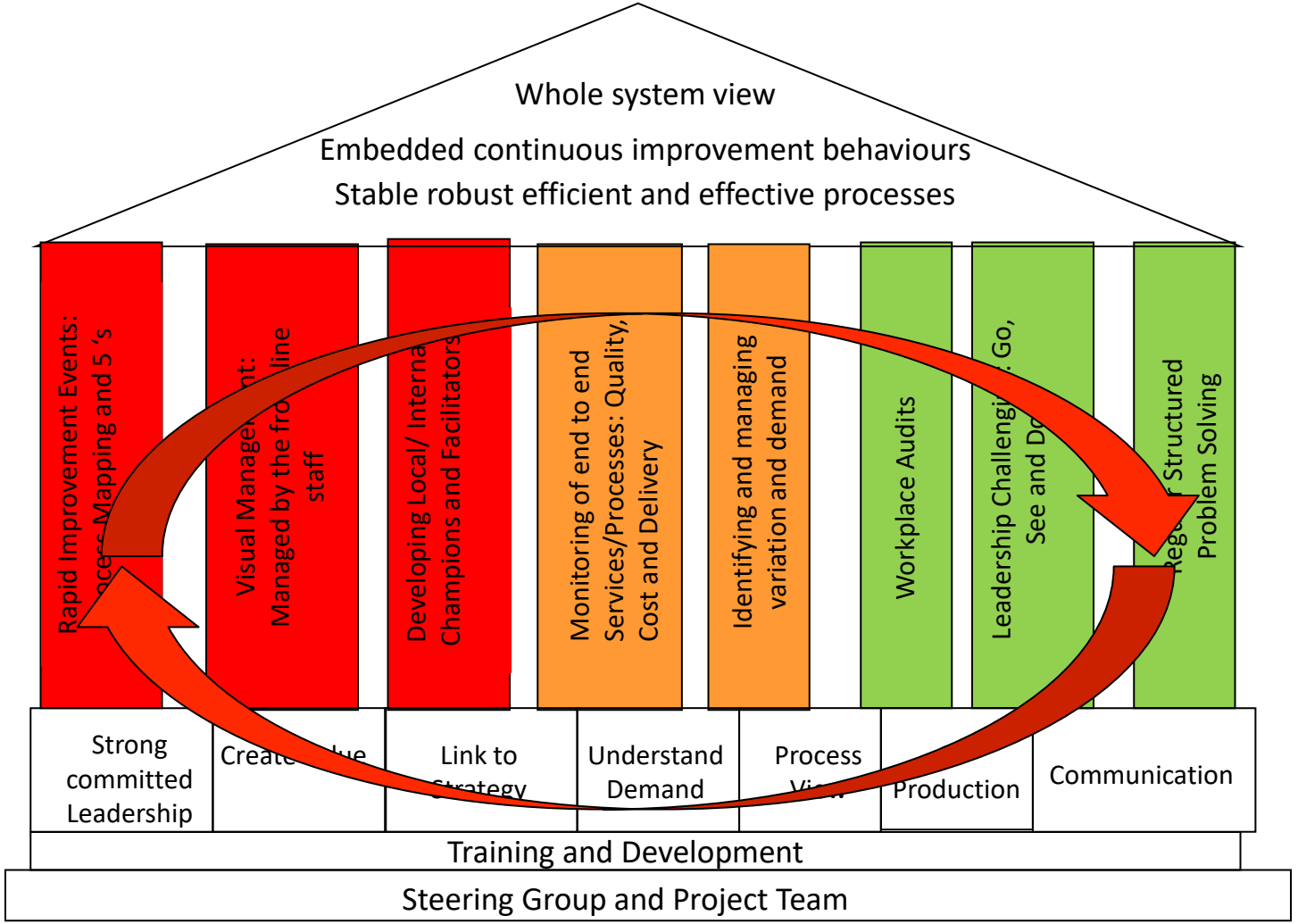
Whole system view
Embedded continuous improvement behaviours
Stable robust efficient and effective processes
Rapid Improvement Events:
Visual Management:
Managed by the front line staff
Developing Local/ Internal Champions and Facilitators
Monitoring of end to end Services/Processes: Quality, Cost and Delivery
Identifying and managing variation and demand
Workplace Audits
Leadership Challenging: Go, See and Do
Structured Problem Solving
Strong committed Leadership
Link to
Understand Demand
Process
Production
Communication
Training and Development
Steering Group and Project Team

Radnor (2011)

Lean in Healthcare and Public Services

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- Need to consider Lean not as a quick fix but as an implementation philosophy: "*A series of RIEs does not Lean make!*"
- There is a need to develop a mindset within the organisation of process and customer view: *"Public Service not Public Sector ethos."*
- Move thinking from task/ policy to value/ process: *Opportunity to redefine the end to end process.*
- Need to develop an awareness of variation, demand and capacity relationships: "*See the variable as the work not the demand/ customer"*
- Create and focus on improving stable processes: *Standardise the process not the outputs and outcomes*
- Need to ensure that there is strong and committed leadership and there is a link to strategy: *Not just about cost cutting and efficiency but about effectiveness*

What do we already know about healthcare improvement?

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Three decades of research and implementation (Burgess and Radnor, 2013; Dixon-Woods, 2019; D'Andreamatteo et al, 2015; Radnor and Willams, 2025)

Lean in healthcare is one of the most prominent approaches

Several literature reviews and discussions on what it is, what works and what doesn't and a fascination to identify enablers and inhibiting factors to success.

Interviews with senior healthcare and QI practitioners/ academics

50+ years in advising, designing, implementing, researching and evaluating quality improvement in healthcare..

Radnor Z and Williams SJ. (2025) Lean as a Healthcare Improvement Approach. In: Dixon-Woods M, Brown K, Marjanovic S, et al., editors. Elements in Improving Quality and Safety in Healthcare. Cambridge: Cambridge University Press; 2025

Findings: What is it called?

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Reluctance to use the term ‘Lean’

- *“It [Lean] has negative connotations with a good chunk of NHS audiences.”*

Myriad of terms

- *“I don't use the words process improvement, …..I use QI [Quality Improvement] a bit, simply because people understand what you mean in healthcare…. QI has definitely become more of the norm and so people will recognise the word QI whereas they might think Lean is something different to it…So there's so many different names for all this stuff, I just increasingly use the word improvement.”*

How to balance tools and culture?

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Many argue QI tools and techniques have dominated the implementation over behavioural and culture change (Dixon-woods and Martin, 2017).

"What hasn't changed is … the tools are really powerful, and I have not lost any of my belief in the tools and methods and philosophy at all... we need that stuff." "Where my thinking has changed, is much more around bringing QI and OD [organisational development] together."

Positive impact of some tools for example 'visual management' boards (information, visual or production) along with the conversations that go with them (Cluley, Bateman and Radnor, 2020).

Need to walk the walk as well as talk the talk.. Practical use of the tools. PDSA cycles are a good example where rigorous application is an issue (Reed and Card, 2015).

What is the role of leadership?

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Lean (Improvement) is context specific (Radnor et al., 2012) and to be sustained there needs to be strong leadership alongside the tools and cultural change (van Elp et al., 2021).

Engaging with staff and the importance of giving them 'agency' to develop and implement ideas and concepts.

"It is about leaders that can create spaces where people can have different kinds of conversations and learn and share. You know, at the end of the day if there is one thing I have seen over the last 25 years it is about the role that leaders play in this, and it is about leaders that have a growth mindset rather than fixed."

"We give them these tools and we give people the training, but we don't change the system. So, we don't create the conditions where people can make a difference…. So, we have to focus on agency as well as competency."

How to sustain healthcare improvement?

- The word ‘projectitus’ was used to describe how some organisations lurch from one improvement project, approach or methodology to another without giving it time to embed.

*Healthcare likes **shiny things**, the new innovations must keep coming, and people will give up on things if we get new things. **Turnover at senior level** means that that will perpetuate it too, and it is unfortunate because I think actually it needs to **consolidate and actually stick with something for a bit longer** …. that is partly why healthcare struggles to get over the cliff on improvement, because it doesn’t **stick with things long enough to really learn it**.”*

- Readiness to implement and maintain improvement (Leite et al., 2019; Williams and Radnor, 2021).

“*After 20 odd years of focusing on building competence and QI skills, it needs to fit in with the whole **co-production movement** and agency, which is about the power to make a positive difference. (It) is no good training people in QI skills if you don’t have a leader to **create the conditions where people can actually use those skills**. So, moving beyond permission cultures, moving beyond compliance and standardisation processes that are kind of imposed on people.”*

Sustaining improvements: Productive Ward 10 years on…

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Health Services and Delivery Research

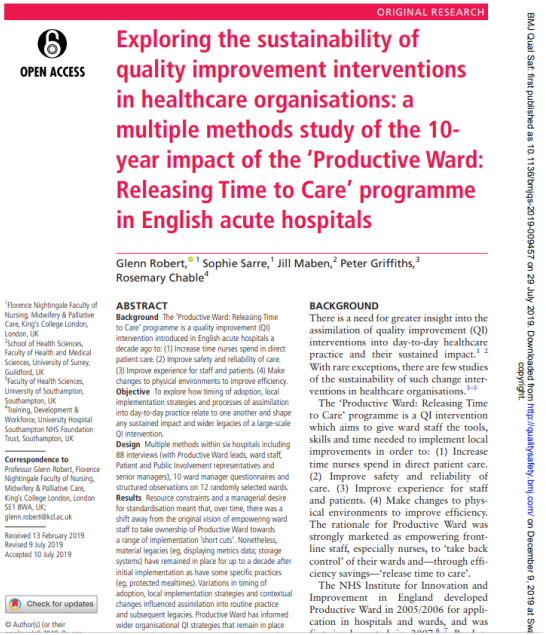
Volume 7 • Issue 28 • August 2019

ISSN 2050-4349

The 10-year impact of a ward-level quality improvement intervention in acute hospitals: a multiple methods study

Sophie Sarre, Jill Maben, Peter Griffiths, Rosemary Chable and Glenn Robert

DOI 10.3310/hsdr07280



ORIGINAL RESEARCH

OPEN ACCESS

Exploring the sustainability of quality improvement interventions in healthcare organisations: a multiple methods study of the 10-year impact of the 'Productive Ward: Releasing Time to Care' programme in English acute hospitals

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ABSTRACT

Background The 'Productive Ward: Releasing Time to Care' programme is a quality improvement (QI) intervention introduced in English acute hospitals a decade ago to: (1) Increase time nurses spend in direct patient care. (2) Improve safety and reliability of care. (3) Improve experience for staff and patients. (4) Make changes to physical environments to improve efficiency.
Objective To explore how timing of adoption, local implementation strategies and processes of assimilation into day-to-day practice relate to one another and shape any sustained impact and wider legacies of a large-scale QI intervention.
Design Multiple methods within six hospitals including 88 interviews (with Productive Ward leads, ward staff, Patient and Public Involvement representatives and senior managers), 10 ward manager questionnaires and structured observations on 12 randomly selected wards.
Results Resource constraints and a managerial desire for standardisation meant that, over time, there was a shift away from the original vision of empowering ward staff to take ownership of Productive Ward towards a range of implementation 'short cuts'. Nonetheless, material legacies (eg, displaying metrics data; storage systems) have remained in place for up to a decade after initial implementation as have some specific practices (eg, protected mealtimes). Variations in timing of adoption, local implementation strategies and contextual changes influenced assimilation into routine practice and subsequent legacies. Productive Ward has informed wider organisational QI strategies that remain in place

BACKGROUND

There is a need for greater insight into the assimilation of quality improvement (QI) interventions into day-to-day healthcare practice and their sustained impact.[1 2] With rare exceptions, there are few studies of the sustainability of such change interventions in healthcare organisations.[3–5]

The 'Productive Ward: Releasing Time to Care' programme is a QI intervention which aims to give ward staff the tools, skills and time needed to implement local improvements in order to: (1) Increase time nurses spend in direct patient care. (2) Improve safety and reliability of care. (3) Improve experience for staff and patients. (4) Make changes to physical environments to improve efficiency. The rationale for Productive Ward was strongly marketed as empowering front-line staff, especially nurses, to 'take back control' of their wards and—through efficiency savings—'release time to care'.

The NHS Institute for Innovation and Improvement in England developed Productive Ward in 2005/2006 for application in hospitals and wards, and was

- The average length of Productive Ward (PW) use was 3 years (range from < 1 year to 7 years)
- 61% of DoNs reported that PW was no longer regularly used. A change in the trust's chosen QI approach was cited as the most common reason.
- PW leads in 97% (32/33) of trusts reported that at least some elements of PW were still being used.
- Processes resulting from past PW activity (e.g. protected mealtimes) were reported to still be in place.
- PW was seen to have led to change through more efficient and/or standardised routines; the display of information; rethinking processes; giving staff a voice; and improving staff QI knowledge and skills.
- In all 6 case study sites, material legacies (e.g. display of metrics data; storage systems) remained.

Six key lessons from the NHS and Virginia Mason Institute partnership

Aston University
BIRMINGHAM UK

1. Build cultural readiness as the foundation for better QI outcomes
2. Embed QI routines and practices into everyday practice
3. Leaders show the way and light the path for others
4. Relationships aren't a priority, they're a prerequisite
5. Holding each other to account for behaviours, not just outcomes
6. The role of the golden thread: not all improvement matters in the same way.

Burgess (2022) Six key lessons from the NHS and the Virginia Mason Institute partnership | News | Warwick Business School (wbs.ac.uk)

Jones (2022) Building an organisational culture of continuous improvement Building an organisational culture of continuous improvement (health.org.uk)

Challenges in Lean Healthcare….

- ‘Responding to the Grand Challenges in Health Care via Organizational Innovation’ (edited Shortell, Burns and Hefner, 2023): Nine chapters which highlight problem, gap and actions to address:
  - Short term vs long term
  - Little research on whole system change
  - Governance across multiple network levels
  - More long-term data on implementation

- ‘Lessons in quality improvement’ Jones and Chatfield (2022) : The Health Foundation and BMJ collection of articles
  - Many interventions had a positive impact on patients but some fail to achieve outcomes or not sustained
  - No improvement intervention should be conducted in isolation
  - Intervention needs to be integrated and aligned with overarching strategic approach to improvement
  - Involvement from the start of patients and citizens as co-producers of improvement
  - Collection of improvement expertise and knowledge… that requires a system wide response
  - Understanding the social and cultural complexity of healthcare organisations

Reflections on Lean in Healthcare 25 years on…

- **Lean is often adopted superficially (“tool-based lean”):** Lean becomes “ritualistic” — organisations perform the tools without changing underlying behaviours, structures, or leadership
- **Lean is frequently used for cost-cutting rather than value creation:** Lean’s original intent — improving flow, quality, and value — gets lost
- **Leadership is the critical enabler (or barrier):** Leadership commitment and behaviour determine whether lean becomes embedded or collapses.
- **Lean cannot be “copied and pasted”:** Contextualisation is essential — lean must be translated, not transplanted.
- **Improvement requires capability building, not just projects:** Lean is a long-term capability, not a short-term intervention
- **Measurement and performance regimes distort lean:** Lean becomes a tool for meeting targets rather than improving systems.
- **Staff engagement is essential — and often missing:** Lean must be participatory to work in healthcare.

Socio-Lean Framework for Healthcare©

- **The "unfilled promise" of lean in healthcare:** Lean's promise is unfilled because the social system is ignored
- **Lean can work — but only when implemented as a whole system:** Lean is powerful in healthcare — but only when treated as a socio-technical, leadership-driven transformation aligning culture, structures, processes, power, and technology.
- Lean must be…
  - contextualised
  - cultural, not just technical
  - leadership-driven
  - capability building
  - participatory
  - understood as a socio-technical system
- **Lean in healthcare must be socio-lean.**

Socio-Lean Framework for Healthcare©

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SOCIO-LEADERSHIP
Leadership misunderstanding and misalignment is the primary barrier

SOCIAL CONDITIONS
Culture, trust, norms: Lean becomes "ritualistic" without cultural change

SOCIAL STRUCTURES
Roles, decision flow: Healthcare structures often block lean adoption

SOCIAL PROCESSES
Learning, Lean tools, huddles: Lean becomes project –based without routines

SOCIAL POWER
Voice, equity, politics: Performance regimes distort lean; politics shape outcomes

SOCIO-TECHNICAL SYSTEM
People + Process + Technology:
Lean must be contextualised, not copied

Radnor (2012–2020): Lean fails to make improvement sustainable when implemented superficially, used for cost-cutting, or divorced from culture, leadership, and context.

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Thank you!

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THE MATURITY OF LEAN MANAGEMENT IN A LARGE ACADEMIC MEDICAL CENTER IN FINLAND: A QUALITATIVE STUDY

3/11/2026 Irmeli Hirvelä, Nurse Manager, Eye Hospital

FINLAND

Finland has a population of 5.6 million.

The capital city is Helsinki.

Health care is mainly publicly organized and maintained with tax revenue.

Finland utilizes the tax-based, Beveridge-type healthcare system model, in which the government provides health care for all its citizens

Helsinki University Hospital

- The largest provider of specialized health care in Finland
- Employees include over 27 000 multiprofessional workers
- Over 711 000 patients were treated at the hospital in 2024
- Lean management has been used since 2009

The Eye Hospital

Data collection and analysis

year 2022

- The interviewed 15 leaders were from the 3 sectors (A, B and C) and their divisions, with 14 being experienced in LM and trained in Lean methodology.
- We used semi structured interviews.
- The interviews averaged 1 h.
- We used grounded theory to analyze the text by identifying the main concepts.

- Reponen *et al*. validated the LHISI maturity tool in a Finnish healthcare context in 2020 by using reviews of experts, practitioners, and leaders; a pilot test; and a survey. The LHISI survey was sent to all 26 172 employees at the Helsinki University Hospital, 6073 of whom responded (the response rate was 27%).
- The original LHISI maturity tool was reduced from 43 to 25 items and identified the 5 dimensions of leadership, commitment, standard work, communication, and daily management system through factor analysis.
- The researchers noticed that the LHISI is a practical tool that can assist in monitoring Lean implementation both overall and in the individual departments.
- Currently, the LHISI is being used in the USA, Spain, and China, while Brazil is planning to use it.
- Our research uses an LHISI framework and its dimensions to evaluate Lean maturity in the hospital through qualitative research.

Lean Healthcare Implementation self-assessment instrument (LHISI)

was developed by the Center for Lean Engagement and Research at the University of California, Berkeley School of Public Health.

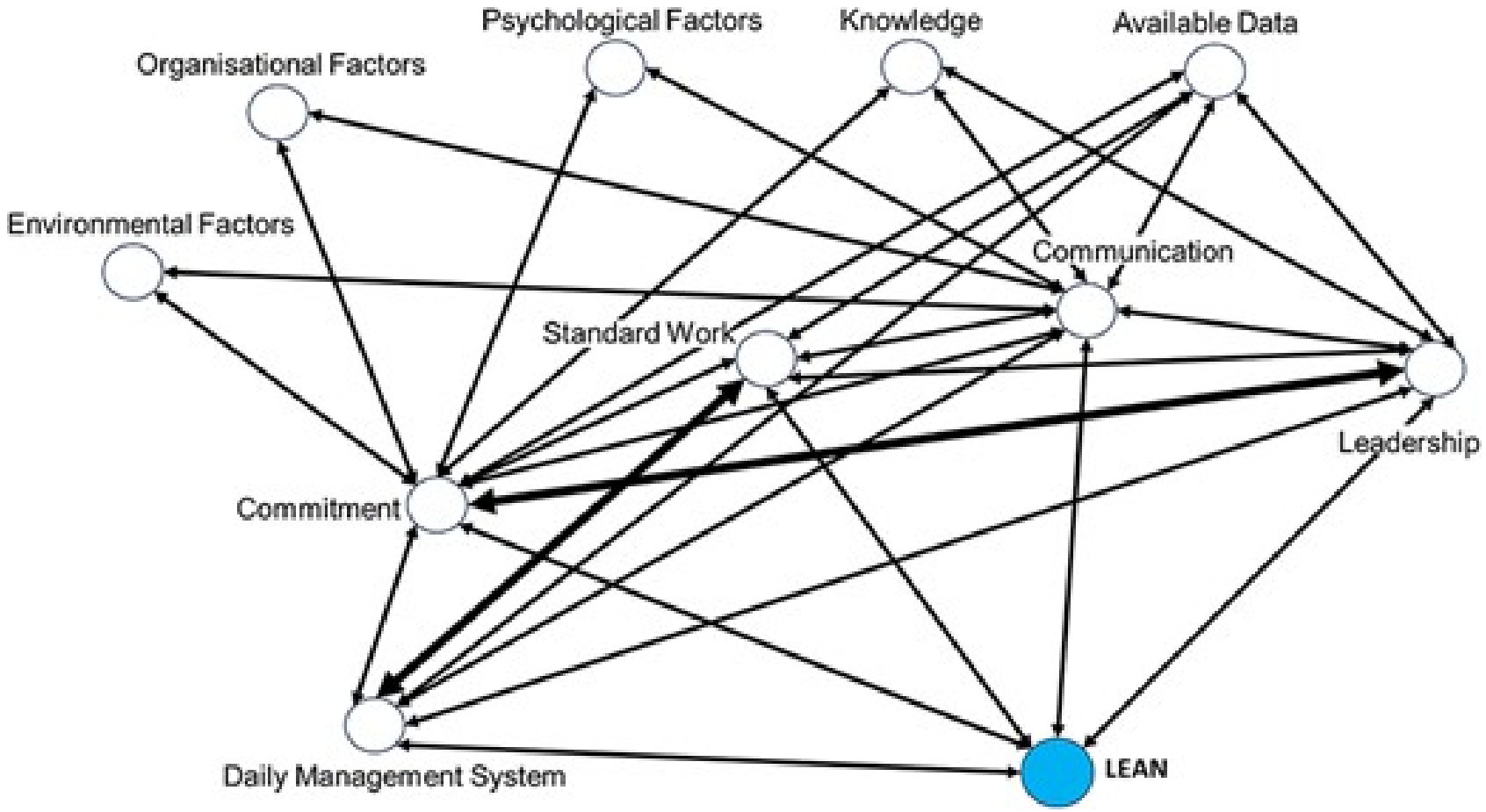
- All 15 leaders described LM as an organization's culture and philosophy, wherein they were committed to continuously developing and streamlining effective patient healthcare processes.
- Even though 14 of the 15 leaders had been trained in Lean, there were variations in their knowledge of the Lean philosophy, and they expressed misunderstandings of LM. The misunderstandings were noticeable in the leaders of Sectors A and C.
- It was evident that the nine leaders lacked knowledge about Lean and its implementation strategy was missing.
- T he staff commitment to LM varied in all three sectors.

Comparing Lean implementation within 3 sectors (A, B and C.

- Sector B was the most mature sector, and its leaders had implemented LM smoothly as part of daily operations;
- Sector B had over 20 Lean coaches, who supervised that all development progress was conducted efficiently.
- The sector's staff actively generated development proposals and were ready to implement them.
- The leaders and the staff were involved in continuous improvement.
- Sector had standardized all mandatory work and shared knowledge about it.
- Sector recorded the responsibilities for the patient processes, and how they follow up and improve those processes.
- Sector had internal quality reviews, wherein issues were discussed with the staff.

The most mature Sector B

THE FACTORS OF LEAN IMPLEMENTATION



Discussion

- The organization-wide Lean implementation needs a good knowledge about Lean; correct leadership activities are on key instruments to increase the maturity of Lean .
- Achieving the desired results with Lean requires a high level of maturity, which needs to be repeatedly evaluated and maintained for continuous improvement by using a low-threshold maturity tool.
- The knowledge about Lean, the availability of data, environmental, psychological, and organizational factors play important roles in supporting and hindering leadership, communication and daily management in the hospital, and commitment to Lean.
- It is most important to focus on five dimensions and the explanatory factors as well as easy-to-use Lean maturity tools when evaluating and developing Lean implementation of organizations continuously.

Conclusion

- The main theoretical findings are that the organization-wide implementation requires a good knowledge of Lean and correct leadership activities that increase the maturity level.
- By developing and maintaining the key dimensions of Lean, organizations can continuously develop and achieve their full potential.
- The main practical conclusion of our study is that the Lean maturity tools should be easy to use, so organizations themselves can evaluate information about Lean implementation and the factors that influence it.


QUESTIONS ?

HUS

THANK YOU 💖

Picture taken from the national park Koli

Lean Healthcare Research

SYMPOSIUM 2026

March 11, Houston

CLEAR

Center for Lean Engagement & Research in Healthcare

Berkeley Public Health

Integrating Industry 4.0 with Lean for Quality Improvement in Healthcare

Evidence from Survey Data

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10th Lean Healthcare Research Symposium | March 11, 2026 | Houston, Texas

Research Context

The Challenge

Many studies address quality or technology in healthcare but fail to recognize:

- Distinct differences between QI tools in healthcare vs. manufacturing
- Specific Industry 4.0 technologies applicable to healthcare

Our Approach

Expert-informed, mixed-methods design:

- Qualitative expert interviews to refine survey instrument
- Quantitative survey to assess technology adoption and impact

Research Questions

1. What is the current state of Industry 4.0 technology adoption in healthcare organizations?
2. How do these technologies impact operational performance and quality outcomes?
3. What is the relationship between technology adoption and lean quality improvement tools?
4. How can technology advance safety, efficiency, patient-centeredness, and equity?

Theoretical Framework

Industry 4.0 Principles in Healthcare

Interconnectivity
Devices, sensors, and humans connected via IoHT
Information Transparency
Big data analytics enabling informed decisions
Technical Assistance
AI, robotics supporting clinical workflows
Decentralization
Distributed decision-making and control
Service Orientation
Cloud-based SaaS/PaaS delivery models

IHI Six Aims for Improvement

Safety
Avoiding harm to patients from care
Effectiveness
Services based on scientific knowledge
Patient-Centeredness
Responsive to preferences and values
Timeliness
Minimizing waits and harmful delays
Efficiency
Cost-effective, avoiding waste
Equity
Care quality independent of demographics

Integration: How can Industry 4.0 technologies enhance achievement of IHI aims through lean practices?

Sources: Cañas et al. (2021); Institute of Medicine (2001); Tortorella et al. (2020)

Methodology: Expert Interview Phase

Qualitative foundation for survey instrument development

Expert Panel (n=5)

Quality & Operations Experts: Former VP of Quality (global responsibilities), Ph.D., decade of university teaching; OpEx Manager with medical technology sector experience

Healthcare Administration: VP Human Resources at long-term acute care hospital; Certified Patient Experience Professional (CPXP), Board-Certified Patient Advocate (BCPA)

Clinical Leadership: Practicing physician, Clinical Professor, Medical Director, Hospital Department Chief with decades of healthcare quality leadership

Key Contributions from Expert Interviews

Survey Refinement

Streamlined technology list; clarified healthcare-specific terminology

KPI Validation

Finalized 11 operational performance indicators relevant to healthcare

Tool Differentiation

Identified distinct QI tools used in healthcare vs. manufacturing

Methodology: Survey Design & Sample

Survey Structure

Section 1: Organization demographics, respondent expertise

Section 2: Industry 4.0 technology adoption (29 technologies)

Section 3: Operational performance indicators (11 KPIs)

Section 4: IHI quality dimensions (6 aims)

Section 5: QI and patient safety tools (19 tools)

Section 6: Technology impact on equity/inclusivity (open-ended)

Data Collection

Period: February 2024 – January 2025

Platform: Online survey (Google Forms)

Distribution: Professional networks, academic conferences, healthcare associations

Sampling: Purposive sampling of healthcare professionals with technology/QI experience

Responses: 102 valid responses

102	10	73%	80%
Respondents	Countries	Healthcare Orgs	Graduate Degree

Analysis: Descriptive statistics, cross-tabulations, thematic analysis of qualitative responses

Respondent Profile

Geographic Distribution

- United States: 75 (73.5%)
- Netherlands: 14 (13.7%)
- Other (8 countries): 13 (12.8%)

Organization Size (Revenue)

- Large (≥$1B): 44 (43%)
- Medium ($50M-$1B): 27 (26%)
- Small (≤$50M): 26 (26%)

Professional Role

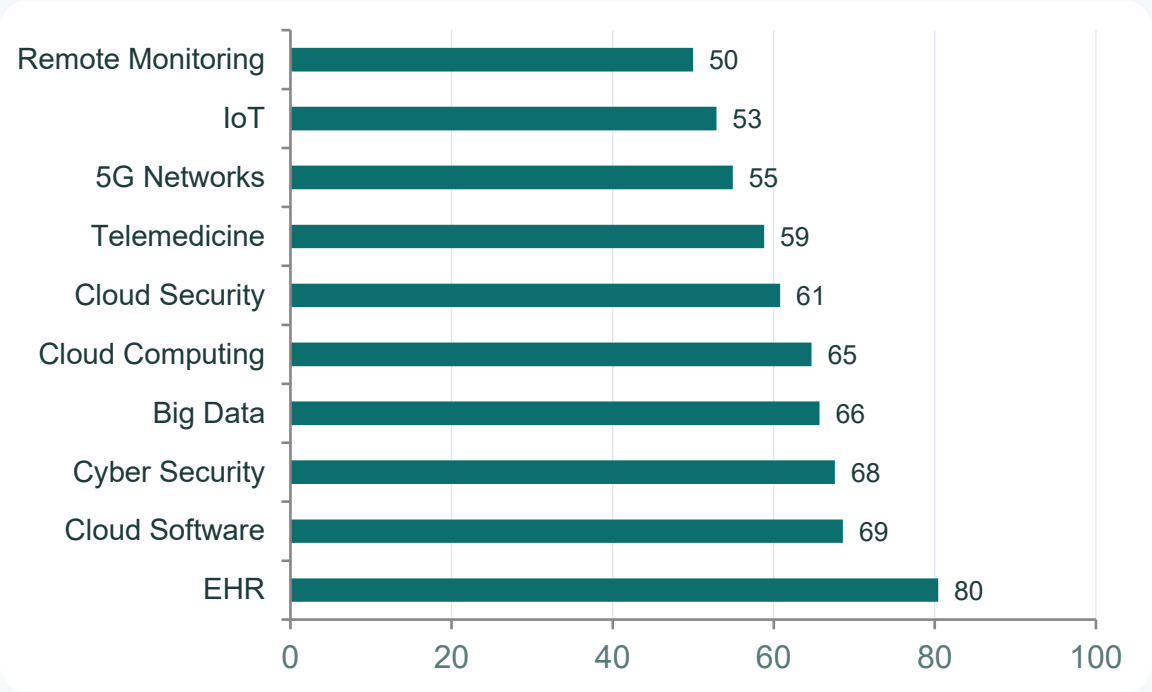
- Executive/Senior Mgmt: 41 (40%)
- Middle Management: 20 (20%)
- Senior Staff/Other: 41 (40%)

Education & Experience

- Doctoral Degree: 49 (48%)
- Master's Degree: 33 (32%)
- >10 years experience: 65 (64%)

Sample represents experienced healthcare leaders well-positioned to assess technology adoption and quality improvement

Industry 4.0 Technology Adoption: Leaders



Key Findings

Foundation technologies lead:

EHR (80%)

Healthcare professionals are highly familiar with EHR applications

Cloud & Security (61-69%)

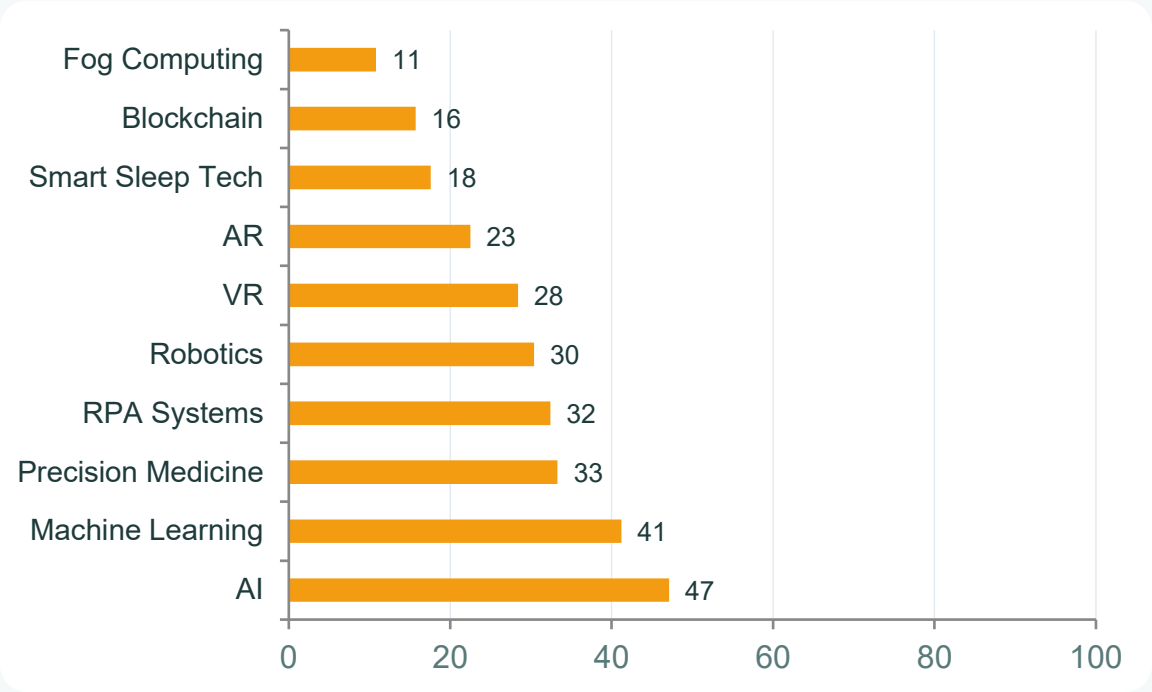
Essential infrastructure for advanced implementations

Telemedicine (59%)

Rapid adoption post-pandemic

Implementation rate = Moderate + Advanced + Expert adoption levels

Industry 4.0 Technology Adoption: Emerging



Expert Insights

AI (47%):

Not yet integrated at organizational level; used individually for presentations, educational materials

AR (23%):

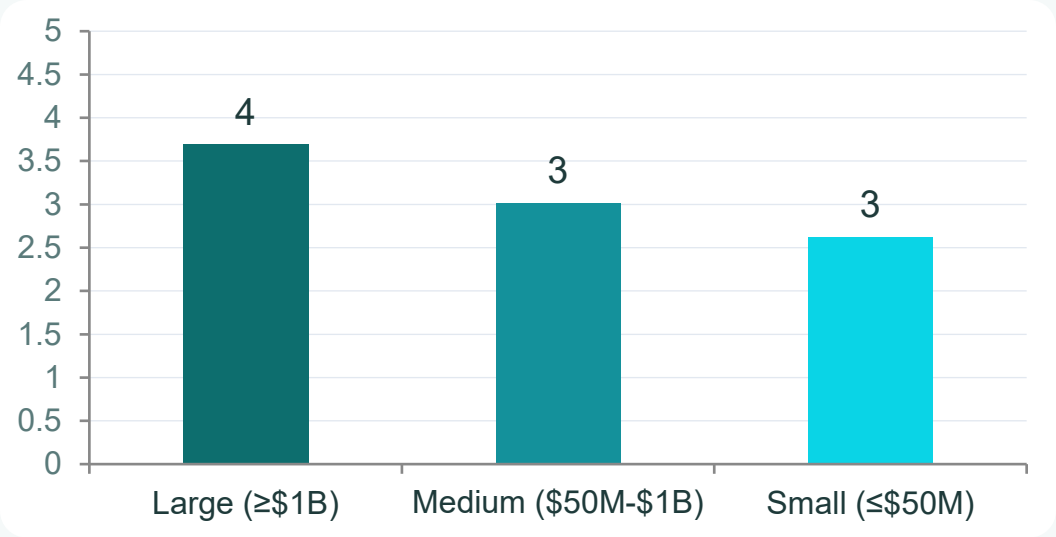
"Least understood technology"—professionals lack clarity on capabilities

VR/Digital Twins:

Considered "cutting-edge" Healthcare 5.0; more for facility planning than clinical care

Significant knowledge gaps exist: Blockchain (52%), Fog Computing (71%) unfamiliar to respondents

Technology Maturity by Organization Size



Maturity Index Scale

5 = Expert (>2 years use)

4 = Advanced (project complete)

3 = Moderate (planning/in progress)

2 = Beginner (considering)

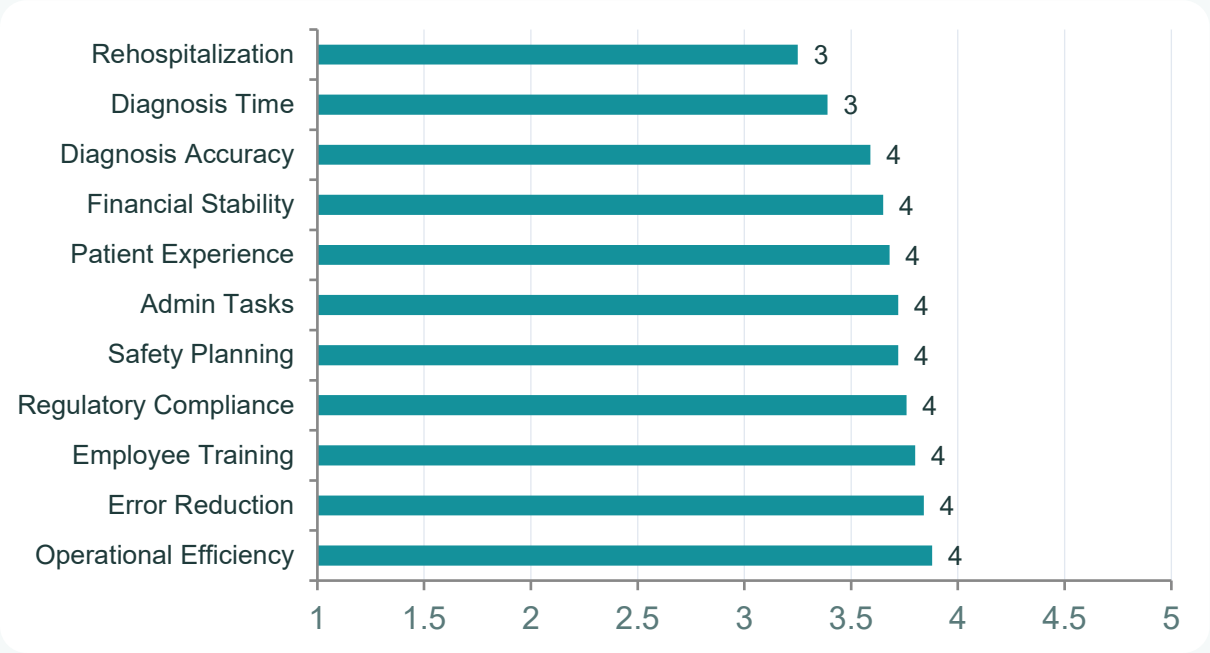
1 = Will not implement

Index = mean score across 29 technologies, excluding 'Don't know'

Key Finding: Large organizations score 41% higher on technology maturity than small organizations, indicating resource availability and scale drive adoption capacity

Operational Performance Impact

How Industry 4.0 technologies affect healthcare KPIs (expert-validated indicators)



Implications

Highest Impact:

- Process efficiency
- Error reduction
- Training support

Moderate Impact:

- Patient experience
- Clinical outcomes

Opportunity: Direct clinical impact requires deeper integration

Scale: 1 (Very Low) to 5 (Very High) perceived impact on performance

Quality Improvement Tools in Healthcare

Expert insight: "Healthcare professionals have their own jargon not aligned with manufacturing quality literature"

Healthcare-Specific Tools

(Patient Safety Essentials Toolkit)

SBAR (74% adopted)
Situation-Background-Assessment-Recommendation
Huddles (74%)
Brief team communication meetings
Five Whys (77%)
Root cause analysis technique
Action Hierarchy/RCA2 (46%)
Structured incident response
Ask Me 3® (18%)
Patient communication tool

Traditional QI Tools

(QI Essentials Toolkit)

Flowcharts (88%)
Process visualization
PDSA Worksheets (75%)
Plan-Do-Study-Act cycles
Pareto Charts (78%)
Prioritization analysis
Cause & Effect Diagrams (69%)
Fishbone/Ishikawa diagrams
Run/Control Charts (67%)
Statistical process control

Both toolkits well-established; opportunity exists for technology-enabled enhancement of underutilized tools

Technology & Health Equity

Qualitative findings from open-ended responses (n=37) and expert interviews

Expert Insight on Equity Assessment:

"Equity is assessed through EHR data and external governmental data—zip code, race, gender—to identify vulnerable populations. Big data analytics enables comprehensive analyses to unveil population demographics for government-sponsored healthcare organizations."

Access Expansion

"Telemedicine allows rural patients to access services offered in urban settings"

Bias Reduction

"Machine learning can help eliminate individual physician biases in diagnosis"

Data-Driven Identification

"Social determinants of health automatically calculated and displayed in EMR"

Equity Concerns Identified

- Digital divide may exclude vulnerable populations lacking technology access
- Algorithm bias can perpetuate existing healthcare disparities
- Mental health practitioners concerned about autonomous patient AI use affecting care protocols

Key Findings from a further Qualitative Study

The authors have further carried out a simple qualitative study with three basic questions and 12 people from 9 countries have participated in the study. Eight practitioners in healthcare and four academics engaged in Lean, AI and Healthcare have responded to the questions.

The three RQs were:

RQ1: What are the challenges in the integration of Lean with Industry 4.0 in the healthcare sector?

RQ2: What are the essential skills required for the successful integration of Lean and Industry 4.0 in healthcare?

RQ3: What is the role of AI and Lean in healthcare? Where can we integrate these two? Please provide a couple of examples.

Key Findings from a further Qualitative Study

Position	Country	Years of Experience
Lean and Digitalization Manager	Portugal	10 +
Lean and AI specialist	Italy	7+
Head of Quality Improvement	USA	15+
Director of CI	USA	20+
Head of Digitalization	India	5+
Quality Improvement Manager	Ireland	10+
Lean Manager	UK	8+
Lean and AI expert (consultant)	Brazil	5+

Key Findings from a further Qualitative Study

Position	Country	Years of Experience
Professor of Operations and Supply Chain Management	UK	10 +
Professor of Operations Management and Business Analytics	Australia	9+
Professor of Industrial Management	Italy	10+
Professor of Quality Management	Sweden	10+

Key Findings from a further Qualitative Study

RQ1: What are the challenges in the integration of Lean with Industry 4.0 in the healthcare sector? (inputs from 12 professionals)

- **Change of mindset (fixed to growth)**
- **Lack of process ownership**
- **Lack of analytical capabilities, especially when AI handles large volume of data (Big data)**
- **Legacy IT systems and fragmented data infrastructures**
- **Cultural factors in the healthcare sector**
- **High clinical variability !!**
- **Data quality for strategic decision-making processes**
- **Risk of producing more waste using automation before Lean !!**

Key Findings from a further Qualitative Study

RQ2: What are the essential skills required for the successful integration of Lean and Industry 4.0 in healthcare? (inputs from 12 professionals)

- **Systems Thinking Skills**
- **Digital Literacy Skills**
- **Analytical and Statistical Thinking Skills**
- **Leadership Skills**
- **Change Management Skills (addressing resistance to change + behavioural change)**
- **Cross-functional Communication and Collaboration Skills**
- **Process improvement skills using right methodologies and tools**
- **Project Management Skills**

Key Findings from a further Qualitative Study

RQ3: Where can we integrate Lean and AI in Healthcare? (inputs from 12 professionals)

- **Predictive AI models integrated with Lean (waiting time, early identification of sepsis, triage time, etc.)**
- **AI-assisted preparation of robotic operating theatres (waiting time)**
- **AI integrated with IoT predicts medical equipment failures**
- **Lean defines value, reduces waste, and standardize processes, while AI enhances visibility, prediction, and decision-making**
- **AI enhances decision support, while Lean ensures that insights are translated into sustainable operational improvements**

Implications for Lean Healthcare Practice

Build on Foundations

- EHR and cloud platforms are prerequisites for advanced technologies
- Cyber security must be integral to any technology strategy
- Start with mature technologies before pursuing emerging ones

Enhance—Don't Replace—Lean

- Traditional QI tools (PDSA, flowcharts) remain essential
- Technology can automate data collection and analysis
- Focus on value stream digitization
- Use AI to support—not supplant—human decision-making

Design for Equity

- Include equity considerations in technology selection
- Address digital divide through hybrid approaches
- Monitor for algorithmic bias in AI applications
- Use technology to identify vulnerable populations

Conclusions

1. Foundation technologies (EHR, Cloud, Cyber Security) have achieved substantial adoption (60-80%); emerging technologies (AI, Blockchain, AR/VR) show significant implementation and knowledge gaps

2. Large organizations demonstrate 41% higher technology maturity than small organizations—resource availability and scale drive adoption capacity

3. Technology impact is highest for operational efficiency and error reduction; direct clinical outcomes require deeper integration

4. Healthcare uses distinct QI tools alongside traditional lean methods—both are well-established and provide foundation for digital enhancement

5. Technology offers promise for advancing health equity (access, bias reduction) while raising concerns about digital divide and algorithmic fairness

Future Research Directions

- Longitudinal studies tracking technology adoption and lean maturity over time
- Comparative analysis across different healthcare systems and regulatory environments
- Impact assessment of specific technologies on patient outcomes and safety metrics
- Development of frameworks for equitable technology implementation in smaller organizations
- Exploration of emerging technology impact on healthcare decision-making (Healthcare 5.0)

Thank You

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Questions?

We thank our collaborators, expert panel and all survey respondents for their valuable contributions to this research.

Addressing Social and Cultural Needs with Lean Management in a National Sample of U.S. Physician Practices

Center for Lean Engagement and Research (CLEAR)
UC Berkeley School of Public Health

The Dartmouth Institute for Health Policy & Clinical Practice
Geisel School of Medicine at Dartmouth

Presenters: Dorothy Hung, PhD, MA, MPH; Lillian Levy, MS; Dasha Zerboni; Karen Schifferdecker, PhD, MPH

CLEAR
Center for Lean Engagement & Research in Healthcare

Berkeley Public Health

Lean in healthcare

- An operating system based on a culture of continuous improvement that empowers frontline workers to ***solve problems*** in response to the ***voice of the customer (patient)***
  - Leads to higher value and quality of care

- Socio-Technical approach highlighting respect for people, humble leadership, standardized work systems & tools

- Examples of lean methodology:
  - A3 thinking / problem-solving
  - Value stream mapping
  - Tiered huddles
  - Daily management system / standard work
  - Kaizen rapid improvement events
  - Analysis tools (e.g., pareto charts)

Drivers of health equity (as value of Lean in healthcare)

- ***Health-related social needs (HRSNs)***: contribute ~50% of influence on variations in health status (CDC 2024)
  - Stable housing
  - Food security
  - Transportation
  - Interpersonal safety

- ***Patient race/ethnicity and language (REAL)***: services impact access and experience of care (Ngo-Metzger et al. 2007)
  - Language translation
  - Patient-provider concordance

Opportunity and challenges in primary care

- ***Primary care practices (PCPs) are well positioned*** to identify & respond to patient needs (Vega Perez et al. 2022)
  - Community outreach
  - Frequent interaction over time
  - Care coordination

- Incorporating social interventions into workflows is challenging for PCPs
  - Lack reliable infrastructure and systems (Boch et al. 2020; Willis 2020)

- ***Wide variation in PCP support for patients***
  - Based on clinic capacity, resource prioritizations, existing operational efficiencies

Lean support for equitable care

- Offers a ***systems-based approach*** to reduce variation and maximize value with focus on respect for people
  - Used to design efficient workflows for care teams
  - Address needs of vulnerable patient populations

- Cost, efficiency in primary care and hospitals are documented (Hung et al. 2015, 2017, 2021-22; Shortell et al. 2021; Roey et al. 2023; Lee et al. 2024)
  - Applications to equity-focused areas are underexplored

- Establish connections between lean and equity to support delivery of sociocultural services in PCPs

Research Questions

1. *Are PCPs that adopt lean more likely to implement systems* for social needs screening, REAL data collection, language services, and workforce training to reduce disparities?

2. How does the *extent of lean implementation* relate to the presence of practice infrastructure for addressing social risk and providing culturally-responsive care?

National Survey of Health Systems & Organizations (NSHOS II)

Nationally Representative Survey

Consists of 1,245 physician practices across the U.S.
Fielded June 2022 – February 2023

Designed & Fielded by

Dartmouth Institute for Health Policy & Clinical Practice
UC Berkeley School of Public Health with SSRS

Organizational Data Collected

Practice characteristics, infrastructure
Insurance mix, alternative payment models
Clinical, operational quality improvement systems

Operational and Care Capabilities

Patient care, patient-reported measures, motivational interviewing, shared decision making, care of complex high-needs patients, information systems, performance improvement

NSHOS II survey

Overview: Nationally representative survey of 1,245 U.S. primary care practices conducted in 2022–2023. Examines organizational capabilities, infrastructure, payment models, and service delivery systems.

Survey Design

Survey Instrument

- 52-item structured survey
- Developed from prior NSHOS I primary care studies
- Expanded using CLAS (Culturally & Linguistically Appropriate Services) standards
- Designed to capture organizational capabilities, not just clinical activity
- Focused on systems-level structures within practices

Conceptual Foundation

- Builds on national primary care organizational research
- Incorporates equity-focused service delivery measures
- Aligns with contemporary payment and delivery reform models
- Designed to assess both operational and cultural capacity
- Reflects evolving expectations for primary care

Practice-Level Measures Assessed for this Study

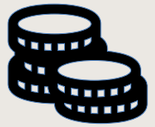
1	Organizational Infrastructure	• Practice ownership and size • Other characteristics from IQVIA OneKey
2	Insurance & Payment Models	• Payer mix (Medicare, Medicaid, Commercial) • Capitation • Participate in value-based payment models
3	Quality Improvement Systems	• Clinical quality measurement systems • Operational performance tracking • Structured QI processes
4	Lean Methodology Use	• Use of A3 structured problem-solving • Process mapping and workflow redesign • Continuous improvement activity
5	Social & Cultural Supports	• Language access services • Culturally responsive care practices • Social needs screening, referral, follow-up

Domains of NSHOS practice features

Structural

Structural characteristics capture the organizational form of the practice that shapes its operational capacity

Financial



Financial characteristics reflect payer mix and reimbursement models that influence resource constraints and incentive alignment.

Geographic

Geographic context reflects regional variation and rural–urban setting, which shape patient population needs and resource environments.

Structural practice features

Ownership
- Independent, Group, Hospital, Health system, FQHC, Other
- Reflects organizational affiliation

Practice size
- Solo, Small (2-9 physicians), Medium (10-19), Large (20+)
- Captures staffing capacity

IPA Affiliation
- % Yes

Financial practice features

Insurance mix
- (Commercial, Medicaid, Medicare, Uninsured/Self-pay/Other)
- Reflects financial composition of the practice's patient population

Capitation
- % Yes
- Indicates whether a practice receives fixed per-patient payments

ACO participation
- Number of ACO payer types

Geographic practice features

Rural-Urban continuum
- Metropolitan, Micropolitan, Rural/Small town
- Captures differences in patient demographics

Geographic region
- East, Midwest, South, West
- Accounts for variation in state-level policy environments, payer markets, and population health

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Lean Implementation Measures

Adoption of Lean processes

(Yes / No) indicator of any Lean use

Extent of Lean implementation

(# of processes; range: 1-6)

Types of Lean processes

- A3 thinking
- Value stream mapping
- Huddles
- Analysis tools
- Kaizen continuous improvement events
- Standard work/daily management system

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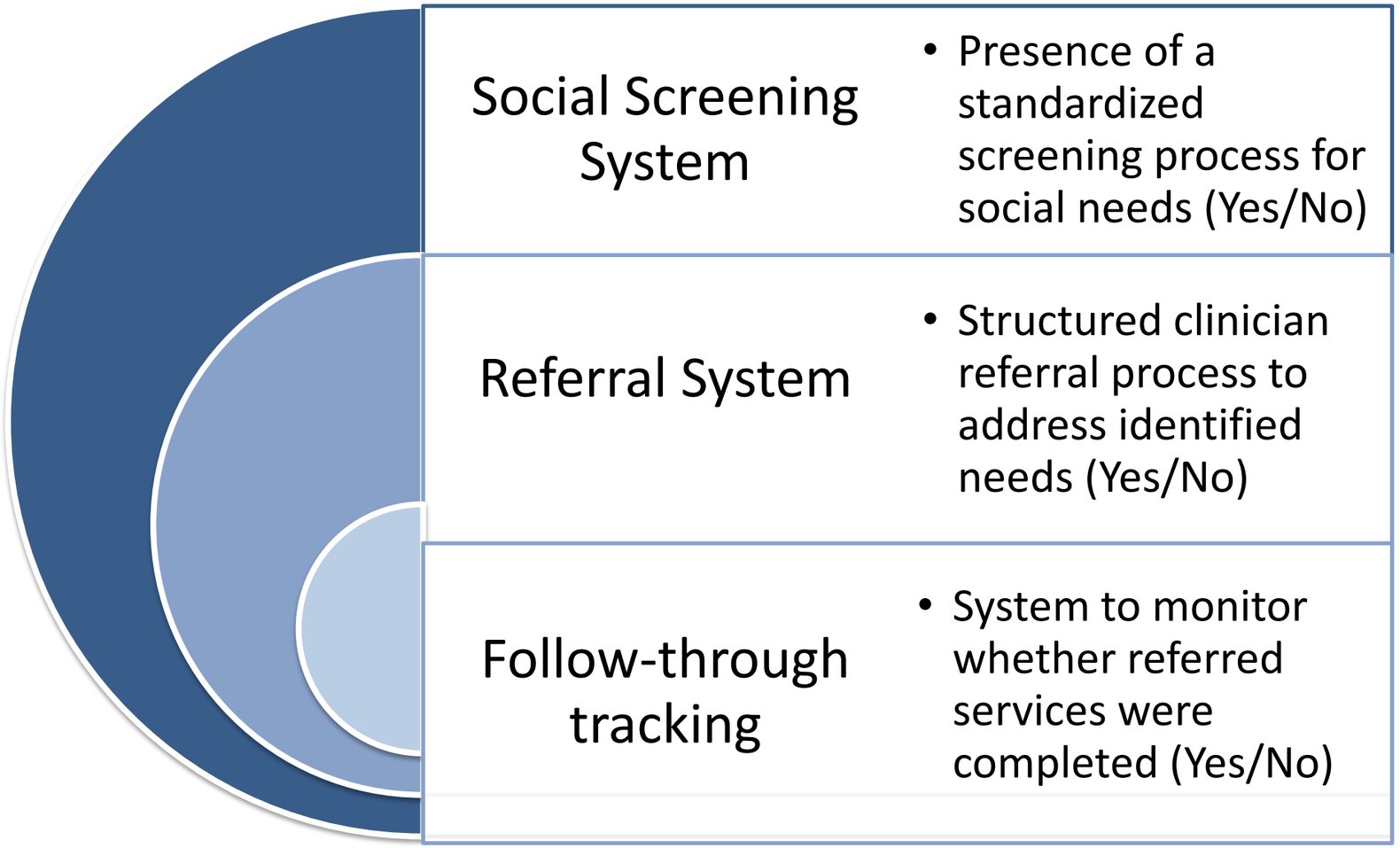
Outcomes of Interest (HSRN)



Social Screening System	• Presence of a standardized screening process for social needs (Yes/No)
Referral System	• Structured clinician referral process to address identified needs (Yes/No)
Follow-through tracking	• System to monitor whether referred services were completed (Yes/No)

Performance Review Stratified by Payer

- Review of preventive service delivery by payer category (Yes/No)
- Commercial, Medicare, Medicaid, Uninsured/Self-pay

Training Requirement

- Formal training requirement on providing care to socioeconomically disadvantaged patients (Yes/No)
- Assessed for clinicians and support staff

Outcomes of Interest (REAL)

Language infrastructure

- Provision of translation services (Always/Often coded as 1)
  - "Always" and "Often" indicated as 1, all others coded as 0
- Reflects operational capacity to support language access

Workforce alignment

- Clinician Representation of Patient Demographic (Quite a lot / Some / A little / Not at all)
  - "Quite a lot" = 1, all others = 0
- Captures alignment between clinician composition and patient population

Cultural climate and data infrastructure

- Confidence in addressing racism/discrimination ("Quite a lot" coded as 1)
  - "Quite a lot" = 1, all others = 0
- Among patients, clinicians, and staff

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Statistical Analysis

Descriptive Analysis	Unadjusted Analysis	What our models contribute
Purpose *Characterize lean adoption across practice structures.*	***Purpose*** *Identify raw differences in equity-related capabilities.*	***Purpose*** *Estimate independent associations controlling for context.*

• Profiled physician practices by lean adoption (Yes/No) and extent (1–6 processes)
• Examined distribution across ownership, size, financial structure, and geographic context
• Assessed variation in lean implementation across practice types
	• Examined raw associations between lean implementation and HSRN and REAL outcomes
	• Compared outcome prevalence across lean vs. non-lean practices
	• Statistical tests:
	  • T-tests
	  • Chi-square tests
		• Estimated logistic regression models for binary outcomes
		• Outcomes modeled:
		  • HSRN composite capability score
		  • REAL capabilities (translation services, discrimination confidence, REAL data collection)
		• Adjusted for:
		  • Structural characteristics
		  • Financial characteristics
		  • Geographic characteristics

Results:

Lean Implementation Status Among U.S. practices

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Results

Lean Implementation Status Among U.S. Physician Practices (N = 1,245)

Lean Implementation Status	Adoption of Any Lean Process (n=886)
Number of Lean Processes Implemented [range: 0-6; Mean (SD)]	2.03 (1.28)
Type of Lean Process Implemented	
A3 Thinking for Problem Solving	104 (11.7%)
Value Stream Mapping	105 (11.9%)
Huddles	805 (90.9%)
Standard Work / Daily Management System	453 (51.1%)
Kaizen Continuous Improvement Events	103 (11.6%)
Analysis Tools (e.g., Pareto charts, statistical process control)	233 (26.3%)

Note: Weighted percentages (unweighted counts) are reported to adjust for missing data.

Results

Lean Implementation Status Among U.S. Physician Practices (cont.)

Lean Implementation Status	Adoption of Any Lean Process (n=886)	No Adoption (n=310)	*p-value*
Practice Size			0.0308
Solo	40 (4.6%)	23 (7.4%)	
Small (2-9 physicians)	618 (70.9%)	229 (74.1%)	
Medium (10-19 physicians)	114 (13.1%)	25 (8.1%)	
Large (20+ physicians)	100 (11.5%)	32 (10.4%)	
Ownership			<0.0001
Independently Owned	214 (24.5%)	133 (43.8%)	
Physician Group	77 (8.8%)	31 (10.2%)	
Hospital	76 (8.7%)	26 (8.6%)	
Health System	298 (34.1%)	72 (23.7%)	
FQHC	207 (23.7%)	39 (12.8%)	
Other	1 (0.1%)	3 (1.0%)	
IPA Affiliation (% Yes)	172 (19.7%)	76 (24.9%)	0.0544

FQHC: Federally Qualified Health Center; IPA: Independent Practice Association

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Results

Lean Implementation Status Among U.S. Physician Practices (cont.)

Lean Implementation Status	Adoption of Any Lean Process (n=886)	No Adoption (n=310)	*p-value*
Insurance: Annual Patient Care Revenue[a] (Mean, SD)			
Commercial	3.12 (1.00)	3.18 (0.91)	0.3727
Medicare (incl. duals)	3.01 (0.84)	3.15 (0.85)	0.0219
Medicaid	2.25 (1.16)	1.88 (1.08)	<0.0001
Uninsured/Self-pay/Other (Tricare, VA, Worker's Comp, etc)	1.44 (0.78)	1.37 (0.75)	0.2152
Capitation (% Yes)	390 (47.7%)	104 (36.6%)	0.0012
ACO Participation[b] (Mean, SD)	1.80 (1.2)	1.46 (1.2)	<0.0001
Rural-Urban Continuum Code[c]			0.7161
Metropolitan	714 (82.8%)	245 (80.9%)	
Micropolitan	89 (10.3%)	36 (11.9%)	
Rural/Small Town	59 (6.8%)	22 (7.3%)	
Geographic Region			0.0005
East	182 (20.5%)	48 (15.5%)	
Midwest	242 (27.3%)	77 (24.8%)	
South	233 (26.3%)	120 (38.7%)	
West	229 (25.9%)	65 (21.0%)	

[a]Annual patient care revenue, 1:<10%, 2: 10-19%, 3: 20-49%, 4: 50-79%, 5:>80%

[b]Number of ACO payer types (ACO: Accountable Care Organization)

[c]Classification for practice's business address

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Results:

Associations between Lean & Social Support

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Results

	HRSN Screening, Referral and Follow-up Systems		Training to Care for Socioeconomically Disadvantaged Populations		Performance Review of Preventive Service Delivery, Stratified by Payer	
	Odds Ratio	95% CI	Odds Ratio	95% CI	Odds Ratio	95% CI
Lean Implementation Status						
Adoption of Any Lean Process	3.15***	[1.26, 7.87]	3.56**	[1.78, 7.13]	2.15*	[1.12, 4.13]
Number of Lean Processes Implemented	1.45**	[1.14, 1.84]	1.70***	[1.36, 2.13]	1.31**	[1.07, 1.61]
Practice Ownership						
Independent	1.69	[0.63, 4.52]	1.47	[0.71, 3.06]	2.45*	[1.19, 5.03]
Physician Group	6.23*	[1.54, 2.53]	2.20	[0.71, 6.83]	1.99	[0.64, 6.23]
Hospital	0.25	[0.04, 1.40]	0.53	[0.19, 1.52]	1.99	[0.71, 5.60]
FQHC	9.85***	[3.91, 2.48]	2.61*	[1.25, 5.43]	2.14	[1.00, 4.57]

Note: The table presents results from two separate regressions with “Adoption of Lean Process” (Yes/No) and “Number of Lean Processes Implemented” as the main independent variable in each variable, respectively.

All regressions adjust for: practice size, ownership, IPA affiliation, insurance (annual patient care revenue), capitation, ACO participation, rural-urban continuum, and geographic region.

*p<0.10, **p<0.05, ***p<0.001, ****p<0.0001

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Results (cont'd.)

	HRSN Screening, Referral and Follow-up Systems		Training to Care for Socioeconomically Disadvantaged Populations		Performance Review of Preventive Service Delivery, Stratified by Payer	
	Odds Ratio	95% CI	Odds Ratio	95% CI	Odds Ratio	95% CI
Capitation	3.34**	[1.81, 6.19]	1.90*	[1.05, 3.47]	0.85	[0.44, 1.63]
Insurance: Annual Patient Care Revenue[a]						
Commercial	1.96*	[1.11, 3.44]	0.75	[0.55, 1.02]	0.90	[0.68, 1.18]
Medicare (incl. duals)	1.42	[0.95, 2.11]	1.19	[0.87, 1.63]	1.17	[0.87, 1.56]
Medicaid	1.75**	[1.21, 2.53]	1.62**	[1.15, 2.29]	1.01	[0.78, 1.33]
Uninsured/Self-pay/Other (e.g.Tricare, VA, Worker's Comp)	1.33	[0.88, 2.02]	1.10	[0.79, 1.53]	1.15	[0.87, 1.52]

Note: The table presents results from two separate regressions with "Adoption of Lean Process" (Yes/No) and "Number of Lean Processes Implemented" as the main independent variable in each variable, respectively.

[a]Annual patient care revenue, 1:<10%, 2: 10-19%, 3: 20-49%, 4: 50-79%, 5:>80%

*p<0.10, **p<0.05, ***p<0.001, ****p<0.0001

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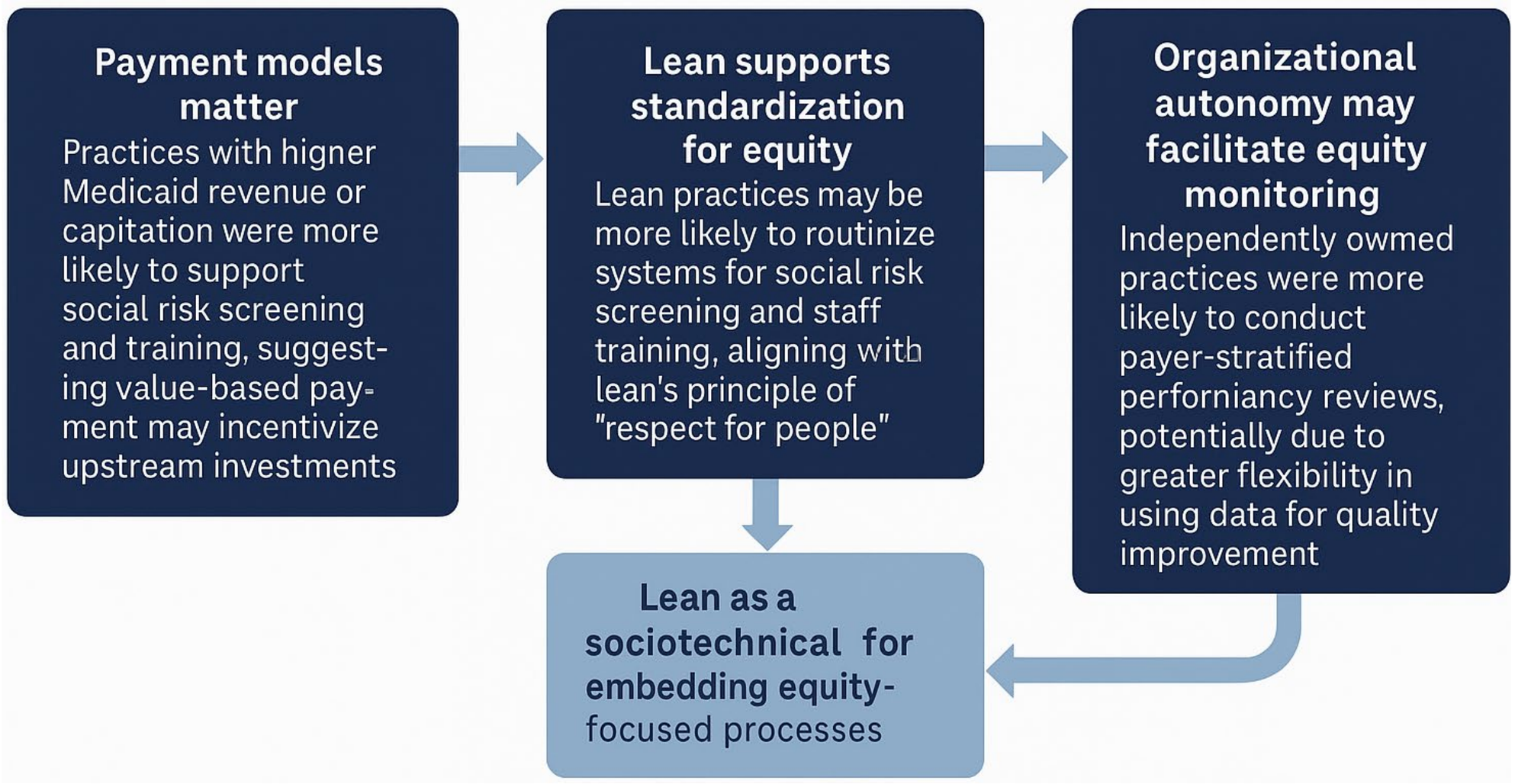
Lean as a Lever for Equity-Oriented Infrastructure



Results:

Associations between Lean & Cultural Support

Data showcases gains in cultural infrastructure

	Language Assistance Services		Clinician Representativeness	
	Odds Ratio	**95% CI**	**Odds Ratio**	**95% CI**
Lean Implementation Status				
Adoption of Any Lean Process	1.93*	[1.03, 3.62]	1.44	[0.80, 2.60]
Number of Lean Processes Implemented	1.27	[0.93, 1.74]	1.18	[0.97, 1.45]

	Patient REAL Data Collection		Ability to Address Race And/Or Discrimination	
	Odds Ratio	**95% CI**	**Odds Ratio**	**95% CI**
Lean Implementation Status				
Adoption of Any Lean Process	3.67***	[1.87, 7.20]	0.16*	(0.063)
Number of Lean Processes Implemented	1.79**	1.15-2.27	0.10***	0.022

Key Observations

1. Lean adoption was associated with greater availability of language services, nearly twice the odds of reporting consistent language assistance.
2. Lean was not significantly associated with clinician representativeness, suggesting lean influences operations not composition.
3. Lean practices were more likely to routinely collect patient REAL data. This was the strongest observed association in the model.
4. Lean practices reported greater confidence in addressing discrimination within the practice, suggesting that lean may shape organizational culture.

Key Takeaway

Lean appears to enhance operational and cultural capacity for equity, particularly through data infrastructure and discrimination response, without changing clinician demographics

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Why REAL Data Collection Matters

Flow	What this enables operationally	Where Lean supports each step
Collect REAL Data	When practices collect patient race, ethnicity, and language data, this information becomes embedded within routine clinical workflows	Lean's emphasis on standardized work and clearly defined intake processes increases the likelihood that demographic data are captured consistently, aligning with our findings
Stratify by race/language	The availability of structured demographic data allows practices to stratify performance, screening rates, and utilization across different patient populations.	Through structured performance review, Lean encourages routine stratification of outcomes, reinforcing our earlier results showing stronger preventive service review in lean practices.
Detect disparities	Stratified data reveal measurable gaps in preventive services, access to language assistance, or other aspects of care	Formal problem-solving methods, such as A3 thinking, provide a disciplined approach to analyzing disparities once identified, supporting the transition from awareness to structured action.
Target interventions	Once disparities are identified, practices can design targeted interventions that directly address the populations experiencing inequities.	Rapid improvement processes enable targeted interventions. This could explain our observed association between lean implementation and greater availability of language services.
Monitor outcomes	Through structured management, these adjustments can be refined and sustained over	Daily management systems create space for open dialogue, which may help explain why lean practices reported greater confidence in addressing race and discrimination within the practice.

Key takeaway

The strong association between lean implementation and routine REAL data collection suggests that lean may strengthen the foundational data infrastructure necessary to identify, measure, and systematically address disparities in primary care. Through REAL Data collection, practices are better positioned to move from general commitments to equity toward sustained, measurable improvement in culturally responsive care.

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From Lean to culture, where changes occur

Lean Principles

Respect for People

Lean emphasizes respect for people by encouraging frontline input and valuing diverse perspectives, reinforcing attention to patient experience. Thus, lean creates conditions where concerns about inequity are more likely to be surfaced

Participatory Management

Participatory management structures create formal opportunities for staff to surface inequities and contribute to structured problem-solving through mechanisms such as A3 thinking.

Standardized Work + Daily Management

Standardized workflows make review of patient experience and disparities routine. By aligning these processes with ongoing monitoring, lean reduces the likelihood that concerns about discrimination are treated as isolated incidents.

Organizational Conditions Created

Psychological safety

Structured routines reduce ambiguity around escalation, making it safer for clinicians and staff to raise concerns related to discrimination.

Data Transparency

Routine collection and review of REAL data increase visibility of inequities, shifting discussions from perception to measurable patterns.

Accountability structures

Defined roles and monitoring processes ensure that concerns related to race or discrimination are addressed through documented action.

Domains of Lean's impact within the workforce

Operational Systems

Operational systems refer to the workflows and management structures that shape how care is delivered within a practice. :

Our findings indicate that lean implementation is associated with:

- Routine collection of REAL data
- Structured screening and referral processes
- Greater availability of language assistance
- Stronger monitoring of performance across patient groups

Lean strengthens these systems by standardizing processes and embedding equity-related review into daily operational management.

Workforce composition

Workforce composition reflects the demographic representation of clinicians and staff within a practice.

In contrast to operational systems, workforce representativeness depends on:

- Recruitment and hiring pipelines
- Retention strategies
- Regional labor market availability
- Long-term structural investment

Our results suggest that workflow redesign alone does not directly alter clinician demographic representation.

Boundary of Lean's Influence

High Operational Impact

Lean appears to meaningfully influence internal systems that govern data capture, performance review, and service delivery. These operational structures make equity-related processes more consistent and sustainable.

Limited Direct Workforce Impact

Shifting clinician demographics requires external workforce strategies and structural investment that extend beyond internal management redesign.

Practice Context and Limits of Lean Processes

Practice Context

Primary care practices operate with varying levels of operational infrastructure and resource capacity.

- Larger practices and those affiliated with health systems often have established systems for standardized data capture, performance monitoring, and service coordination.
- In contrast, independently owned practices may face constraints that limit their ability to implement equity-oriented workflows.

Our results suggest that these structural differences influence the availability of REAL data systems and language support capabilities.

Extent of Lean Implementation

Lean implementation varies in depth across practices, ranging from isolated tools to fully integrated management systems.

- Using a single lean technique may improve specific processes, but its impact can remain localized without broader system alignment.
- In contrast, implementing multiple lean processes reinforces routines through daily management, structured review, and continuous improvement cycles.

More integrated lean systems appear better positioned to sustain reliable equity-related practices.

Infrastructure Capacity and Implementation Depth

Structural Capacity

Practice size, ownership structure, and available infrastructure shape the feasibility of implementing standardized workflows and equity-focused routines

Implementation Reinforcement

The extent of lean implementation influences whether equity-oriented processes become embedded within daily management or remain isolated initiatives.

Key Takeaway

Together, our findings suggest that both practice context and the depth of lean implementation shape whether equity-oriented capabilities become reliable, routine, and sustainable. Infrastructure capacity influences feasibility, while integrated lean systems reinforce consistency and accountability.

Policy Levers for Equity-Oriented PCP Infrastructure

Policy Lever	Implementation Mechanism	Equity Impact
Payment Reform	• Value-based payment models should incentivize social needs screening, referral follow-up, and language services • Reimbursement structures must recognize the operational infrastructure required to collect REAL data and implement culturally responsive workflows.	• Our findings suggest that lean-aligned practices are more likely to embed these capabilities when supported by structured systems • Aligning payment incentives with equity-related processes increases the likelihood that these workflows become standardized rather than optional.
Operational Standards	• Participation in value-based care programs could require implementation of structured performance management systems that include standardized processes and review • Encouraging adoption of organized management frameworks may help ensure that equity efforts are institutionalized	• Because lean implementation was associated with stronger data collection and monitoring, structured operational standards may provide necessary scaffolding for sustainable equity improvement. • Embedding review into daily operations reduces the risk that disparities remain unaddressed.
Infrastructure Investment	• Targeted investment in data systems, workforce training, and implementation support is particularly important for smaller and independently owned practices. • Without adequate infrastructure capacity, practices may struggle to reliably collect REAL data or sustain equity-focused workflows.	• Our results indicate that practice context influences capability, suggesting that structural constraints can limit implementation even when commitment exists • Supporting infrastructure development may help narrow disparities in equity-related capacity across practice types.

Key takeaway

Policy can accelerate equitable primary care by aligning payment incentives, operational standards, and infrastructure investment with the structured management systems required to identify, monitor, and reduce disparities.

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Lean as Scaffolding for Equitable Primary Care

Lean provides a scalable management framework that integrates operational reliability with respect for people, creating the structural conditions necessary for culturally responsive and equity-oriented care.

Equity becomes sustainable when it is embedded in daily workflows, data systems, and management routines—not treated as a parallel initiative.

Conclusion & Next Steps

Concluding points

- ***Equity & quality in primary care are deeply interconnected***, particularly in settings serving patients with unmet social or cultural needs.
- ***Efficiency alone is not sufficient***—organizational strategies must consider patient context to avoid reinforcing disparities.
- ***National guidelines call for systematic approaches*** to address the needs of diverse populations in high-quality primary care.
- ***Lean offers a sociotechnical framework*** that combines operational reliability with respect for individuals—supporting more inclusive, patient-centered care.
- ***Embedding equity-focused processes into daily workflows*** creates conditions for practices to consistently respond to the real-world needs of their patients.

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Toward a Roadmap for Sustainable Lean Adoption in Hospitals (SOLAR): A Delphi Study

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Introduction: Who We Are

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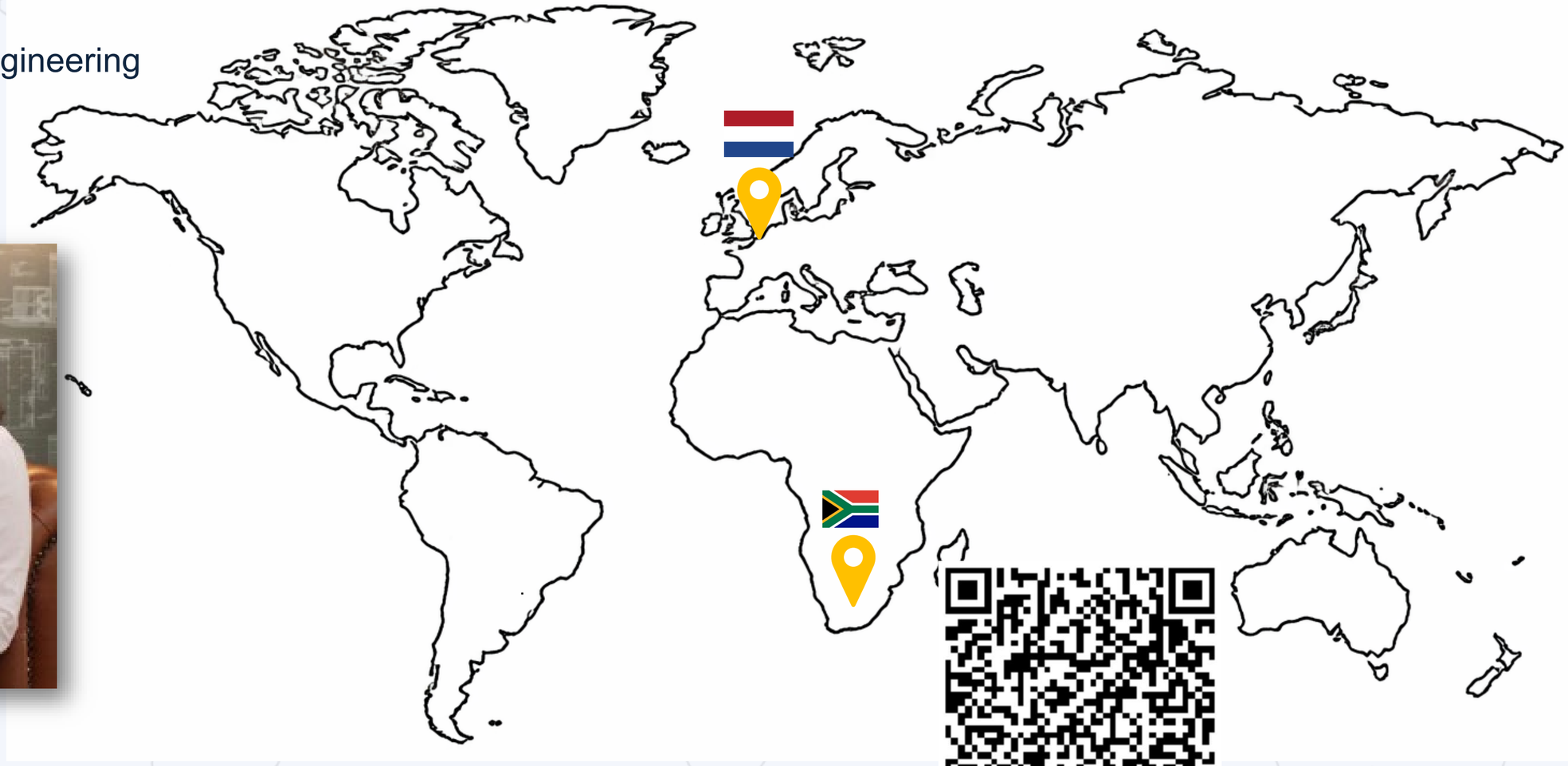

Introduction: Who We Are

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Introduction: Who We Are

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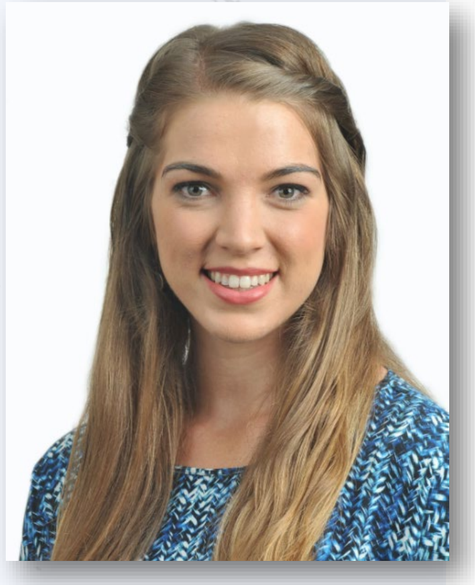


Adopting Lean in Hospitals is a Major Change

- Lean in hospitals ⟶ efficiencies + quality of patient care
- Many hospitals have implemented lean
- Lean tools ≠ sustainable implementation
- Organisational change required

Issues with Lean Adoption in Hospitals

- Lean in hospitals is complicated due to complex environment: hierarchies, silos and various stakeholders
- High failure rate of continuous improvement initiatives in hospitals over the long run
- Available guidelines often lack contextualization
- Need for guidelines to sustainably adopt lean in hospitals

Developing the Sustaining of Lean Adoption in Hospitals Roadmap (SOLAR)

Initial Framework

Developed from theory

Delphi Round 1

Online survey of the original model

Delphi Round 2

Online survey of refined model

Delphi Round 3

Narrative interview to confirm model

SOLAR

Finalization and naming

SOLAR Theory

Designed from established literature streams:

SOLAR Theory

Maturity Models

Maturity model: Guide to organisational transformation from initial to desired state through maturity levels

Descriptive Maturity Models

- Determine current maturity level
- Assess progress towards desired maturity level

Prescriptive Maturity Models

- Detailed action from historical data
- Guide towards desired state

SOLAR Theory

Maturity Models

- 19 available lean maturity models in the literature
- Adoption of lean in phases or milestones
- Extent to which maturity achieved measured against different criteria
- Progress described in four levels

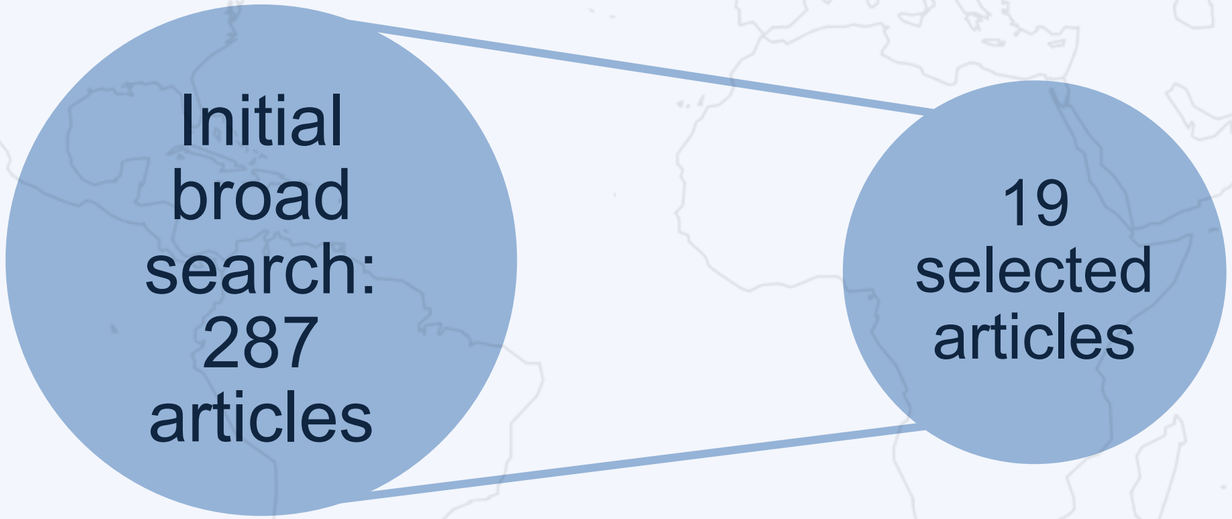
Level 1	Level 2	Level 3	Level 4
Small lean initiatives	Isolated lean implementation	Improvement initiatives aligned	Continuous use of lean concepts

SOLAR Theory

Maturity Models

Success Factors

The key question driving our systematic literature review:
Which factors influence successful adoption of lean in a hospital environment?



SOLAR Theory

Maturity Models

Success Factors

1. **Labelling similar factors** in the papers, for instance:

- Financial Resources
- Contextualisation
- Communication
- Define Value
- Expertise
- Supportive Culture
- Patient/Physician Engagement
- Leadership Style
- Data Collection

2. **Themes derived from the labels**:

1. Strategy
2. Resources
3. Engaging People
4. Culture

SOLAR Theory

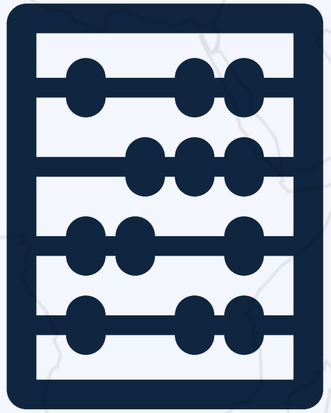
Implementation Science: **Making it happen**

Study of methods that aim to diffuse research findings and evidence-based practices into organisation routine

SOLAR Theory

Implementation Science: **Making it happen**

Quality Implementation Framework (QIF)



Maturity Models

Success Factors

Implementation Science

SOLAR Theory

Organisational change more likely to succeed if all **stakeholders are involved**

Change management theory: **Frameworks and mechanisms** to manage change with minimal negative disruption

Change management models need to be adapted according to **organisation's context**

Maturity Models

Success Factors

Implementation Science

Change Management Theory

SOLAR Theory

Change Types → Change Methods → Enablers and Outcomes

Variation in Scale

Variation in Duration

Change Management Methods

Broad and conceptual:
- Lewin's 3-phase model
- Kotter's 8-step model
- Etc.

Systematic Change Methods

Cyclical and integrative:
- Six sigma
- Total Quality Management
- Etc.

Maturity Models

Success Factors

Implementation Science

Change Management Theory

SOLAR Theory

Another point of view: **Prescriptive change management models**

Guide through sequential steps in executing change interventions

Lean implementation = change over a large period

Our change steps derived from models that are both classified as prescriptive change management models and change management methods

Maturity Models

Success Factors

Implementation Science

Change Management Theory

Research Design: Delphi Study

Initial Framework

Developed from theory

Delphi Round 1

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Online survey of refined model

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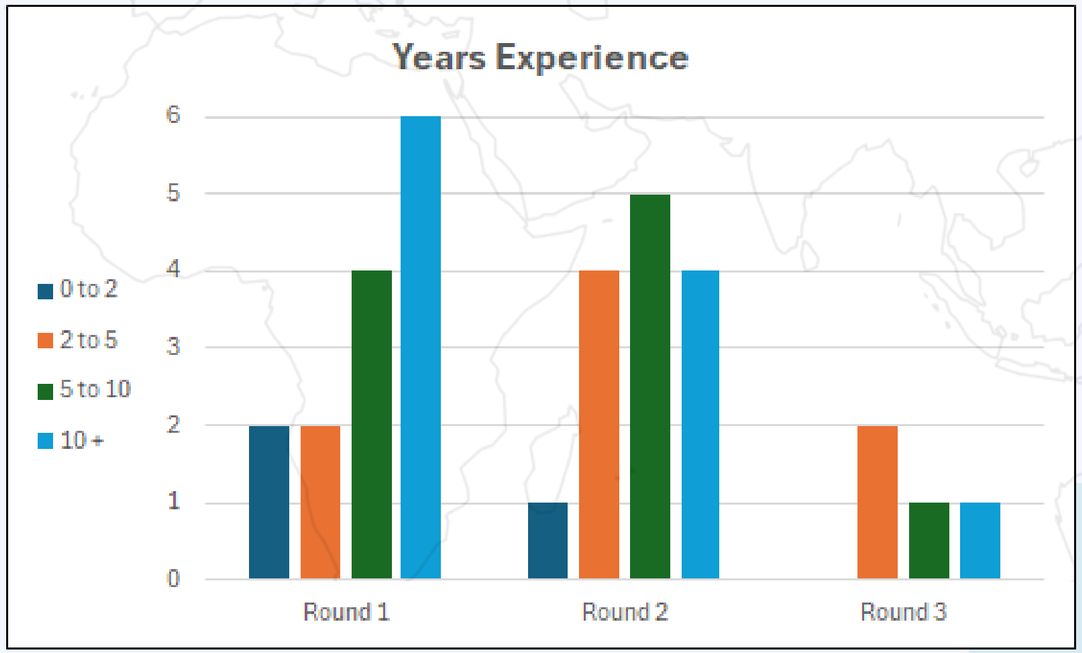
SOLAR

Finalization and naming

Research Design: Delphi Study

	Round 1	Round 2	Round 3
Number of respondents	14	14	4
Academia	0	2	1
Healthcare Industry	7	10	1
Academia and Healthcare Industry	7	2	2



Results: SOLAR

SOLAR Architecture

1. Assess the opportunity motivating the change
2. Select and support a guiding coalition
3. Formulate a clear compelling vision
4. Communicate the vision
5. Mobilise energy for change
6. Empower others to act
7. Develop and promote change-related knowledge and ability
8. Identify short-term wins and use as re-enforcement of the change process
9. Monitor and strengthen change process
10. Institutionalise the change in company culture and practices

Strategy

- Common strategic direction
- Adoption barriers
- Identify stakeholders

Strategy

- Adaptions in operating environment
- Task specific adoption plan
- Stakeholder value

Strategy

- Top management support
- Contextualise lean for specific hospital
- Measure value

HOW WOULD YOU SUSTAIN STRATEGY?

PREPARE | PLAN | EXPERIMENT AND LEARN | SUSTAIN

Strategy

Please use the camera on your device and access the Mentimeter poll:

Which elements on Strategy would you inlcude in the Sustain phase of the SOLAR?

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1 of 1 responded

Resources

- Which current resources are available?
- Any current lean adoption?

Resources

- List and invest in required resources
- Experts for lean in healthcare training

Resources

- External experts to co-guide adoption
- Develop internal experts
- Make process changes in line with change vision

Resources

- Supporting resources up to date
- Institutionalise change into SOPs and structure

Engaging People

- Management commitment
- Engage with stakeholders
- Create sense of urgency

PREPARE | PLAN | EXPERIMENT AND LEARN | SUSTAIN

Rank the aspects of Engaging People in order of importance

Engaging People

PREPARE | PLAN | EXPERIMENT AND LEARN | SUSTAIN

Engaging People

Rank the following aspects of "Engaging People" in order of importance

- Appoint adoption team consisting of lean champions and frontline employees
- Ensure that the message conveyed about lean contribute towards acceptance
- Adopt organisational structure to break down hierarchies
- Communicate the shared vision to all stakeholders
- Develop performance feedback system

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Waiting for participants

Engaging People

- Evaluate performance adoption of team
- Ensure this triggers remedial action
- Communicate progress to stakeholders
- Inter-departmental cooperation
- Lean adoption feedback throughout hospital

Engaging People

- Continuous training and support to staff

EXPERIMENT AND LEARN

PREPARE | PLAN | EXPERIMENT AND LEARN | SUSTAIN

- Evaluate employee readiness
- Analyse hospital culture

Culture

Change steps

1 Opportunity
2 Coalition
3 Vision
5 Energy

PREPARE | PLAN | EXPERIMENT AND LEARN | SUSTAIN

- Manage resistance to change
- Establish supportive lean culture
- Separate from past behaviours not conducive to lean

Culture

Change steps

2 Coalition
4 Communicate
5 Energy
6 Empower
7 Knowledge

PREPARE | PLAN | EXPERIMENT AND LEARN | SUSTAIN

- Reinforce lean culture of continuous improvement
- Ensure management displays exemplary lean behaviour

Culture

Change steps

2 Coalition
4 Communicate
5 Energy
6 Empower
7 Knowledge
8 Wins
9 Monitor

PREPARE | PLAN | EXPERIMENT AND LEARN | SUSTAIN

- Normalise supportive lean culture

Culture

Change steps

9 Monitor

10 Institutionalize

Practical Implicat ions

Offers guidelines

Of use for academics and practitioners

Emphasises actions

(No exhaustive list)

Allows a tailored hospital approach

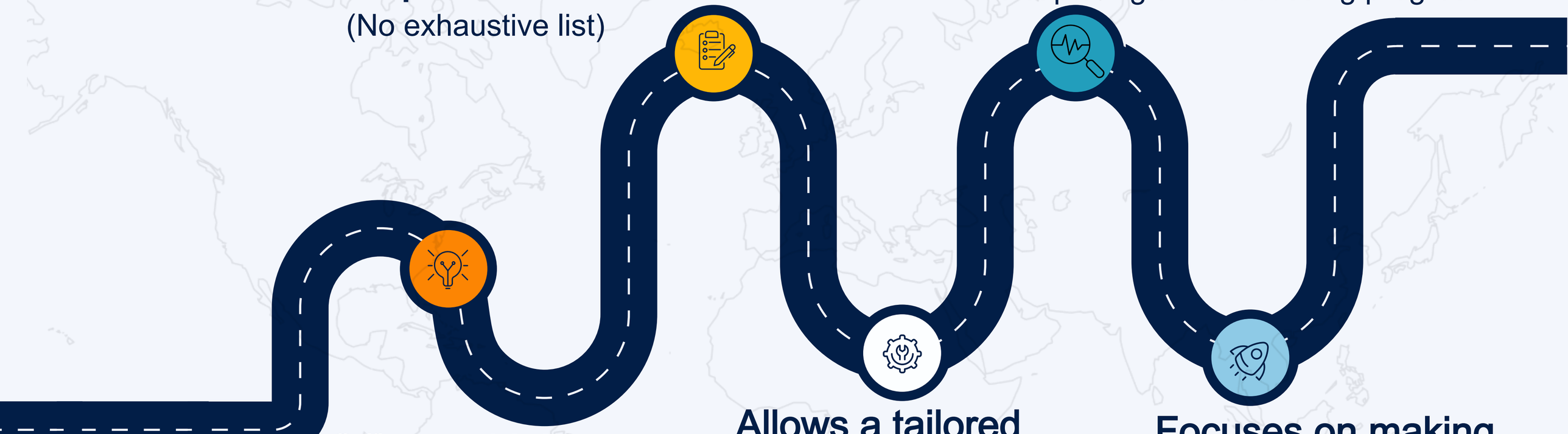
Helpful for top managers and strategic advisors

Stimulates data gathering on the Lean adoption

Allows capturing and discussing progress

Focuses on making it happen

A good balance between theorizing and practicality



Questions and Discussion

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THANK YOU

Lean Healthcare Research

SYMPOSIUM 2026

March 11, Houston

CLEAR

Center for Lean Engagement & Research in Healthcare

Berkeley Public Health