BMJ Open How to increase value and reduce waste in research: initial experiences of applying Lean thinking and visual management in research leadership

Malene Grubbe Hildebrandt ⁽¹⁾, ¹ Kristian Kidholm ⁽¹⁾, ² Jørgen Ejler Pedersen ⁽¹⁾, ³ Mohammad Naghavi-Behzad ⁽¹⁾, ¹ Torben Knudsen ⁽¹⁾, ⁴ Aleksander Krag ⁽¹⁾, ⁵ Jesper Ryg ⁽¹⁾, ⁶ Oke Gerke ⁽¹⁾, ¹ Annmarie Touborg Lassen ⁽¹⁾, ⁷ Torkell Ellingsen ⁽¹⁾, ⁸ Henrik J Ditzel ⁽¹⁾, ⁹ Vibeke Andersen ⁽¹⁾, ¹⁰ Annette Langhoff, ¹¹ Gert Nielsen, ¹¹ Tahir Masud, ¹² Anna-Marie Bloch Münster ⁽¹⁾, ¹³ Kirsten Kyvik ⁽¹⁾, ¹⁴ Kim Brixen ⁽¹⁾, ¹⁵

ABSTRACT

Waste in research has been well documented, but

initiatives to reduce it are scarce. Here, we share our initial

experiences of implementing Lean thinking and visual

management into hospital research units in the Region

of Southern Denmark. A Transformation Guiding Team

(TGT) anchored in the top management was established

with participation from leaders, researchers and patient

Lean methods, considering patients as primary end-users

decision on setting patient values first in clinical settings

at participating hospitals. The leaders of the research units

were instructed in Lean thinking and Lean methods during

reducing waste in research production. Initial experiences

were that Lean tools could create a patient-centred vision

work processes. Concerns were lack of evidence for using

Lean methods in research leadership and that the model

itself could be a time consumer. Some lessons learnt were that adding Lean tools in research leadership should not just provide increased research productivity, but also improve other important key performance indicators such

as quality of research and patient-relevant results. We

intend to evaluate the value of the initiative by follow-up

research and publish the outcome of key behavioural and

that through visual management could identify waste in

a five-module course focusing on increasing value and

representatives. The role of the TGT was to implement

of the research results. This is in line with an explicit

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For numbered affiliations see end of article.

Correspondence to

Dr Malene Grubbe Hildebrandt; Malene.grubbe.hildebrandt@ rsyd.dk

INTRODUCTION

key performance indicators.

Can research leadership be taught? We suggest that implementing Lean thinking and visual management in research leadership may improve current strategies and thereby increase value and reduce waste in research.

'We need less research, better research, and research done for the right reasons'. This important statement was put forward by the world-renown statistician Altman in

Strengths and limitations of this study

- ⇒ Waste in research has been well documented, but initiatives to reduce it are scarce.
- ⇒ We suggest Lean thinking to create a patient-centred vision, implemented through visual management to identify waste in work processes. Further, we propose on-site meetings to 'go-see and ask-why' to identify root causes of stuck processes and to make agreed realistic and actionable plans.
- ⇒ Value stream mapping of the research process is a useful tool to identify avoidable waste. The mapping of ten recent publications or projects is a feasible technique to uncover key value and waste drivers such as time lags, inefficiencies and coordination problems.
- ⇒ Adding Lean tools in research leadership should not just provide increased research productivity, but also improve other important key performance indicators.

1994.¹ Since then several reports have highlighted the considerable amount of waste in research and its unfavourable consequences for healthcare development. Notably, a Lancet series in 2014 described examples of research waste together with suggestions on how to avoid it.²⁻⁶ Prioritising research ideas, correct study designs and analyses, time-consuming regulation processes, and accessible research reports were the major topics discussed. To stimulate change, a prize was established by the Cochrane Centre in 2015 to Reduce Research Waste and Reward Diligence,⁷ and in 2017, the Evidence Based Medicine (EBM) manifesto for better health was established to develop more trustworthy evidence.⁸ Despite these attempts, waste is still prevalent in research and remains an unsolved problem.⁷

Lean thinking is a widely acknowledged improvement set of tools that has been applied to reduce errors and improve efficiencies in industrial production. The Lean approach emphasises focus on consumers' needs in organisations rather than internal specialised matters, and the goal of Lean is to create value for the end-user. Lean originated in the Japanese automobile industry, most widely known from the Toyota Production System, and the methods have been successfully applied since then in various enterprises. Lean conceptualises work as processes and comprises a continuous improvement model.⁹ Lean approaches have been applied with varying success in hospital management, with some studies showing plausible effects for patients and society, but high-quality research is lacking.^{10 11} Lean methods may also be valuable in research management in public healthcare systems but have not been fully evaluated.^{12 13} This article aims to outline an initiative on implementing a Lean based improvement model focusing on visual management, streamlining work processes and having patients as partners in healthcare research.

Lean approach in research leadership and management

The Region of Southern Denmark has approximately 1.2 million inhabitants. One university and five hospitals in the region are collaborating on the initiative of implementing Lean methods in research leadership. The initiative was introduced by the hospitals' and university's top management, who encouraged a culture change of improved leadership in their research organisations. With a statement of performing research relevant to the patients and reducing waste in research processes, the organisation decided to apply an improvement model, implementing Lean thinking and methods in research leadership. The Department of Clinical Research at

the University of Southern Denmark, Odense University Hospital and the Psychiatry encompass 47 research units with approximately 750 employees. The number of research articles published by the Department of Clinical Research in peer-reviewed journals was 1647 in 2019.¹⁴

The current initiative is a consequence of an 'improvement model' used in our clinical production, based on Virginia Mason's 'Transforming Healthcare Programme'.¹⁵ From this programme, we understood the importance of defining research consumers.^{9 16} Patients were defined as primary end-users in line with the explicit decision around focusing on patient values in the hospitals' clinical production. Clinicians and decision-makers in healthcare were other relevant end-users of the research production. The aim was to increase value and reduce waste in our research production. To achieve this, five primary drivers were defined along with secondary drivers and action plans as outlined in figure 1. The five primary drivers were based on the concept applied as suggested by the Virginia Mason team.

Primary driver 1: creating the infrastructure

A Transformation Guiding Team (TGT) was established as a steering group during 2019, and monthly governance meetings continue to be held to coordinate the continuous organisational transformation. The TGT is composed of two medical directors of the regional hospitals, the leader of the department of clinical research at the university, seven research leaders from multiple disciplines and with varying experience, one Lean consultant, one consultant in economy and planning, and two patient representatives. Hence, the TGT constituted the top management, research leaders and end-user representatives. Each member participates with suggestions for action, for example, courses and workshops for relevant topics to streamline. An operational improvement team in our hospital production was formed, and three Lean



Figure 1 The driver diagram shows the overall aim of the initiative. Five primary drivers were defined along with secondary drivers and action plans.

Table 1 Baseline, 1-year measurement and the 5-year goal for Odense University Hospital*				
Baseline (2020)	1 year (2021)	5 years (2025) (%)		
-	29 (73%)	100		
-	31 (91%)	100		
-	20 (59%)	100		
-	26 (76%)	100		
13 (33%)	17 (43%)	100		
11 (28%)	7 (18%)	100		
56%	-	66		
	ear goal for Odense University H Baseline (2020) - - - 13 (33%) 11 (28%) 56%	Baseline (2020) 1 year (2021) Baseline (2020) 1 year (2021) - 29 (73%) - 31 (91%) - 20 (59%) - 26 (76%) 13 (33%) 17 (43%) 11 (28%) 7 (18%) 56% -		

*Results shown as the number of research units, and the percentages represent the fraction of 40 research units at Odense University Hospital.

†The response rate for these KBIs was 34/40 (85%).

[‡]The numbers for publications were registered from Scival and may still change for 2021 due to delay in registration. The top 10%/25% was obtained according to the Scimago Journal Ranking system.

\$The percentage for external financing represent the pooled number for all research units at the hospital and was registered from Statistics Denmark. The number for 2021 will be available by approx. June 2022.

consultants assisted in the initiative of improving daily research management. In total, this involved one full-time Lean consultant per year. One Lean consultant has been the organiser and project leader for the whole TGT and the organiser and teacher at a Lean leadership course.

Primary driver 2: engaging the researchers

Workshops, courses, seminars and a research strategy are initiatives that have been established to engage the researchers in Lean thinking. An example is the 'How to create better research ideas' workshop, where patient participants and clinical researchers presented their ideas, which were followed by an interactive discussion. Some emphasis was also placed on developing systems to evaluate the research ideas upfront, in order to avoid research waste by early cancelling or delaying erroneous or ill-conceived projects or those that had not been adequately developed.

In the university hospital's 2021–2025 research strategy, goals and actions were specified for a 5-year period for value-creating key behavioural and key performance measurements (table 1). Working groups for each topic/ chapter in the strategy were defined and one of the research leaders took the lead for each working group, in order to plan activities in the organisation for the purpose of developing strategic goals.

Value creation is essential and should benefit the enduser of healthcare research—the patient.¹⁷ For this, the researcher must have a dialogue with patients, and emphasis should therefore be placed on involving patients in the research processes, sometimes called patient and public involvement (PPI); in a Danish context, PPI is often applied as involving patients and their relatives. PPI is already widely adopted in research initiatives such as in codesign and coproduction methods. Lean thinking emphasising patient values had already been implemented in our clinical production where the hospital works with a simple and patient-centred vision called 'The Patient First'. We think of PPI as being integrated into the organisational change as part of this initiative of implementing Lean methods in research leadership. Therefore, in our 2021–2025 research strategy implementation of PPI was highly prioritised.¹⁸ Annual events with waste-oriented topics and PPI are held, recommendations to involve patient representatives in research committees across all research-active units are in place, and a centre focusing on creating research with patients as partners has been established.

Primary driver 3: building the capability of lean leadership

A five-module course for research leaders with additional work packages and coaching was provided to enhance research leaders' capability of using Lean methods as part of their research leadership development. A pilot group tested the course from September 2019 to March 2020. The course was then implemented during the remaining year and recommended to all research leaders and professors in the oganisation. Topics can be seen in figure 2; module 1 emphasises curiosity, and participants are required to prepare process timeline diagram of 10 recent projects or publications, visualising the time spent on each process (figure 3). Module 2 concerns creativity where participants practice root cause analysis and solving the identified problem. Module 3 introduces the continuous improvement model of Plan-Do-Study-Act and the 5S-tool (Sort, Systematise, Secure, Standardize, Sustain) to create improvement management systems within research units. Module 4 focuses on building a leadership board (figure 4) reflecting the goals of the unit's research strategy, for example, in a graphical manner. Module 5 focuses on the management board where common awareness of research processes is visualised to identify

Module 1 Curiosity	Module 2 Creativity	Module 3 Development	Module 4 Leadership	Module 5 Management	
Map the processes behind your last 10 projects	 Solve a problem: use the Double Diamond Structure 	 Mistake-proofing: e.g. checklist, standard work 	 Leadership and strategy 	 Build a management board 	
Identify waste,	 Make a cause and effect analysis; 	visual control	 Build a leadership board 	 Hold a board meeting 	
state	5xWhy	secure, standardize, sustain	 Hold a board meeting 	▶ Plan a Gemba Walk	
Take a Gemba Walk	 Break the habit through targeted 	▶ PDSA-circle: Plan	Evaluate your	 Evaluate your management 	
Evaluate resistance to change	creativity	Do, Study, Act	leadership standard work	standard work	

Figure 2 A five-module course for the research leaders was established: each module was designed to last 1 day and the total course duration 6 months.

problems that need to be solved. Lists of Lean tools and principles applied in our organisation are provided in online supplemental tables 1 and 2.

As an example, the 5S model was employed in one of the research units for streamlining the fundraising process. We wanted to save time looking for relevant calls for fund applications. We applied the 5S model to create a system to easily access links to funds sorted according to the relevance for the specific research unit. A list was then created and systematised chronologically according to application deadlines so that relevant calls could easily be identified for the researchers in good time. The funding list was created to include standardized information on whether the fund is internal or external to the organisation, which type of grant could be applied for (eg, PhD salaries, travel costs, training costs), and requirements for the upper and lower amounts for grant applications, and links to the specific calls. The list was created in a Share-Point system that could be accessed by all researchers in

the unit and provided a clear overview (*shining*) of imminent calls. Information on the funding list is updated by a responsible researcher although all researchers can help add calls to the list; this ensures the *sustainability* of the list.

Primary driver 4: applying the method

Lean methods have been applied in work packages during the five-module course. Two examples are presented from modules 1 and 4, respectively: (1) a process timeline diagram of ten recent publications (figure 3) and (2) an on-site meeting at a leadership board (figure 4).

Figure 3 shows the average timeline for 10 recent publications, reconstructed retrospectively by one of the newly appointed research leaders. The awareness of waste in the research process revealed significant opportunities for improvement, for example, little time was spent on planning the projects, yet considerable time was spent on executing and publishing them. Root cause analysis was



Figure 3 The average timeline is illustrated for research processes for 10 recent publications. The processes are illustrated continuously over time, but processes can sometimes be overlapping in time.

Figure 4 A research team is holding an onsite meeting (Gemba walk) at a research leadership board, enabling identification of goals that are not met and celebration of goals that are met. Staff consent for publication obtained.

applied and potential solutions were identified. Planning the projects by first carrying out systematic reviews or protocol articles would add value to the time spent in this initial phase and increase the research quality. PPI in planning of the study could improve the recruitment process and emphasise patient-relevant outcomes. Preparing and submitting a paper could be an example of a repetitive process which might benefit from dividing it into phases to allow identification of root causes to streamline the process; for example, presentation of the study results for patient participants should be added in the initial phase of the publication process.

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A Gemba walk is a Japanese term for an on-site meeting where the needs of the end-user meet the front line workers; in this case, the end-users (patients as well as clinicians and decision-makers) meet the researchers. An example of a Gemba walk can be seen in figure 4 at a leadership board reflecting the vision and patient-relevant goals for the research unit. If these goals were not met, the possible root cause of problems could be identified, allowing the team to formulate a realistic problem-solving plan. Important elements that might be considered include publications, grant applications, and human and economic resources.

Primary driver 5: sharing the learning

We intend to observe and measure the effects of this organisational initiative by employing key behavioural indicators (KBI) and key performance indicators (KPI) which will then be shared in publications. Focused areas of KBI include improved competences in Lean leadership, implementation of visual boards, Gemba Walks and establishing partnerships with patients in the research units. We will also measure KPIs such as the number and type of projects initiated, publication types and channels concerning journal rankings and success rates with external fundraising. Baseline, 1-year measures, and the goal for the 5years measures are provided in table 1. Measures after the first year were collected in a survey performed among leaders at 40 research units at Odense University Hospital (the largest of the regional hospitals) in January 2022. High percentages were reached for KBIs in the research units at the 1-year measures, while a slight reduction in the KPIs is seen. This may indicate that the time invested in the change by implementing KBIs in the initial phase has resulted in an initial slight decrease in one of the KPIs, as perhaps can be expected. External factors such as the Corona epidemy may also have influenced the KPIs in this phase. The success criteria have been defined as reaching the goal for the 5-year strategy as set by the KPI measurements at 5 years (table 1).

Initial lessons learned

We are aware that the whole initiative is subject to the improvement model itself and is under continuous development. The Scandinavian culture with its less hierarchical structure may have facilitated learning across the organisation with genuine reflections and discussions, relevant for continuous improvement. Lean methods such as the production of boards for visual management are being implemented in research units around the organisation, and we have discovered engagement and cross-organisational networking during the introduction of the initiative as indicated by the high percentages in KBIs.

We have also experienced some resistance to this top-down driven initiative. Key personnel in the transformation process are the research leaders and professors who are used to taking the lead themselves in an unrestricted environment. This attitude provoked some resistance initially to these new ideas. Concerns included a lack of evidence for these new methods and whether the model itself is a time consumer that creates more regulation and allows less time for creativity in the research process. With an initial slight dive in one of the KPIs in our organisation, this indicates that initial time consumption or time investment may be expected. Resistance to change is also reported as a significant problem in initiatives for implementing Lean at hospitals where staff empowerment has been encouraged to engage healthcare professionals.¹⁹ The idea that Lean is used successfully in the car industry and may potentially improve operational tasks in hospitals is quite acceptable, as experienced in the Virginia Mason initiative in Seattle and the ThedaCare initiative in a community health system in Wisconsin.²⁰ But would these methods also add value in a creative research environment? Lean methods may work for repetitive tasks where one-size-fits-all methods can be applied to improve these processes continuously, but some researchers were not convinced about the appropriateness of adopting such methods into healthcare research settings. The issue of whether Lean is a theory or a concept has been discussed, and the majority of experts seem to agree that Lean is not a theory but is rather a practical-based concept. Some essential principles of Lean include what and how to create value for the customer (the patient), flow in internal work processes, customer (patient) demands and continuous improvement. Lean is often used successfully to improve repetitive tasks, and we still need further experience and evaluation of whether this concept can improve more complex work processes like healthcare research.

Some research leaders were reluctant to employ the 'visualisation of the goals' due to concerns that it could create frustration and unhealthy competition if the goals were not reached. Therefore, the Lean thinking mindset should encourage helpfulness so that researchers will get help solving problems rather than being blamed if they are stuck in processes. It is also crucial to bear in mind that the aim is to improve the quality and the relevance of research, creating value for the patients as the main goal, rather than increasing the research production itself.

We are aware that we have just started a long journey of implementing Lean methods with a continuous improvement framework and that it will take time to improve the KPIs. The KPIs commonly represent hard Lean practices for which the measurements should be assessed in a later phase after up to 5 years to be representative for the changed leadership practices. Hence, implementing Lean philosophy or soft Lean practices requires a culture change that takes time to integrate into the organisation as it is also observed in other healthcare initiatives.²¹

Previous initiatives

A Lean approach on a national scale has previously been trialled by the National Institute for Health Research in the UK named 'Push the Pace'.¹³ They introduced a cycle for continuous improvement and streamlined the process for funding applications. They found it challenging to make a change in a disseminated national organisation and encouraged running health research systems to focus on continuous improvement.¹³ However, this initiative refers to the Lean methods applied in research while the UK National Health Service has improved work processes and team efficiency in an effective system in the Productive Ward with the Releasing Time to Care programme.²² Lean methods were also applied in the section for animal studies at the Seattle Children Hospital. A daily management system with a work-inprocess board achieved up to 17% time reduction in its research sections.¹² Initiatives aiming at streamlining selected research processes were sporadically identified. Gillies et al report that patient recruitment and retention in clinical trials may be enhanced in studies with outcomes relevant to potential participants and their clinicians.²³ This is supported by a study at our hospital, where involving patients as partners in a clinical study on breast cancer led to higher than expected patient recruitment and retention.²⁴ When it comes to publishing research results, just over half of these outputs seem to appear in full.²⁵ A potential quick-hit solution for this process is the so-called mind-topaper method, which is an effective way of using a certain structure and dictation for producing scientific papers.²⁶ In a recent study, automated tools were used to enhance speed and accuracy of conducting a systematic review, which was then completed within 2weeks.²⁷ Some of the steps suggested in the EBM manifesto for the development of better health comprise an expanded role for patients, making research evidence relevant and accessible, and encouraging the next

generation of leaders in EBM.⁸ We think the initiative of implementing Lean thinking and methods in research leadership may be a feasible roadmap in achieving some of the listed priorities in the EBM manifesto for better health and in facilitating better research being performed for the right reasons.

Conclusion

The initiative of implementing Lean methods has been embraced by the research leaders in our organisation despite some initial resistance. We believe that the encouragement by top management and our experiences from the clinical production has been crucial for the success of implementing a management change in research leadership. We encourage other organisations to integrate workable value-adding systems in research leadership to enhance patient-relevance and waste reduction in research processes. It may be relevant initially to focus on selected repetitive research processes in streamlining efforts. We intend to share our experiences and publish the outcome of KBI and KPI.

Author affiliations

¹Department of Nuclear Medicine, Odense University Hospital, Odense, Denmark ²Centre for Innovative Medical Technology, Odense University Hospital, Odense, Denmark

³Department of Quality and Patient Collaboration, Odense University Hospital, Odense, Denmark

⁴Department of Gastroenterology, Southwest Jutland Hospital, Esbjerg, Denmark
 ⁵Department of Gastroenterology, Odense University Hospital, Odense, Denmark
 ⁶Department of Geriatric Medicine, Odense University Hospital, Odense, Denmark

⁷Department of Emergency Medicine, Odense University Hospital, Odense, Denmark
 ⁸Department of Rheumatology, Odense University Hospital, Odense, Denmark
 ⁹Oncology Research Unit, Department of Oncology, Odense University Hospital, Odense, Denmark

¹⁰Department of Regional Health Research, University of Southern Denmark, Odense, Denmark

¹¹The Research Committee, Odense University Hospital, Odense, Denmark ¹²Department of Geriatric, Nottingham University Hospitals NHS Trust, Nottingham, UK

¹³Department of Managment, Southwest Jutland Hospital, Esbjerg, Denmark ¹⁴Institute of Regional Health Research, University of Southern Denmark, Odense, Denmark

¹⁵Board of Direction, Odense University Hospital, Odense, Denmark

Twitter Vibeke Andersen @vandersen9

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discussion points about the Initiative; they are integrating the Lean methods in their research practice in the Region of Southern Denmark. TM is a UK based visiting professor at the Odense University Hospital who understands Danish culture. He has helped to ensure that the article has an international scope and is accessible to a wide readership. AL and GN have participated as patient representatives and contributed in all steps of designing and performing the study, as well as writing of the manuscript.

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ORCID iDs

Malene Grubbe Hildebrandt http://orcid.org/0000-0003-2720-9018 Kristian Kidholm http://orcid.org/0000-0003-1037-6514 Jørgen Ejler Pedersen http://orcid.org/0000-0002-5388-3316 Mohammad Naghavi-Behzad http://orcid.org/0000-0002-6761-8126 Torben Knudsen http://orcid.org/0000-0002-9598-4932 Jesper Ryg http://orcid.org/0000-0002-9598-4932 Jesper Ryg http://orcid.org/0000-0002-8641-3062 Oke Gerke http://orcid.org/0000-0001-6335-3303 Annmarie Touborg Lassen http://orcid.org/0000-0003-4942-6152 Torkell Ellingsen http://orcid.org/0000-0003-0426-4962 Henrik J Ditzel http://orcid.org/0000-0003-3927-5135 Vibeke Andersen http://orcid.org/0000-0002-0127-2863 Anna-Marie Bloch Münster http://orcid.org/0000-0002-3398-3977 Kirsten Kyvik http://orcid.org/0000-0001-6521-0904

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