This report is part of the RAND Corporation research report series. RAND reports present research findings and objective analysis that address the challenges facing the public and private sectors. All RAND reports undergo rigorous peer review to ensure high standards for research quality and objectivity.

RAND EUROPE

Supporting the development of a new health R&D strategy

A rapid review of international theory and practice for Norway's HelseOmsorg21

Jonathan Grant, Alexandra Pollitt, Sophie Castle-Clarke, Gavin Cochrane, Susanne Sondergaard, Veronika Horvath

RAND EUROPE

Supporting the development of a new health R&D strategy

A rapid review of international theory and practice for Norway's HelseOmsorg21

Jonathan Grant, Alexandra Pollitt, Sophie Castle-Clarke, Gavin Cochrane, Susanne Sondergaard, Veronika Horvath

Prepared for the HelseOmsorg21 Strategy Group, Research Council of Norway

The research described in this report was prepared for the HelseOmsorg21 Strategy Group, Research Council of Norway.

RAND OFFICES

SANTA MONICA, CA • WASHINGTON, DC

PITTSBURGH, PA • NEW ORLEANS, LA • JACKSON, MS • BOSTON, MA

DOHA, QA • CAMBRIDGE, UK • BRUSSELS, BE

www.rand.org • www.rand.org/randeurope

Preface

The HelseOmsorg21 initiative was set up by the Ministry of Health and Care Services to develop a new research and innovation strategy for health and care services in Norway. The HelseOmsorg21 Strategy Group, through the Research Council of Norway which is providing the secretariat for the strategy development, asked RAND Europe to support the strategic review process. RAND Europe's role was to conduct a series of rapid evidence reviews around the recommendations arising from the five working groups that comprise the initiative. The reviews were conducted around networks and collaboration, data linkage and exchange, culture, values and leadership, and incentives for innovation, while capacity building was a recurrent theme throughout.

This report presents the rapid evidence reviews, summarising relevant literature and highlighting international examples of particularly relevant or innovative approaches. The issues and ideas identified around each theme are then pulled together in a suggested conceptual representation of the Norwegian health and care research system.

RAND Europe is an independent not-for-profit policy research organisation that aims to improve policy and decision making in the public interest, through research and analysis. RAND Europe's clients include European governments, institutions, non-governmental bodies (NGOs) and firms with a need for rigorous, independent, multidisciplinary analysis. This report has been subject to RAND's quality assurance process which consists of rigorous peer review.

For more information about RAND Europe or this document, please contact:

Alexandra Pollitt
RAND Europe
Westbrook Centre
Milton Road
Cambridge CB4 1YG
United Kingdom
Tel. +44 (1223) 353 329
apollitt@rand.org

Table of Contents

Executive Summary

The primary objective of any health research system should be to improve the health of the general public and the health outcomes of patients through research. The HelseOmsorg21 initiative was set up by the Ministry of Health and Care Services to develop a new research and innovation strategy for health and care services in Norway, with the secretariat provided by the Research Council of Norway. RAND Europe was invited to support the strategic review by conducting a series of rapid evidence reviews around recommendations arising from the initiative's five working groups. The working groups focused on industrial development and entrepreneurship, research quality and internationalisation, knowledge systems, municipalities and global health challenges.

Rapid evidence reviews are a resource-efficient way to identify and summarise the general characteristics, issues, data and knowledge gaps surrounding a problem. They aim to be rigorous, transparent and explicit in method, but make concessions for the timeliness and utility of the output, and thus are not full systematic reviews of the literature or wider evidence. The rapid evidence review focused on five common themes that arose from the preliminary reports produced by the working groups. The purpose of the review was to examine, test and validate the underlying evidence – and the strength of that evidence – for each theme. The themes were identified by reviewing (translated) summaries of the working group preliminary reports and discussions with the HelseOmsorg21 secretariat. The final set of agreed themes covered research networks and collaboration; research infrastructure; research culture, values and leadership; and incentives for innovation. A fifth theme, capacity building, cut across all the others and so was incorporated into discussions of each theme as appropriate.

Networks and collaboration

There is strong evidence to show that networking and collaboration are crucial to any research system, and the increasingly complex and interdisciplinary nature of modern health research has served to encourage researchers and research funders to engage and actively promote collaborative research.

Stakeholder engagement plays a critical role in establishing research networks and collaborations. This requires an understanding of who the key stakeholders are, as well as the barriers and enablers to their engagement. The engagement of GPs in primary care research has been low internationally, and the wider context in which primary care research is being conducted must be considered in implementing an intervention to improve engagement. Given the current skew in Norwegian research funding towards six university hospitals, there is a need to try to bring stakeholders from the municipalities into the wider research ecosystem, and to consider strategies for research collaborations between universities and colleges,

research centres, hospitals and the municipalities. Central coordinating bodies and Primary Care Research Networks (PCRNs) may help to facilitate this interaction between the various institutions.

Data linkage and exchange

The healthcare sector is becoming saturated with previously unobtainable data, from next-generation DNA sequencing to clinical and health outcomes data contained in electronic health records and national registers. This has considerable implications for the delivery of health services and for health research. Data are becoming increasingly integrated into healthcare and health research in several ways: the use of DNA sequencing to determine optimum treatment regimes; electronic health records that make it possible to track the patient through the treatment process; and comprehensive monitoring and surveillance programmes that can address threats such as infectious diseases and antimicrobial resistance by integrating data from a wide range of both structured and unstructured data sources – these are just some examples.

Coping with this vast array of structured and unstructured data brings a number of challenges apart from the skills in bioinformatics necessary to draw meaningful inferences from the data. Ethical concerns (particularly around patient consent to the use of their data), interoperability (both within Norway and internationally), standardisation of records and incorporating information from the increasing numbers of self-diagnostic devices are just some of the issues that are inherent in the use of data for health research.

Culture, values and leadership

Structural changes do not in themselves deliver enhanced quality and performance. Some argue that the management of organisational culture is a necessity in healthcare reform, and in a complex system that ranges from primary care delivery to research institutions, separate organisational cultures can hinder as well as promote collaborative efforts. It seems unlikely that an entire system could ever share a single culture of similar values and behaviours, but it may be possible to shape and align aspects of the system towards a shared goal.

Organisational culture can be seen as part of a larger 'innovation ecosystem', a concept that takes account of the different components of an environment, and the way these components impact one another to give shape to that environment. The benefit of taking a systems view is that the system itself can be shaped and characterised by an array of legal, cultural, social, economic, organisational, political, commercial, scientific and technological aspects. One of the unique characteristics of health research systems is that they interface and overlap with other 'systems', such as education systems and healthcare systems. It is necessary to understand that the individual components and collective dynamics within and between these systems should be viewed as part of a dynamic whole.

Although systems thinking is prevalent in the academic literature – particularly within organisational theory, including emerging literature on systems leadership – there is very little on systems culture. In discussion with the HelseOmsorg21 secretariat we focused our review on interventions that could enhance the leadership of a health research system, prompted in part by a number of innovative interventions in this area. The literature suggests that leaders required to operate in complex systems may need various attributes including: the ability to span boundaries effectively, strong stakeholder management skills, a collective impact perspective, and the ability to act as stewards, where they are not motivated by

individual goals but by motives aligned with the objectives of the system as a whole. Organisations seeking to adopt a stewardship perspective should 'aim to widen employees' views of beneficiaries to include a broader base of stakeholders and longer time frame in which to create and maintain value'. The development of leaders operating in a systems context should take these aspects into account.

Finally, in addition to developing leadership capability, it is important to consider the wider capacity building of the health research system, including its 'absorptive capacity' – a term used in the innovation literature to describe a system's ability to value, assimilate and apply information and knowledge external to the system. Increasing absorptive capacity needs actions at both individual and organisational levels, depending on the organisation's wider environment and specific needs.

Incentives for innovation – supply- and demand-side policy instruments

It is widely accepted that there is a role for public policy to support innovation-related activities. This is because there is generally thought to be a link between investments in research and economic growth, which in many cases has led to ambitious R&D targets. This is the case in Norway, where there is a 3 per cent target for public and private spending on R&D as a share of GDP. The reason that public policy is needed, it is argued, is that under ordinary market conditions, there may be a tendency for firms to underinvest in R&D due to a number of market failures.

A wide range of incentives can be employed to stimulate innovation. Supply-side measures include those intended to improve the performance of innovation systems and can be financial- or service-oriented (ie focused on information exchange or networks). Demand-side incentives are defined as measures to increase the demand for innovations, improve the conditions for the uptake of innovations and improve the articulation of demand to spur innovation and the diffusion of innovations.

On the supply side, policies around R&D tax credits can address problems of under-investment in research by private companies and issues around the awarding of direct government grants, which have become recognised as inefficient. The establishment of science parks also appears to drive innovation and research in some cases, but importantly not in all, and does present an option for Norway to consider given that it has significantly fewer science parks than its regional counterparts – although the number of science parks alone is not a sufficient comparator measure. Moreover, science parks require a significant amount of thought, investment and planning to be successful.

On the demand side, public sector procurement and prizes are both becoming increasingly significant as drivers of innovation. The US Small Business Innovation Research (SBIR) programme and variations thereof are useful models for developing a public sector procurement programme in Norway. For example, prizes have been incorporated into the EU's Horizon 2020 flagship initiative and have been adopted by many other governments, and are increasingly regarded as an important aspect in driving innovation. Prizes can, under some circumstances, have the added benefit of attracting different, sometimes unexpected, disciplines into solving a particular problem.

Taking the health research system in Norway forward

The Norwegian health and care research system, like many others, is inherently complex and features a range of different missions, multiple objectives and different masters. In Figure S.1 we have tried to

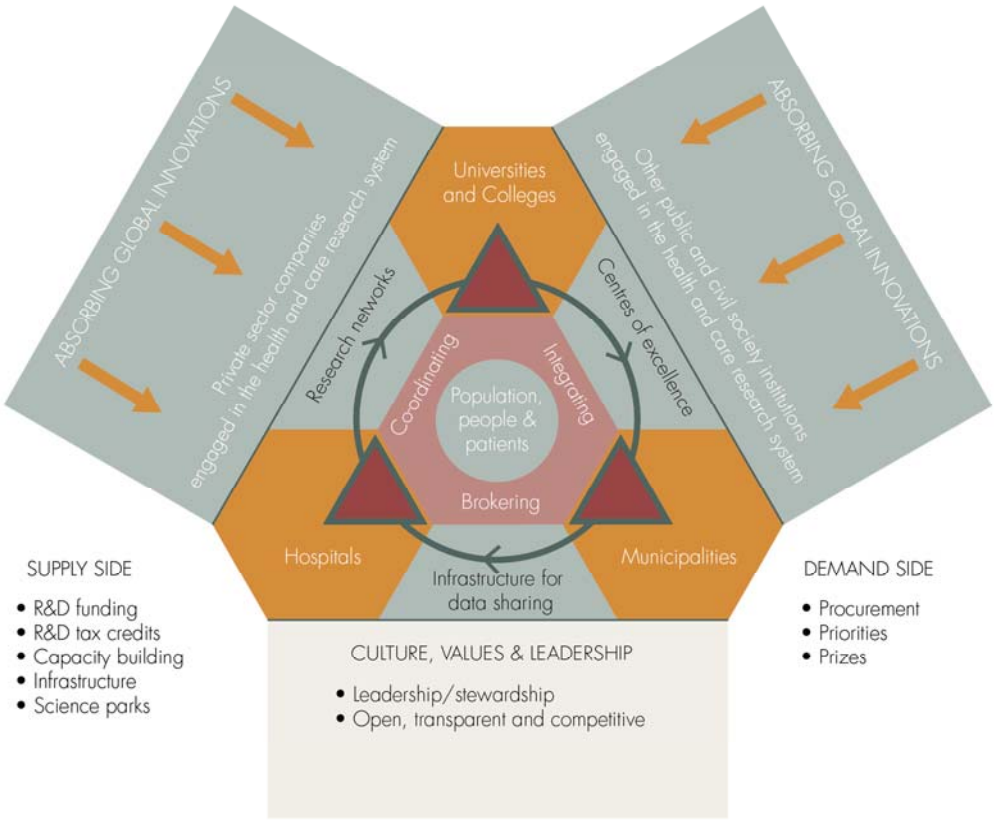
capture this by illustrating how some of the ideas that were identified in the rapid evidence review contribute to that systems thinking. It should be stressed that this is not a comprehensive attempt at describing the system as there are other ideas and interventions that we have not reviewed.

Given the multiplicity of actors and institutions, it is important to take a systems approach that considers the interactions involved. There may be value in establishing a role targeted at co-ordinating, integrating and brokering across the health system as a whole. To ensure that such a function is embedded within the system, we have identified three key areas of intervention for consideration based on the rapid evidence review: the first is to establish primary care research networks, linking research activities in hospitals, universities and colleges, and municipalities (Section 2.2.1); the second is to further develop Centres of Excellence around different priority areas with a clear focus on delivering high quality patient-oriented research (Section 2.2.2); the third is to establish data linkage and exchange activities across the health research system, providing a unique research (and care) resource, differentiating Norway in a global health research market (Section 3.3).

In addition, the co-ordinating role would work towards developing a system-wide culture that promotes the position of research as an integral part of patient care. A training programme in research and personal leadership, and stewardship contextualised within the wider system could develop leadership capabilities and encourage boundary spanning.

At the same time, policy instruments to encourage innovation aimed at both the supply and demand sides could help to embed research thinking across the system.

Figure S.1 Norwegian Health Research System



Acknowledgements

We would like to thank John-Arne Røttingen, Signe Bang and Hilde Dorthea Grindvik Nielsen at the Research Council of Norway for their support and guidance throughout the project. Further thanks go to the various people involved in the strategy development who were interviewed during a visit to Oslo in January 2014.

We would also like to thank Gwilym Jones and Kate Kirk for editing the report, and Jess Plumridge for assisting with graphics.

Finally, our quality assurance reviewers Susan Guthrie and Molly Morgan Jones provided helpful comments on earlier drafts of this report and we would like to thank them for their valuable insights and constructive feedback.

Abbreviations

BRIDG	US Biomedical Research Integrated Domain Group
CBS	Copenhagen Business School
CCTST	Center for Clinical and Translational Science and Training
CDISC	Clinical Data Interchange Standards Consortium
CFHI	Canadian Foundation for Healthcare Improvement
CLAHRCs	Collaborations for Leadership in Applied Health Research and Care
CLI	Community Leaders Institute
EHR	Electronic Health Record
EHR4CR	Electronic Health Records for Clinical Research
EU	European Union
EXTRA	Executive Training for Research Application
FDA	US Food and Drug Administration
FORTE	Swedish Council for Health, Working Life and Welfare
GDP	Gross Domestic Product
GP	General Practitioner
ICT	Information Communication Technology
IMI	Innovative Medicines Initiative
MRC	Medical Research Council
MSD	Merck Sharp & Dohme
NCI	US National Cancer Institute
NHS	National Health Service
NHSR	Danish National Health Service Register
NIHR	National Institute for Health Research
NIPH	National Institute of Public Health
NOK	Norwegian Krone

NPRI	National Prevention Research Initiative
OECD	Organisation for Economic Co-operation and Development
OSCHR	Office for Strategic Coordination of Health Research
PCRNs	Primary Care Research Networks
R&D	Research and Development
RCRIM	Health Level 7 Regulated Clinical Research Information Management Technical Committee
SBIR	Small Business Innovation Research
SEK	Swedish Krona
SME	Small and Medium Enterprise
SWOT	Strengths, weaknesses, opportunities and threats
Tekes	The Finnish Funding Agency for Technology and Innovation
UKCRC	UK Clinical Research Collaboration
VINNOVA	The Swedish Governmental Agency for Innovation Systems
WestREN	Western Research and Education Network
WHO	World Health Organization
ZonMw	Netherlands Organisation for Health Research and Development

1. Introduction and methodology

1.1. Background and objectives

Norway's Ministry of Health and Care Services initiated the HelseOmsorg21 (HO21) process to develop a new national strategy for research and innovation in health and care services. The strategic review process, for which the Research Council of Norway is providing the secretariat, has involved the establishment of five working groups, focusing on the following areas:

- industrial development and entrepreneurship
- research quality and internationalisation
- knowledge systems
- municipalities
- global health challenges.

Each of these groups undertook a SWOT-style analysis and consultation with the wider stakeholder community, before reporting a series of recommendations for the future direction of health and care research in December 2013.[1] The HO21 Strategy Group, through the Research Council of Norway, asked RAND Europe to support the strategic review process by conducting a series of rapid evidence reviews around the recommendations arising from the five working groups. These aimed to examine, test and validate the international evidence – and the strength of that evidence – around the recommendations.

1.2. Methodology

The RAND Europe team aimed to highlight some of the important areas to consider in developing a health and care research strategy, provide illustrative examples from other countries in relation to these areas, and bring together some of the key issues and ideas to consider in the current strategy development process in Norway. The intention was not to conduct a systematic or comprehensive review of the

[1] SWOT-style analysis identifies strengths, weaknesses, opportunities and threats. For the recommendations and full reports see: http://www.forskningsradet.no/prognett-helseomsorg21/Nyheter/Arbeidsgruppenes_delrapporter_er_na_tilgjengelige/1253992879080?WT.mc_id=nyhetsbrev-helseomsorg21

literature, but to produce a targeted and efficient review focused on examples that were most pertinent to the Norwegian context.

We employed a three-stage methodology to develop the rapid evidence review, consisting of:

- initial review, gap analysis and prioritisation of themes, based on the preliminary reports of the working groups
- rapid evidence reviews around the prioritised themes
- analysis.

1.2.1. Initial review, gap analysis and prioritisation

The five working groups established as part of the HO21 process delivered their preliminary reports in December 2013. The reports detailed the consultations they had conducted and set out a series of recommendations. The executive summaries and recommendations of these reports were translated into English and reviewed by the project team. The key themes emerging from each of the reports were identified, the recommendations grouped according to these themes, and areas of overlap between the working groups noted.

The themes that emerged clearly from the reports were: research networks and collaboration; research infrastructure, data collection and management; incentives, regulation and legislation; procurement; and innovation systems. Although less prominent, we also noted a number of recommendations relating to capacity building and user engagement.

When looking at the recommendations in the broader context of the literature and practice in international health research, we also considered areas which were not covered across the set of reports as a whole. The apparent gaps identified were leadership and innovation culture, and monitoring and evaluation.

This process resulted in a final list of nine themes, which were then prioritised in consultation with the head of the HO21 Strategy Group and members of the secretariat based at the Research Council. Other processes were already underway to explore how best to address issues around user engagement and monitoring and evaluation, so these two themes were not included in this review. The prioritisation exercise resulted in agreement on the following five themes around which to build rapid evidence reviews:

- networks and collaboration
- data linkage and exchange
- culture, values and leadership
- incentives for innovation
- capacity building.

During the review it became clear that capacity building was best considered as a component of each of the other themes, as explained in Section 1.2.3, and so it is not presented as a stand-alone chapter in this report.

1.2.2. Rapid evidence reviews around the prioritised themes

Rapid evidence reviews are a resource-efficient way to identify and summarise the general characteristics, issues, data and knowledge gaps surrounding a problem. They aim to be rigorous, transparent and explicit in method, but make concessions for the timeliness and utility of the output, and thus are not full systematic reviews of the literature or wider evidence. RAND Europe staff are experienced in using this approach for rapid turnaround projects whereby we bring the best available evidence to a policy or strategy formulation process within a time/resource constraint.

The framework used in this report was constructed around the recommendations highlighted by the five working groups, and aimed to relate these to the wider academic and grey literature both theoretically and in terms of practical application. A targeted search process focused on major health and innovation research journals and key policy documents, from which a snowballing approach was used to identify further relevant literature. The academic literature search was conducted in JSTOR, EBSCO and Google Scholar databases, while additional documents were retrieved through a general internet search (Google). As highlighted above, given the wide-ranging nature of all possible literatures, our approach to undertaking a review of the literature was not to try to be comprehensive or systematic. Rather we initially drew upon our existing knowledge of health research and innovation, then targeted our search to identify literature that offered valuable empirical or conceptual insights. For each theme, we examined international examples, selecting those which have been shown by evaluation to have had positive results, which seem particularly relevant to the Norwegian context, or which illustrate innovative approaches.

1.2.3. Analysis

An internal team workshop identified a set of issues and ideas relating to each theme that may be relevant for the current strategy development process. These emerging ideas were presented in draft form to the HO21 Strategy Committee and further thoughts and feedback from this were incorporated in preparing the final version.

During the review, it became clear that the concept of capacity building cuts across the other themes. It can, for example, refer to capacity to conduct research, use research findings, lead or build a research-focused institution/system or relate to physical capacity in terms of research infrastructure. In these various forms, capacity building is an integral part of every aspect of a research system, and so was included in discussions around each of the other four themes.

Finally, we attempted to draw together the various issues identified into a single conceptual model of the Norwegian health and care research system.

While useful lessons can be taken from the literature and the international examples explored in our analysis, it must be remembered that a national research system operates within the wider context of its country, and as such it is important to consider the culture, infrastructure, opportunities, constraints and national objectives that frame the system. As a result, while we highlight a number of areas to consider and possible options for the future direction of the Norwegian health and care research system, it remains for HO21 to determine whether and how these can best be operationalised in Norway.

1.3. Structure of the report

The following chapters address each of the four themes in turn. Each begins with an overview of why the theme is important and what we mean by it in the context of health and social care research. We then discuss a series of international examples, before identifying a set of 'issues and ideas' to consider when putting some of these ideas into practice. The final chapter draws together all of these and presents a draft conceptual representation of the Norwegian health and care research system, illustrating how the various stakeholders and concepts might fit together in practice.

2. Networks and Collaboration

2.1. Overview

2.1.1. Why collaborate?

The increasingly complex and interdisciplinary nature of modern health research has served to encourage researchers and research funders to engage and actively promote collaborative research.[2] In health research, networks have been used increasingly since the 1980s as a means of engaging multidisciplinary researchers, practitioners and other key stakeholders.[3] Research networks[4] provide an opportunity to pool resources and expertise while spreading risks and costs. The flexibility of a networked model for research also allows for the coordination of diverse activities and provides opportunities to disseminate research findings to a wide audience.[5] In addition, the informal engagement and personal interactions created between members of a research network have been shown to have a positive impact on health research, through researchers 'sharing tacit knowledge and advancing research agendas'.[6] There is therefore value in research funders encouraging the organisation of conferences and meetings, to facilitate both face-to-face meetings and virtual communications through social networking.

Nevertheless, there are a number of factors to consider if a research network is to be sustainable and produce high quality research. By definition a research network is a virtual entity which increases the role

---

[2] Lee, S. and Bozeman, B. (2005). 'The impact of research collaboration on scientific productivity', Social Studies of Science 35(5): 673–702.

[3] Thomas, P., Griffiths, F., Kai, J. and O'Dwyer, A. (2001). Networks for research in primary health care. BMJ 322(7286): 588.

[4] For the purpose of this review 'research networks' refers to formal mechanisms for facilitating collaboration as opposed to informal links.

[5] Thomas et al (2001).

[6] Wooding, S. et al. (2013). Mental Health Retrosight: Understanding the returns from research (lessons from schizophrenia): Policy Report. Santa Monica, CA: RAND Corporation. http://www.rand.org/pubs/research_reports/RR325. p.48. See also: Kraut, R., Egido, C. and Galegher, J. (1988). Patterns of contact and communication in scientific research collaboration. Proceedings of the 1988 ACM conference on Computer-supported cooperative work, 1–12; Katz, J. S. and Martin, B. R. (1997). 'What is research collaboration?' Research Policy 26(1): 1–18; Subramanyam, K. (1983). 'Bibliometric studies of research collaboration: A review', Journal of Information Science 6(1): 33–38.

of organisational coherence as a factor in successful networks.[7] This includes defining clear membership criteria and governance structures as well as incorporating evaluation activities to assess whether the network is achieving its aims.[8] Also, the value of participating in a research network needs to be apparent for all members to ensure buy-in, especially when research networks aim to engage a wide range of stakeholders.

The remainder of this chapter discusses issues around engaging stakeholders and the role of coordinators in more detail, before presenting international examples of Primary Care Research Networks (PCRNs) and Centres of Excellence, which are two common mechanisms for facilitating engagement between researchers, policymakers and practitioners in health research.

2.1.2. Engaging General Practitioners

In most European countries, general practice is the cornerstone of healthcare systems and family medicine.[9] For primary care research, it is essential that these key stakeholders are involved in setting research agendas, conducting research and disseminating findings, in order to ensure that primary care is responsive to patient needs and underpinned by an evidence-based culture. Nevertheless the level of participation in research by general practitioners (GPs) is low internationally.[10]

Numerous studies have attempted to explore the barriers to GP engagement in primary care research[11] yet many find contradictory results. For example, the Askew et al. (2000) survey of Australian GPs found that, although 84 per cent of participants felt that research was useful to their practice, only 29 per cent wanted to be more involved in research.[12] Hummers-Pradier et al. (2008) studied the barriers to participation in primary healthcare research for German GPs by surveying their attitudes towards research and their reasons for and against participation. The major barriers identified included:

---

[7] Thomas, et al. (2001).

[8] Clement, S., Pickering, A., Rowlands, G., Thiru, K., Candy, B. and de Lusignan, S. I. M. O. N. (2000). 'Towards a conceptual framework for evaluating primary care research networks', The British Journal of General Practice 50(457): 651.

[9] Heath, I., Evans, P. and van Weel, C. (2000). 'The specialist of the discipline of general practice: semantics and politics mustn't impede the progress of general practice', BMJ 320(7231): 326.

[10] Salmon, P., et al. (2007). 'Peering through the barriers in GPs' explanations for declining to participate in research: the role of professional autonomy and the economy of time', Family Practice 24(3): 269–275.

[11] Hummers-Pradier, E., Scheidt-Nave, C., Martin, H., Heinemann, S., Kochen, M. M. and Himmel, W. (2008). 'Simply no time? Barriers to GPs' participation in primary health care research', Family Practice 25(2): 105–112; Askew, D. A., Clavarino, A. M., Glasziou, P. P. and Del Mar, C. B. (2002). 'General practice research: attitudes and involvement of Queensland general practitioners', Medical Journal of Australia 177(2): 74–77; Lionis, C., Stoffers, H. E. J. H., Hummers-Pradier, E., Griffiths, F., Rotar-Pavlič, D. and Rethans, J. J. (2004). 'Setting priorities and identifying barriers for general practice research in Europe. Results from an EGPRW meeting', Family Practice 21(5): 587–593; Rossi, S., Zoller, M. and Steurer, J. (2006). 'Research interest by general practitioners: a survey', Praxis 95(49): 1913–17.

[12] Askew, et al. (2002).

- *Relevance of research* – lack of obvious relevance means that research is not seen as part of a GPs job role and/or there is a perceived conflict between research and patient care.
- *Time pressures and other obligations* – there is insufficient time to conduct/contribute to research.
- *Perception of researchers* – a feeling that GPs are simply contributing to a researcher's career, and/or that researchers are only serving their own personal interests.
- *Influence on the research agenda* – a perceived or actual lack of influence on the study design, sample or research process.[13]

These findings correlate with numerous studies on GPs' attitudes to research which highlight the disconnect between primary care research and practitioners.[14] Lionis et al. (2004) go beyond GPs' attitudes and discuss broader issues concerning the health system and academic infrastructure which may contribute to low participation of GPs in research, including:

- lack of incentives for GPs to engage in research or promote research in general practice
- lack of GPs trained to conduct research
- insufficient funding for general practice as an academic discipline
- insufficient infrastructure.[15]

2.1.3. Engaging end users

The relationship between researchers and decision makers, or end users of the research, is the key to knowledge translation. A problem often associated with health research is that translating the knowledge generated from research into practice is often an arduous and lengthy process.[16] Promoting linkage, exchange and research collaboration between researchers and policy makers is crucial for successful knowledge transfer as well as ongoing capacity building in health research. Graham et al (2006) note that research funded under a model which engages both researchers and decision makers is four times more likely to actively encourage efforts to disseminate and implement research findings.[17]

When trying to link research to practice, Lavis et al. (2006) observe four key approaches which can be established individually or in combination with each other. These approaches can be broadly categorised into push, user pull, exchange and integrated efforts:

---

[13] Hummers-Pradier, E., Scheidt-Nave, C., Martin, H., Heinemann, S., Kochen, M. M. and Himmel, W. (2008). 'Simply no time? Barriers to GPs' participation in primary health care research', Family Practice 25(2): 105–112.

[14] Mason, V. L., Shaw, A., Wiles, N. J., Mulligan, J., Peters, T. J., Sharp, D. and Lewis, G. (2007). 'GPs' experiences of primary care mental health research: a qualitative study of the barriers to recruitment', Family Practice 24(5): 518–525; Russell, S. C. and Spooner, S. A. (2004). Barriers to EMR adoption in internal medicine and pediatric outpatient practices. Tennessee Medicine 97: 457–460; Salmon, et al. (2007).

[15] Lionis, et al. (2004).

[16] Morris, Z. S., Wooding, S. and Grant, J. (2011). 'The answer is 17 years, what is the question: understanding time lags in translational research', Journal of the Royal Society of Medicine 104(12): 510–520.

[17] Graham, I. D., Logan, J., Harrison, M. B., Straus, S. E., Tetroe, J., Caswell, W. and Robinson, N. (2006). 'Lost in knowledge translation: time for a map?', Journal of Continuing Education in the Health Professions 26(1): 13–24.

- *Push efforts* from researchers to end users occur when attempts to link research to practice are led by researchers, often in situations in which end users are unaware of the key issues around a research topic.
- *User pull efforts* from research users or decision makers to researchers occur when attempts to link research to practice are led by end users in situations in which an information gap is identified and research is needed to address the gap.
- *Exchange efforts* occur when both researchers and end users come together to address a research problem.
- *Integrated efforts* often combine elements of the three models stated above, through establishing knowledge translation platforms.[18]

In recent years, an international trend favouring partnerships based on decision maker involvement in research projects has become evident, although more evidence is needed to assess how these partnerships can be improved. Lomas (2000) identifies a range of challenges to this type of partnership, identified by both researchers and decision makers:

- *Time constraints* – linkage is not always rewarded and it is difficult to coordinate given differing workloads. It is especially difficult in exchange and integrated efforts for knowledge translation, which require buy-in from all parties throughout all stages of the research process.
- *Multiple stakeholders* – decision makers for health are often a broad array of people who are also difficult for researchers to identify. This has a particular impact on push efforts for linking research to practice.
- *Understanding the research process* – decision makers are perceived as having a poor understanding of the overall research process and have few opportunities to learn. In addition, decision makers often need results faster than the research process can produce them. This can be a barrier to 'user pull efforts' for translating research to practice.[19]

Additional factors also include: the frequency of personnel changes; communications/presentation skills of researchers; and the difficulty of managing varying expectations and interests of diverse stakeholders.

Therefore, while engaging end users in the research process is certainly beneficial to the translation of findings and wider capacity building goals, models seeking to engage end users must be aware of the barriers associated with this sort of exchange and should develop effective strategies for overcoming them.

2.1.4. Role of central coordinators

The 2006 Cooksey report into health research funding in the UK made a number of recommendations for improving the strategic direction and co-ordination of existing funding arrangements, which included

[18] Lavis, J. N., Lomas, J., Hamid, M. and Sewankambo, N. K. (2006). 'Assessing country-level efforts to link research to action', Bulletin of the World Health Organization 84(8): 620–628.

[19] Lomas, J. (2000). 'Using "linkage and exchange" to move research into policy at a Canadian foundation', Health Affairs (Project Hope) 19(3): 236–240.

the establishment of the Office for Strategic Coordination of Health Research (OSCHR) in 2007.[20] The main function of the OSCHR is to co-ordinate the activities of the UK's two main public funding streams for health research, the National Institute for Health Research (NIHR) and the Medical Research Council (MRC). It also plays a pivotal role in communicating health research priorities to the health industries, such as for the development of new pharmaceuticals.[21] Since its establishment, the OSCHR has contributed to the development of better National Health Service (NHS) electronic data capabilities for research; created a research programme for public health; and greatly enhanced the translation of health research.[22] Together with the UK Clinical Research Collaboration (UKCRC), which was established in 2004, the OSCHR plays a central coordinating function, overseeing all the stakeholders engaged in the health research system, such as funding bodies, academia, the NHS, regulatory bodies, the private sector, industries and patients.[23] Other than OSCHR and UKCRC in the UK there are very few international examples of central coordinating bodies for health research. However, a similar model can be found in the Netherlands in the form of The Netherlands Organisation for Health Research and Development (ZonMw). ZonMw was created in 2001 when the original Care Research Netherlands (ZON) was merged with the Dutch Organisation of Scientific Research with the aim to cover the 'continuum of medical research through to applied studies and evaluation of programmes thus strengthening health services research'.[24] ZonMw's coordinating position is between ministries, organisations implementing health research programmes, evaluators and advisory boards. They were also instrumental in establishing the Dutch Academic Collaborative Centres for Public Health in 2005 – which are long-term collaborations between primary care practitioners, universities and governments aimed at facilitating structural partnerships between researchers, policy makers and healthcare professionals.[25]

---

[20] Cooksey, D. (2006). A review of UK health research funding. December 2006. London: HM Treasury.

[21] HSR-Europe (2011). Health Services Research into European Policy and Practice. Final report of the HSREPP project. Utrecht: NIVEL.

http://www.healthservicesresearch.eu/mediaFiles/upload/publications/HSR-Europe_2011_-_Final_report_-_Health_Services_Research_into_European_Policy_and_Practice_Policy.pdf

[22] http://www.nihr.ac.uk/about/Pages/About_OSCHR_2013.aspx

[23] http://www.ukcrc.org/about-the-ukcrc/what-is-the-ukcrc/

[24] Øvretveit, J. and Klazinga, N. (2013). Linking research to practice: The organisation and implementation of The Netherlands health and social care improvement programmes. Health Policy 109(2): 176.

[25] Wehrens, R., Bekker, M. and Bal, R. (2012). 'Dutch Academic Collaborative Centres for Public Health: development through time issues, dilemmas and coping strategies.' Evidence & Policy: A Journal of Research, Debate and Practice 8(2): 149–170.

2.2. International examples

2.2.1. Primary care research networks

As the discussion above has shown, engaging multiple stakeholders in research through networks provides an opportunity to improve knowledge translation and pool resources. This has been particularly useful for primary care research networks (PCRNs), which can be defined as organisations that aim to facilitate the involvement of primary care practitioners in research, either at an individual or practice-based level,[26] and have been operating in Europe and North America for several decades. PCRNs offer an opportunity for universities, hospitals and local healthcare providers to collaborate on research and vital national resources for improving primary care, translating research into practice, and meeting national, regional and local health goals.[27] The networks also provide a platform for facilitating recruitment into research studies.[28]

In the UK, PCRNs began to gain recognition in the early 1990s. An NHS report in 1997 recommended that PCRNs be established in every region[29] and since then the proliferation of PCRNs has increased significantly. This trend has also been observed internationally, with PCRNs becoming commonplace in countries such as the US,[30] Canada,[31] Australia[32] and the Netherlands.[33] The size and scope of the research projects conducted by these networks vary considerably and they focus on a range of issues, such as clinical studies of diagnosis, treatment and practice improvement, and observational and epidemiological studies based on data collection from patient records. In addition to strategies to improve collaboration

---

[26] Clement, S., Pickering, A., Rowlands, G., Thiru, K., Candy, B. and de Lusignan, S. I. M. O. N. (2000). 'Towards a conceptual framework for evaluating primary care research networks', The British Journal of General Practice 50(457): 651.

[27] Tierney, et al. (2007). 'A national survey of primary care practice-based research networks', The Annals of Family Medicine 5(3): 242–250.

[28] Bakken, S., Lantigua, R. A., Busacca, L. V. and Bigger, J. T. (2009). 'Barriers, enablers, and incentives for research participation: a report from the Ambulatory Care Research Network (ACRN)', The Journal of the American Board of Family Medicine 22(4): 436–445; Goodyear-Smith, F., York, D., Petousis-Harris, H., Turner, N., Copp, J., Kerse, N. and Grant, C. (2009). 'Recruitment of practices in primary care research: the long and the short of it', Family Practice 26(2): 128–136; Pace, W. D., Staton, E. W. and Holcomb, S. (2005). 'Practice-based research network studies in the age of HIPAA', The Annals of Family Medicine 3(Suppl 1): S38–S45.

[29] Mant, D. (1997). R&D in primary care: national working group report. Westminster, UK: Department of Health.

[30] Tierney, W. M., Oppenheimer, C. C., Hudson, B. L., Benz, J., Finn, A., Hickner, J. M., Gaylin, D. S. et al. (2007). 'A national survey of primary care practice-based research networks', The Annals of Family Medicine 5(3): 242–250.

[31] Birtwhistle, R., Keshavjee, K., Lambert-Lanning, A., Godwin, M., Greiver, M., Manca, D. and Lagacé, C. (2009). 'Building a pan-Canadian primary care sentinel surveillance network: initial development and moving forward', The Journal of the American Board of Family Medicine 22(4): 412–422.

[32] Soos, M., Temple-Smith, M., Gunn, J., Johnston-Ata'Ata, K. and Pirotta, M (2010). Establishing the Victorian Primary Care Practice Based Research Network. Australian Family Physician 39:857–62.

[33] Van Weel, C., de Grauw, W. (2006). 'Family practices registration networks contributed to primary care research', Journal of Clinical Epidemiology 59:779–83.

and engagement of multiple stakeholders, almost all PCRNs also include strategies to build research capacity for their members.

Despite the proliferation of PCRNs, the evidence base around what has been achieved remains limited. Bleeker et al. (2010) note that there is a 'fundamental lack of evaluative studies about the progress, impact, and output of PCRNs, which prevents a validated comparison of different networked models and thus insight into what type of model is optimal for achieving specific goals'.[34] Nevertheless, the aims behind PCRNs and their proliferation mean they merit further consideration. It is important to note that the success of research networks is context specific. Therefore, the following international examples are only intended to present a sample of the diverse range of models for PCRNs that can be applied at various levels.

Case 1: Collaborations for Leadership in Applied Health Research and Care (CLAHRCs)

In 2008, the National Institute for Health Research (NIHR) in the UK established nine partnerships between academic institutions and local health authorities known as Collaborations for Leadership in Applied Health Research and Care (CLAHRCs). These partnerships focus on conducting and applying health research that is transferable across the NHS to provide the highest quality of patient care and outcomes. In this respect, CLAHRCs represent a slightly different manifestation of a PCRN. This approach draws upon findings from the 2006 Cooksey report into UK health research funding, which highlighted the gaps in translating research into clinical practice.[35] Additionally, the CLAHRCs approach can 'create and embed approaches to research and its dissemination that are specifically designed to take account of the way that healthcare is increasingly delivered across sectors and a wide geographical area'.[36] While it is still too early to identify the full impact of CLAHRCs on translating research into policy, a series of evaluations have found that the CLAHRC model has been successful in improving mutual understanding around practice-based research and in providing the opportunity to improve research training for its members. As a result, in 2013 the number of CLAHRCs was increased to 13 and a further £124 million was invested.[37] There are a number of key success factors:

- The nine CLAHRCs were established around pre-existing local relationships and built upon existing capacity, knowledge and expertise. This has allowed them to develop strategies which are responsive to local needs, and eased the process of disseminating research findings.
- The CLAHRCs are committed to sustaining the engagement of multiple stakeholders, including policy makers, clinicians, academia and members of the public. While ensuring engagement is a lengthy process, members of the CLAHRCs have benefitted from the exposure to people outside

[34] Bleeker, J. M., Stalman, W. A. and van der Horst, H. E. (2010). 'Evaluating primary care research networks: a review of currently available tools', The Journal of the American Board of Family Medicine, 23(4): 466.

[35] Cooksey, D. (2006). A review of UK health research funding. December 2006. London: HM Treasury.

[36] http://www.nihr.ac.uk/infrastructure/Pages/CLAHRCs.aspx

[37] http://www.nihr.ac.uk/infrastructure/Pages/CLAHRCs.aspx

their field, which has contributed to a better understanding of the problems of translating research into practice.

- In order to ensure buy-in from NHS organisations, the CLAHRCs are required to attract matching funding from local health authorities. This furthers opportunities for engagement between universities, hospitals and local health authorities. There is now an increased awareness that NHS participation in research design is a crucial element in the success of projects.[38]
- Efforts have been made to establish a clear brand around the CLAHRCs, which has helped to improve communications with policy makers.

One of the overall objectives of the CLAHRC initiative has also been to embed cultural change so that both NHS organisations and universities are more receptive to change.[39] Recruitment strategies that target 'boundary spanners', who are experienced in working across academia and the NHS, and investments into research training are essential to achieving this objective.[40] Cultural change across diverse institutions is a lengthy process and the CLAHRCs future success will depend on its ability to meet this objective and scaling across the NHS.

Case 2: Canadian Foundation for Healthcare Improvement

Since 1996, the Canadian Foundation for Healthcare Improvement (CFHI) has been dedicated to accelerating healthcare improvement in Canada by collaborating with multiple stakeholders to ensure evidence-based research and innovative practices are converted into efficient, coordinated and patient-centred healthcare.[41] As of 2012, the CFHI supports 13 collaborative projects that include partnerships with researchers, practice leaders and decision makers.[42]

Building on the arguments for engaging research users, as presented above, the principal of linkage and exchange has been the cornerstone of the CFHI's activities aimed at improving health research. Lomas (2000) outlines some of the ways in which linkage and exchange have been strengthened by the CFHI:

- *Setting priorities* – Every three years, the CFHI brings together a group of researchers, policy makers and practitioners to discuss relevant issues for research, allowing end users a say over research priorities and facilitating a forum for stakeholders to share knowledge.
- *Funding programmes* – In an approach similar to the CLAHRC model, the CFHI offers half of the overall funding for research projects, with the remainder coming from the other partners

[38] Soper, B., Yaqub, O., Hinrichs, S., Marjanovich, S., Drabble, S., Hanney, S. and Nolte, E. (2013). 'CLAHRCs in practice: combined knowledge transfer and exchange strategies, cultural change, and experimentation', Journal of Health Services Research & Policy, 18(Suppl. 3), 53–64.

[39] *Ibid.*

[40] Ling, T., et al. (2011). Delivering the aims of the CLAHRCs: evaluating CLAHRCs' strategies and contributions. Cambridge, UK: RAND Europe.

[41] Verma, J. Y., Rossiter, M., Kirvan, K., Denis, J. L., Samis, S., Phillips, K., O'Connor, P., et al. (2013). 'Going far together: Healthcare collaborations for innovation and improvement in Canada', International Journal of Healthcare Management 6(2): 66–76.

[42] http://www.cfhi-fcass.ca/AboutUs.aspx

involved. Again the aim is to encourage active participation in the research process from design to dissemination, and to create a sense of ownership for local authorities.

- *Assessing applications* – In assessing applications, a multidisciplinary panel of decision makers and researchers uses explicit criteria to assess both scientific merit and potential impact of the research.
- *Conducting research* – A requirement of the funding for a research project is that at least one decision maker is actively involved in conducting the research, either in an advisory role, as a co-investigator or leading the project.
- *Communicating findings* – The CFHI also acts as a knowledge broker between researchers and decision makers, in helping to support the communication of research findings.
- *Plans for evaluation* - Given the limited evidence base on PCRNs, CFHI is keen to implement evaluations to measure whether their collaborations have been successful in translating research into practice.[43]

In addition to its commitment to engage decision makers in primary care research, the CFHI also makes use of coaches and mentors to improve research capacity both among researchers and end users, drawing heavily on its leadership programme Executive Training for Research Application (EXTRA). [44]

Case 3: Western Research and Education Network (WestREN), Ireland

The Western Research and Education Network (WestREN) in Ireland was established in 2009. It is a university-affiliated general practice research network involving the National University of Ireland, Galway, and 71 West of Ireland general practices.[45] The network covers a population of over 500,000 in a geographic area that includes both rural and urban communities with diverse socio-economic backgrounds.

WestREN was established with the mission of supporting primary care research and education in order to improve the quality of patient care. It also differs from CLAHRCs and CFHI as it is more of a regional than a national programme, and is hosted by a single academic institution. In terms of organisational structure, WestREN follows a 'whole system leadership' approach, whereby a multidisciplinary group of practitioners and academics is involved in developing research in the hope that it encourages members to generate their own research ideas as well as becoming involved in university research.[46] The network also offers research bursaries, sponsored by the pharmaceutical company Merck Sharp & Dohme (MSD)

[43] Lomas, et al. (2000).

[44] Denis, J. L., Lomas, J. and Stipich, N. (2008). 'Creating receptor capacity for research in the health system: the Executive Training for Research Application (EXTRA) program in Canada', Journal of Health Services Research & Policy 13(Suppl. 1): 1–7; Verma, et al. (2013).

[45] http://westren.nuigalway.ie/

[46] Kavanagh, K. E., O'Brien, N., Glynn, L. G., Vellinga, A. and Murphy, A. W. (2010). 'WestREN: a description of an Irish academic general practice research network', BMC Family Practice 11(1): 74.

Ireland, to member practices in order to carry out primary care research. These bursaries range from €1,000 for smaller scale studies to €10,000 for larger pilot projects.[47]

The WestREN network also has a strong focus on capacity building and aims to facilitate better education and research training for GPs. GPs are incentivised to join the network through a range of benefits including support for continued professional development, which is now a requirement for all Irish GPs, and full access to university resources.[48]

2.2.2. Centres of Excellence

Another widely used model for facilitating research collaboration and engagement is establishing Centres of Excellence, whereby researchers are brought together with funding and infrastructure in collaborative entities, which harmonise research efforts through a more efficient allocation of resources. Centres of Excellence are part of a wider policy shift towards research excellence initiatives, which 'focus on rewarding and fostering exceptional quality in research and research-related activities'.[49] This is seen as a move away from traditional models of research funding and combines elements both of project funding, whereby funding is competitive and outcome-oriented, and institutional block funding, whereby funding is extensive and long-term.[50]

Centres of Excellence tend to be positioned within academic institutions and aim to build a critical mass of interdisciplinary researchers around research areas that are deemed to be strategically important to a country's international competitiveness in attracting research funding, and build upon areas in which the country has a comparative advantage.[51] Again, like PCRNs, the context in which Centres of Excellence are established is a crucial element to their success. Therefore, the following examples present different approaches undertaken in other European countries.

Case 1: UKCRC Public Health Research Centres of Excellence

In 2008, eight major funders of public health research in the UK came together under the auspices of the UKCRC and committed over £20 million to develop five UKCRC Public Health Research Centres of Excellence.[52] The centres aim to improve infrastructure, build capacity and promote multidisciplinary partnerships in the hope of furthering research excellence in public health. With its dual aims of capacity building and engaging with policy and practice across the UK, the initiative continues to occupy a unique

[47] http://westren.nuigalway.ie/bursaries.html

[48] http://westren.nuigalway.ie/education.html

[49] Orr, D., Jeager, M. and Wespel, J. (2011). New Forms for Public Research: A Concept Paper on Research Excellence Initiatives.

[50] Aksnes, D., et al. (2012). Centres of Excellence in the Nordic countries: A comparative study of research excellence policy and excellence centre schemes in Denmark, Finland, Norway and Sweden. NIFU.

[51] Fisher, D., Atkinson-Grosjean, J. and House, D. (2001). 'Changes in academy/industry/state relations in Canada: The creation and development of the networks of centres of excellence', Minerva 39(3): 299–325.

[52] http://www.ukcrc.org/index.aspx?o=1529

niche in the UK public health research landscape. The centres have also managed to leverage external funding from the NIHR, MRC and the National Prevention Research Initiative (NPRI).[53]

In 2013, the progress and impact made by the individual UKCRC centres was assessed and all were recommended for further funding.[54] The funders endorsed the recommendations of the panel and all five centres will be supported for a second five-year term at a cost of £16m.

In addition, the UKCRC Public Health Research Centres initiative was also evaluated as a whole, and found to have been successful in achieving its initial objectives. It was, moreover, considered to be at the international forefront of integrating public health research, policy and practice. In particular it was argued that the initiative provided:

- a successful model of combining both knowledge exchange and capacity building
- innovative ways of gaining buy-in and engagement with research users, that has shown evidence of impact at local and national levels
- effective collaboration in building a UK-wide infrastructure for public health research
- excellent capacity building attracting academics from different disciplines.[55]

However, the evaluation also identified some issues for the centres. Their long-term sustainability will depend on structural and cultural changes at their host institutions, and capacity building activities may be at odds with key drivers at these institutions to promote research excellence.

Case 2: Swedish Council for Health, Working Life and Welfare (FORTE) and the National Institute of Public Health (NIPH), Sweden

The Swedish Council for Health, Working Life and Welfare (FORTE) and the National Institute of Public Health (NIPH) are both responsible for providing research on public health to decision makers in government and in regions, county councils and municipalities.

FORTE supported the establishment of 13 research centres at Swedish universities. For example, the Centre of Excellence on Global Health within Umeå University was set up in 2007 through a grant from FORTE, and supported by co-funding from the university, with an aim 'to engage with a global agenda on health research, addressing critical issues in global health and facilitating interaction and collaboration between Northern and Southern partners'.[56] The centre focuses on five key areas: epidemiological transition; life course perspectives on health interventions; strengthening primary healthcare; gender and health; and climate and health. During its first four years, the centre received SEK 5.5 million annually, of

[53] http://www.ukcrc.org/researchcoordination/jointfund/publichealth/

[54] http://www.ukcrc.org/index.aspx?o=3738

[55] http://www.ukcrc.org/research-coordination/joint-funding-initiatives/public-health-research/

[56] http://www.globalhealthresearch.net/

which FORTE contributed around 28 per cent and the host university contributed around 12 per cent.[57] In a recent evaluation of the FORTE Centres of Excellence, it was noted that the funding from FORTE allowed the centres to secure additional funding from other sources, such as the EU, and that an advantage of FORTE's funding is that it is flexible and not bound to specific projects.[58]

The NIPH is a national centre of excellence for the development and dissemination of methods and strategies in the field of public health. The NIPH also has a role in monitoring and evaluating the efficacy of public health research policy in Sweden and reports back to decision makers. Swedish research on public health has a relatively high degree of internationalisation, with the World Health Organization (WHO) establishing collaborating centres at Umeå and Karolinska Institutet to enhance international collaboration.[59] The NIPH also serves as the contact point for several international programmes with the EU.

2.3. Issues and Ideas

The literature above highlights the critical role of stakeholder engagement in establishing research networks and collaborations. This requires an understanding of who the key stakeholders are, as well as the barriers and enablers to their engagement. The low engagement of GPs in primary care research in Norway is reflected internationally, and the wider context in which primary care research is being conducted must be considered in implementing an intervention to improve engagement. Given the current skew in Norwegian research funding towards six university hospitals,[60] there may be a need to try to bring stakeholders from the municipalities into the wider research ecosystem, and to consider strategies for research collaborations between universities, university colleges – including the regional research centres for care research – hospitals and the municipalities. This is particularly important for primary care research, which may be fragmented given the fact that the municipalities are not obliged to support research.[61]

In this respect, one idea to consider for the Norwegian health research system is to establish a central coordinating body similar to the OSCHR in the UK or ZonMw in the Netherlands to help coordinate health research and facilitate interaction between universities and colleges, regional research centres, hospitals and municipalities. A central coordinating body could also provide a platform for senior

---

[57] Solomos, J., Hemminki, E., Hillmert, S., Knibbe, R. A., Siegrist, J. and Staudinger, U.M. (2011). FAS Centres of Excellence Mid-Term Evaluation, September 2011. http://ki-su-arc.se/wp-content/uploads/2012/06/2011-FAS-evaluation-of-ARC.pdf

[58] *Ibid*

[59] Kamper-Jørgensen, F., Arber, S., Berkman, L., Mackenbach, J., Rosenstock, L. and Teperi, J. (2005). 'Part 3: International evaluation of Swedish public health research', Scandinavian Journal of Public Health 33(Suppl. 65): 46–84.

[60] Fridholm, T., Melin, G., Arnold, E. (2012). 'Evaluation of the Research Council of Norway: Background report No 3. Ministry Steering of the Research Council of Norway', Technopolis Group.

[61] *Ibid.*

engagement across these three sectors and help to foster a culture of one holistic health research system. A challenge for improving the engagement of universities/colleges, hospitals, research centres and municipalities in future health research will be to ensure the alignment of incentives within each of the three sectors, which are currently very diverse.

The potential trade-offs between PCRNs and Centres of Excellence must also be considered. Centres of Excellence, of which Norway currently has 21 across a range of scientific disciplines (including some in health and care), can be a good option for building critical mass and their central position may help to leverage external funding. However, they are also dependent on host university policies and may draw expertise away from the municipalities. PBRNs, on the other hand, are flexible and have the ability to engage a wide range of stakeholders in research. However, they are also highly dependent on the active engagement of all stakeholders and strong organisational coherence.

Table 2.1 Issues and ideas on networks and collaboration

Issues	Ideas
• Engagement of stakeholders is crucial • GP engagement is low internationally • Trade-off between Primary Care Research Networks and Centres of Excellence	• Consider establishing a central coordinating function to help integrate health research agendas across ministries and other stakeholders • Consider establishing Primary Care Research Networks as a mechanism to engage municipalities in research

3. Data linkage and exchange

3.1. Overview

This review focuses on how research infrastructures can adapt in order to maximise the use of increasing amounts of data, with a particular focus on electronic health records and national registries. The ways in which advances in data are likely to be important for health research, monitoring and surveillance are examined, before addressing some of the issues these advances are likely to raise, including data management, effective ICT solutions, shared data standards and appropriate legislative and ethical frameworks.

The healthcare sector is becoming saturated with previously unobtainable data, from next-generation DNA sequence data to clinical and health outcomes data contained in electronic health records and national registers.[62] This saturation has considerable implications both for the delivery of health services and for health research. In terms of research, the use of DNA sequencing allows us to understand which treatments are likely to work in which patients based on genetic markers – simultaneously facilitating research advancements and improvements in patient outcomes.[63] In addition, comprehensive monitoring and surveillance programmes can address threats such as infectious diseases and antimicrobial resistance by integrating data from a wide range of both structured and unstructured data sources, including hospital admissions data, data from environmental tracking (for example water quality monitoring reports), electronic health records and veterinary health records.[64] Electronic health records,[65] electronic medical records[66] and national registers may also serve as important sources for clinical research, including providing information on activities in primary healthcare, and comprehensive patient information within a particular region.

---

[62] O'Reilly, T., Loukides, M., Steele, J. and Hill, C. (2012). How data science is transforming health care. O'Reilly Media, Inc.

[63] *Ibid.*

[64] Morgan Jones, M., Hall, A., Brooker, D., Castle-Clarke, S., Winpenny, E., Jahagirdar, D., Exley, J. and Chataway, J. (2013). The future of public health: A horizon scan. Cambridge, UK: RAND Europe.

[65] For the purpose of this review, electronic health records are understood as an integrated/inter-linked of all health-related data for a patient.

[66] For the purpose of this review, electronic medical records are understood as a GP's or clinician's digitised paper records. This term is used interchangeably with electronic patient records (EPRs) in the literature.

Although electronic medical and health records are primarily used for improvements in healthcare and service delivery, Powell (2005) points out that electronic health records offer a range of benefits for research, including information regarding the prevalence and variance of particular conditions within local contexts; the chance for signals to be sent to clinicians regarding a patient's eligibility for ongoing trials; and the ability for patients to indicate their willingness to participate in research.[67] This point is particularly important, given that a study of patients' consent preferences for using information in electronic medical records in research found that most interviewees (n=17) 'were willing to allow the use of their information for research purposes, although the majority preferred that consent was sought first. The seeking of consent was considered an important element of respect for the individual', even if data was anonymised in most cases.[68]

In order to benefit from the opportunities presented by new approaches to data, a number of factors need to be considered. Firstly, a wide range of skills and expertise is needed for collecting and analysing new types of data. In DNA sequencing, for example, technological advances have led to high throughput genetic sequencing, which has driven down the cost of sequencing organisms. This, combined with advances in bioinformatics, is resulting in the generation of huge amounts of data,[69] and powerful informatics technology and bioinformaticians with skills in large dataset analysis are needed to interpret this data.[70] Similarly, data mining and data fusion techniques, which enable 'data from a wide range of heterogeneous sources to be used in applications such as anomaly detection, hypothesis testing and epidemiological model calibration'[71] will be important for maximising the utilisation of electronic health records, health registers and other sources of data. Data mining and data fusion draw on grid computing, 'sharing heterogeneous resources which are under different ownership or control, over a network using open standards'.[72] These are just a few examples of how skills within a research ecosystem will be driven by advances in digitisation and the broader use of data. Although skills are an important factor in data linkage and exchange, they are not discussed in more detail here.[73]

Interoperability is currently a concern when managing multiple data sources (although this may cease to be significant as advancements in technology are made). At present, it is important that content, structure

---

[67] Powell, J. (2005). 'Electronic Health Records Should Support Clinical Research', Journal of Medical Internet Research 7(1): e4.

[68] Willison, D., Keshavjee, K., Nair, K., Goldsmith, C., Holbrook, A. M. (2003). 'Patients' consent preferences for research uses of information in electronic medical records: interview and survey data', BMJ 326

[69] McEwen, J., Boyer, J. T. and Sun, K. Y. (2013). 'Evolving Approaches to the Ethical Management of Genomic Data', Trends in Genetics 29(6): 375–82.

[70] The Academy of Medical Sciences (2013). 'Realising the Potential of Stratified Medicine', London: The Academic of Medical Sciences.
http://www.acmedsci.ac.uk/index.php?pid=118&pressid=113 Accessed 19/02/2014

[71] Foresight, (2006). 'Infectious Diseases: Preparing for the Future – S3: State-of-Science Review – Intelligent Sensor Networks', London: Office of Science and Innovation, p. 3.

[72] *Ibid.*, p. 13.

[73] For a more detailed discussion of skills in health research please see Morgan Jones et al., (2013).

and technology are standardised within electronic medical and health records and health registers.[74] As Kush et al. (2008) explain:

> the relationship between an adverse event and a particular therapy could be classified as "no," "unlikely," "possible," "definite," or "probably" by one institution; as "not related," "doubtful," "possible," "very likely," or "probable" by a second; and as "no," "yes," or "unknown" by a third. Without the use of common vocabularies, it is impossible not only for a given hospital's computer system to understand a patient record from another hospital, but also for researchers to compare data across organizations or to collect sufficient data to make informed decisions.[75]

Records and ICT systems should be standardised in order to ensure optimum interoperability. One attempt to achieve such standardisation can be found in the US Biomedical Research Integrated Domain Group (BRIDG) project, which aims to produce a shared view of semantics to aid protocol-driven research. It is a collaborative project between the Clinical Data Interchange Standards Consortium (CDISC), the Health Level 7 Regulated Clinical Research Information Management Technical Committee (RCRIM) Work Group, the US National Cancer Institute (NCI), and the US Food and Drug Administration (FDA). The development of a common data language should not only aid research organisations in talking to each other, but should also enable the systems supporting healthcare and those supporting research to talk to each other.[76]

Standardisation and interoperability are also important for collecting comprehensive data. A good example of this is the ever growing prevalence of self-diagnostic devices. In order to ensure up-to-date information, healthcare and research institutions need access to diagnostic information, but there are no mechanisms to capture data from self-diagnostic devices at present. One proposed solution to this problem is to produce devices that automatically relay diagnostic information by radio link to health institutions. However, in order for that process to work efficiently, open standards would need to be developed across diagnostic tests, as well as databases.[77] Moreover, this raises a number of ethical concerns regarding data privacy, particularly given that arguably the appeal of self-diagnostic devices is to escape the institutional health framework.

Finally, as demonstrated in relation to self-diagnostic devices, a sound ethics framework is essential when handling patient information on such a large scale, particularly if that information is to be used for research purposes. In Denmark, the opt-out register for health research provides a good model. As noted above, electronic health records may also provide a good platform for patients to express their desire to participate in health research.

---

[74] Hoerbst, A. and Ammenwerth, E. (2010). 'Electronic Health Records: A Systematic Review on Quality Requirements', Methods of Information in Medicine 49(4): 320–336.

[75] Kush, R. D., Helton, E., Rockhold, F. W., Hardison, D. (2008). 'Electronic Health Records, Medical Research, and the Tower of Babel', The New England Journal of Medicine 358(16): 1738–1740, p. 1738.

[76] *Ibid.*

[77] Smolinski, M. S., Hamburg, M.A., and Lederberg, J. (2006). Microbial Threats to Health: Emergence, Detection and Response. Washington D.C.: Institute of Medicine of the National Academies.

3.2. International examples

Case 1: Utilising health registers: The case of the Nordic countries

Nordic countries have particularly comprehensive health registers which collect data on risk factors and health and health outcomes, and which can be linked to other registries and events in both the past and the future.[78] Moreover, the registers are well established; causes of death have been registered in Sweden since 1751 (and have been computerised since 1952) and a cancer register was established in Denmark in 1943.[79] Norway established its cause of death register in 1951 and cancer register in 1952.[80] However, the Norwegian prescription register is relatively new (having been established in 2004), and at present it does not capture patients in long-term institutional care. Norway could potentially benefit from linking with other registers in the region, and this will be explored further below under applications for Norway.

Health registers are an important resource for research given that they provide answers to questions that clinical trials cannot. Hundreds of studies have benefitted from health registers, and in several cases have produced more reliable findings than similar case-control studies. A good example of this is a case-control study that found that the intramuscular administration of vitamin K doubled the risk of childhood cancer compared with oral administration.[81] This caused particular concern for Sweden, since intramuscular administration was recommended by the National Board of Health and Welfare. A study based on the Medical Birth and Cancer registers in Sweden was initiated, and found that there was in fact no link between the intramuscular administration of vitamin K and increased risk of childhood cancer, which was confirmed by later studies. This may be at least partially explained through the difference in sample sizes between the two studies. The case-control study included 195 cases and 558 controls, whereas the national study included more than 2,300 cases and 1.3 million controls.

In addition to the opportunity for Norway to link with other data registries, four of the research infrastructure-related recommendations from the HO21 Working Groups were concerned with the establishment of a health register for primary care in order to facilitate research in the municipalities. The Danish National Health Service Register (NHSR) provides a leading example of a primary care register. It documents activities in primary care for administrative use and to contribute to research in public health and it is used by GPs, practising medical specialists, physiotherapists, dentists, psychologists, chiropractors and chiropodists. Data in the register have been available for research since 1990, and it contains information on individual citizens, including their unique personal identification number, which reveals the age and sex of the citizen and allows the data to be merged with other registers. The register also

---

[78] Vollset, S. E. (2011). 'Health registries for research in Norway: examples and challenges', Seminar on register-based research in the Nordic countries – Helsinki 5 April 2011.

[79] Rosén, M. (2002). 'National Health Data Registers: a Nordic heritage to public health' Scandinavian Journal of Public Health 30: 81–85.

[80] Vollset, S. E. and Cappelen, I. (2007). 'Registerepidemiologi', in Laake, P. et al., eds. Epidemiologiske og kliniske forskningsmetoder. Oslo: Gyldendal, 347–72.

[81] Golding, J., Greenwood, R., Birmingham, K., Mott, M. (1992). 'Childhood cancer, intramuscular vitamin K, and pethidine given during labour'. BMJ 305: 341–6.

contains data on providers, including contact patterns, prescription habits and admissions to hospitals, as well as services, which are broken down into basic, laboratory and additional services. All services are individually priced, since GPs are reimbursed for services by the Regional Health Administration.

The Danish NHSR has yet to be formally evaluated, although there are a number of reviews[82] which reveal that several lessons can be learned from the implementation and use of the register, both in terms of good practice and necessary improvements. In relation to the former, complete coverage of everyone residing in Denmark is ensured in the register through their unique personal identification number, which is used whenever they contact the healthcare system. This means that, in general practice epidemiology, the population at risk is well defined. Moreover, in most general practices most data in the register are connected to the electronic patient record, adding accuracy to the information about the patient. The data in the register are also relatively complete in terms of services, since GPs are incentivised by being reimbursed for services performed, and their invoices are used to generate the data in the register. In 2011, it was reported that the NHSR contained more than 600 million patient contacts since 1990, enabling the detection of even small changes in contact rates.[83] Finally, the data are readily available, although for them to be supplied with personal identification numbers permission must be given by the relevant authorities, particularly the Danish Data Protection Agency.

In terms of improved systems and lessons for the development of a primary health register in Norway, there are a number of things to bear in mind, as set out in the register reviews.[84] Firstly, the NHSR contains only minimal information about citizens' health problems and reasons for using the service, which, if augmented, could provide more research opportunities using the dataset. Secondly, until 1996, services provided to children under the age of 16 were reported under the personal identification number of the mother or father, which may have invalidated the register for research purposes. Thirdly, no validity studies have been carried out on the register, which means that the frequency of errors in the register is unknown. Fourthly, although the economic incentives ensure good coverage in the register, they do mean there is an incentive to over-report, although this is mitigated by GPs having to explain their invoices to the Regional Health Administration if they exceed 25 per cent above the average for GPs in the region. Moreover, as small services such as the examination of urine using a dipstick only incur a small fee, they may not always be reported. Fifthly, the way in which some services are coded is vague (eg psychotherapy), which provides problems in undertaking research. In addition, vague terms may be interpreted differently by different service providers, further invalidating the data for research purposes. Finally, although official evaluations of the register have not been conducted, a 1997 review of the register found that:

> To take advantage of the register for research purposes within clinical and health services research…one must possess not only a detailed knowledge of the Danish society, including the

[82] Olivarius N. deF., Hollnagel H., Krasnik A., Pedersen P. A., Thorsen H. (1997). The Danish National Health Service Register. Danish Medical Bulletin 44: 449–53; Andersen, J. S., Olivarius, N. deF., Krasnik, A. (2011). 'The Danish National Health Service Register', Scandinavian Journal of Public Health 39(Suppl. 7): 34–37.

[83] *Ibid.*

[84] *Ibid.*

> structure of the Danish health care system, but also an intimate acquaintance with rather complex agreement system and the actual interpretation of this.[85]

Similarly, in 2011, Andersen et al. found that 'knowledge of the daily working conditions and routines in practice is necessary to interpret the data in the NHSR.'[86]

Case 2: Implementing a national Electronic Health Record system: The case of the UK

In 2002, the UK attempted to implement nationally procured software for electronic health record (EHR) systems in individual care settings, which was the first attempt at such an endeavour worldwide. After investing £1.4 billion in the project since its inception, the attempt was abandoned in 2011. However, evaluations of the process have revealed lessons that other countries can take into account. This may be of particular importance to Norway, given that a five-year contract was awarded in 2012 to implement a national EHR system.

Cresswell et al. (2011) conducted a real-time evaluation of the implementation of the EHR system in the UK, sampling the 12 hospitals across England that were the first to implement nationally procured EHR software systems. Their evaluation produced several important findings. Firstly, they found that the software needs to be able to evolve with the needs of a variety of user groups. They found that where software design reflected the needs of the user or was customised to do so over time, users were more motivated and early benefits were more likely to be realised.[87] Secondly, timelines for the implementation of the new systems need to be realistic. The evaluation found that ambitious implementation timelines hampered progress. Thirdly, implementing a national system from the top-down requires relationship building at all levels. The evaluation found that across settings 'local relationship building between suppliers and users was often inhibited by centrally managed contracts resulting in delays in incorporating locally requested software changes due to complex bureaucratic processes'. Moreover, 'nationally negotiated contracts largely excluded individual hospitals. Therefore, implementation team members had limited power for making the systems usable in each environment due to national arrangements'.[88] Fourthly, the evaluation found that there was a tension between the need to show implementation progress locally and an incremental implementation approach to allow for the required local adjustments to occur. Finally, new national EHR systems need to consider interoperability at the national and potentially international levels. However, the evaluation found that these concerns were thought to be secondary to organisational and local needs – meaning that it may be easy to miss the opportunity for wider interoperability when implementing a national EHR system.

---

[85] Olivarius et al. (1997), p. 449.

[86] Andersen et al. (2011), p. 37.

[87] Creswell, K. M., Robertson, A., Sheikh, A. (2012). 'Lessons learned from England's national electronic health record implementation: implications for the international community.' Paper presented at the Proceedings of the 2nd ACM SIGHIT International Health Informatics Symposium, Miami.

[88] Cresswell et al. (2012), p. 687.

Overall then, there are considerable tensions between a top-down approach, which may help to ensure adherence to national data standards and therefore interoperability, and allowing for the specific needs of each healthcare institution, as well as the expectations and available capacity at a local level.

Case 3: Using Electronic Health Records for Clinical Research: The EHR4CR project

Electronic Health Records for Clinical Research (EHR4CR) is a project that is part of the European Innovative Medicines Initiative (IMI) programme. The four-year project started in 2011 and is expected to run until 2014. It has a budget of more than €16 million and is made up of ten pharmaceutical companies, 24 public partners (including hospital sites in France, Germany, Poland, Switzerland and the UK), and two subcontractors. The project is built on the premise that electronic health records 'offer large opportunities for the advancement of medical research, the improvement of healthcare, and the enhancement of patient safety'.[89] The aim of the project is to demonstrate how data held in EHRs can be reused to enhance clinical research processes in a multinational context, whilst protecting privacy.[90] The primary output from the project will be a technology platform and a set of tools that:

- support the feasibility, exploration, design and execution of clinical studies and long-term surveillance of patient populations
- enable trial eligibility and recruitment criteria to be expressed in ways that permit searching for relevant patients across distributed EHR systems, and initiate confidentially participation requests via the patients' authorised clinicians
- provide harmonised access to multiple heterogeneous and distributed clinical (EHR) systems and integration with existing clinical trials infrastructure products (eg EDC systems)
- facilitate improvements of data quality to enable routine clinical data to contribute to clinical trials, and importantly vice versa, thereby reducing redundant data capture.[91]

The platform will be developed and integrated as a common set of components and services that will allow the integration of the lifecycle of clinical studies with heterogeneous clinical systems, workflow interactions, privacy protection, information security and compliance with ethical, legal and regulatory requirements.[92] A key component of the project has been to review the ethical, legal and regulatory landscape in Europe. At the European level, there are two ethical approaches: the consent model and the trust model. The consent model requires the consent of the individual to use the data for research, although it is debateable whether explicit consent is required for the reuse of pseudonymised EHR data. The Health Research Act in Norway states that consent must be gained for the use of personal data in

[89] Electronic Health Records for Clinical Research:

http://www.ehr4cr.eu/index.cfm Accessed 25th February 2014.

[90] Coorevits, P., Sundgren, M., Kelin, G. O., Bahr, A., Claerhout, B., Daniel, C., Dugas, M., Dupont, D., Schmidt, A., Singleton, P., De Moor, G. and Kalra, D. (2013). 'Electronic health records: new opportunities for clinical research', Journal of Internal Medicine 274: 547–560.

[91] http://www.ehr4cr.eu/index.cfm

[92] Coorevits et al. (2013).

research, unless the data has been anonymised, although it does not mention pseudonymisation.[93] The trust model is to reduce the information content in the data so that individuals can no longer be identified. In this case consent is not required and privacy risks are removed. However, it is hard to ensure that a data set is fully anonymised and this makes it difficult to be fully compliant with the legislation.

The EHR4CR project is currently concerned with ethical approaches and is ensuring appropriate security measures for de-identification, paired with security measures for confidentiality, integrity, availability and auditability using cryptographic techniques and public key infrastructures.[94] It is hoped that this element of the platform will speed up the current ethics review process and clarify the correct ethical frameworks to use.

The project is based on an innovative business model which will allow the approach to be scaled up and used across Europe. Among other things, it will define a road map for pan-European adoption and for funding future developments.[95] As the project has yet to be completed it has not been evaluated, although it may provide an important model for using electronic health records for research purposes.

3.3. Issues and Ideas

These case studies have highlighted a number of general issues to consider for Norway: the harmonisation of national and international ICT standards; optimising the use of Nordic health registers; ethical considerations when using data from electronic health records; challenges in implementing a primary care health register; and lessons to bear in mind when implementing a national electronic health record system. Although skills were not addressed directly through the case studies, the importance of skills in data linkage and exchange was highlighted at the beginning of the review.

With regard to optimising the use of Nordic health registers, Norway could explore the possibility of linking with other health registers in the region in order to form a comprehensive dataset across four countries. This has been suggested by NordForsk[96] and a workshop hosted by NordForsk in March 2013 considered issues around legal and statutory requirements, trust, ethics and infrastructure frameworks in order for the project to work.[97] In terms of implementing a primary care register, there are a number of lessons which can be learned from the Danish case. These include being aware of the increased functionality that adding health information to the register would add, accurately reporting how children

[93] ACT 2008-06-20 no. 44: Act on medical and health research (the Health Research Act) Available at: http://www.ub.uio.no/ujur/ulovdata/lov-20080620-044-eng.pdf [Last accessed 11 February 2014].

[94] Coorevits, et al. (2013).

[95] http://www.ehr4cr.eu/index.cfm

[96] Stenbeck, M., Jonsson, U., Heimisdottir, M., Melbye, M., Salokannel, M. and Stoltenberg, C. (2014). 'Sharing registry data for health research in the Nordic countries – a proposal for increased collaboration: Report from the Nordic Task Force for Access to national data repositories', NordForsk, N.D.

[97] 'Sharing data among the Nordic countries', NordForsk web site:
http://www.nordforsk.org/en/news/sharing-data-among-the-nordic-countries?set_language=en
Accessed 25 February 2014.

are treated, undertaking or commissioning regular validity tests in order to understand the accuracy of register data for research, considering economic incentives based on the Danish model in order to ensure complete data, and ensuring that codes within the register are narrow and well defined in order to ensure comparability across health providers. Finally, to maximise the utility of a primary care register, it should be as transparent as possible, and should require minimal prior knowledge of the Norwegian health service or individual practices in order to fully optimise the data. To some extent this could be achieved through clearly defining standards for using the register across all service providers, and making those standards publicly available.

The case of the UK may provide useful lessons for Norway when implementing a national electronic health record system. It underscores the need to use adaptable software, ensure interoperability of the system from the outset, and to set realistic timelines in order to allow the use of the records to be embedded within the system and serve the needs of the users. Perhaps more importantly though, it highlights the need to ensure relationships at the local level are established and maintained, and to ensure that each local setting has sufficient time and capacity to adapt to the changes. This may be of particular significance to Norway, given that there is currently some fragmentation in the involvement of the municipalities in research.

Norway is likely to benefit from the outputs of the EHR4CR project, since it is hoped the platform will be used by EU member states (although whether this also includes Norway has not been clearly specified). The platform may help Norway to address ethical concerns around using electronic health records and data registries for research purposes, a concern expressed by one of the working groups. It may also provide benefits in terms of identifying study participants, identifying the feasibility of a project, providing harmonised access to multiple electronic health record systems and facilitating improvements in data quality.

Table 3.1 Issues and ideas on data linkage and exchange

Issues	Ideas

• Primary health registers:
  o Functionality
  o Accuracy
  o Validity
  o Completeness of data
  o Ambiguous coding
  o Transparency
• National EHR system:
  o Adaptability
  o Interoperability
  o Timelines in implementation
  o Relationship building at all levels (particularly given fragmentation of municipalities)
• Ensuring skills are in place to maximise the returns on technological advances
	• Aim to position Norway as a unique global resource for research through the linkage of diverse data sources, such as EHR and registries, across all health providers

4. Culture, values and leadership

4.1. Overview

Given the complexity of a health research system and the competing objectives and incentives within and across the system, it is important to actively shape the behaviours and norms at play within the system. This can be done through articulating, implementing and monitoring the organisational culture and through leadership training to develop a cohort of researchers and health managers who are co-owners or stewards of the system.

Anthropologists would define culture as the shared set of implicit and explicit values, ideas, concepts, and rules of behaviour that allow a social group to function and perpetuate itself.[98] Organisational culture thus includes a wide range of social phenomena, including language, behaviours, beliefs, values, assumptions, symbols of status and authority, myths, ceremonies and rituals, and modes of deference and subversion; all of which help to define an organisation's character and norms.[99] An organisational culture is therefore not just about how things are done in the organisation, but also about the norms, values and beliefs contained within the organisation, or in other words, the 'normative glue' that allows group members to communicate and work effectively together.[100] The organisational culture can be part of a larger 'research and innovation ecosystem', in which different elements, actors and institutions within the system impact each other. The benefit of taking a systems view is that it encourages attention to the wide array of legal, cultural, social, economic, organisational, political, commercial, scientific, and technological aspects that shape and characterise it. Furthermore, a systems perspective argues that all individual components and collective dynamics between these must always be viewed as part of the whole.[101]

---

[98] Scott, T., Mannion, R. Davies, H. and Marshall, M. (2003a). 'The Quantitative Measurement of Organizational Culture in Health Care: A Review of the Available Instruments', Health Services Research 38(3): 923–945.

[99] *Ibid.*

[100] Hudelson, P. M., (2004). 'Culture and quality: an anthropological perspective', International Journal for Quality in Health Care 16(5): 345–346.

[101] Nelson, R., ed. (1993). National Innovation Systems. A Comparative Analysis. New York and Oxford: Oxford University Press.

Some argue that the management of organisational culture is a necessity in healthcare reform.[102] It seems unlikely that an entire system shares a single culture of similar values and behaviours, but it may be possible to shape and align aspects of the system towards a shared goal. A research culture describes the degree to which an organisation defines itself in relation to research and how integral research is to practice.[103] This type of culture includes recognition by the organisational members of the research-in-practice cycle where research informs and enhances clinical practice. For instance, Verhoef et al. (2010) found that participants supportive of in-house research in nineteen Canadian Integrated Health Care clinics had very clear ideas on what they would like to achieve through research and its resultant benefits.[104]

Thomas (2011) found that multiple factors at the individual, organisational and policy level influence research activity in a healthcare setting.[105] These include the skills and attitudes of the individuals, the resources and the environment of the work, and the management values and priorities. Verhoef et al. (2010) highlight a number of key factors needed to achieve a sustainable research culture, including protected, dedicated research time, effective managerial support, research training, immediate access to mentorship and a nurturing workplace environment.[106]

Although 'systems thinking' is prevalent in the literature, including emerging literature on systems leadership, and national systems of innovation[107] there is very little on the culture of overall systems and how they might be shaped. However, if we consider the systems culture to be influenced by leadership in a similar manner as organisational leadership, a focus on systems leadership is necessary. Systems leadership can be described as 'leadership across organizational and geopolitical boundaries, beyond professional disciplines, within a range of organizational and stakeholder cultures, and often without managerial control'.[108] The expectations of leaders required to operate in complex systems may therefore require a number of leadership behaviours that are appropriate within a systems setting. For instance, an increased emphasis on effective boundary spanning, managing diverse stakeholders, taking a collective

---

[102] Scott, T., Mannion, R., Davies, H. and Marshall, M. (2003b). 'Implementing culture change in health care: theory and practice', International Journal for Quality in Health Care, 15(2): 111–118.

[103] Gardner, F., and Nunan, C. (2007). 'How to develop a research culture in a human services organization', Qualitative Social Work 6: 335–351; Thomas, V. (2011). '"Think Research" in Everyday Clinical Practice: Fostering Research Culture in Health Care Settings' Oman Medical Journal 26(2): 75–76.

[104] Verhoef, MJ, A Mulkins, A Kania, B Findlay-Reece, and S Mior, "Identifying the barriers to conducting outcomes research in integrative health care clinic settings - a qualitative study.," BMC Health Services Research Vol. 10, No. 14, 2010. As of 16 February 2014: http://www.biomedcentral.com/1472-6963/10/14

[105] Thomas, V, ""Think Research" in Everyday Clinical Practice: Fostering Research Culture in Health Care Settings " Oman Medical Journal, Vol. 26, No. 2, 2011, pp. 75-76.

[106] Verhoef, M. J., Mulkins, A. Kania, A. Findlay-Reece, B. and Mior, S. (2010). 'Identifying the barriers to conducting outcomes research in integrative health care clinic settings – a qualitative study', BMC Health Services Research 10(14): http://www.biomedcentral.com/1472-6963/10/14 Accessed 16 February 2014.

[107] *Ibid.*

[108] Van Dyke, M. (2013). Systems Leadership for Children's Services in the USA. National Implementation Research Network. p. 4

impact perspective, and acting in the benefit of the system of a whole. The latter is often referred to a stewardship, that is leaders acting as stewards, where they are not motivated by individual goals.[109] Organisations seeking to adopt such a stewardship perspective should 'aim to widen employees' views of beneficiaries to include a broader base of stakeholders and longer time frame in which to create and maintain value'.[110]

4.1.1. The role of leadership in research culture

In the section above, we have demonstrated the need to consider the wider health research system as well as the organisational culture which is an important factor in the quality of care.[111] Business and organisational psychology literature points to the importance of leadership behaviours and their impact on productivity and employee engagement. It is clear that leadership can be a driving force within an organisation or culture. Leaders effect cultural change directly and indirectly, and the way they behave communicates their assumptions both explicitly and implicitly.[112] But what leadership is required in a health research system? In a health research system, successful delivery of high-quality health research requires not only an effective research base, but also a system of leadership supporting it. As Morgan Jones et al. (2012) pointed out in their review of the NIHR's leadership programme, research leaders are not often given the opportunity, nor do they have the time, to attend formal leadership or management training programmes.[113] This is unfortunate because research has shown that leadership training can have a hugely beneficial effect on an organisation and system.[114]

Leaders are generally expected to take clear ownership for setting the direction of the organisation.[115] DeHaven's research (1998) on research programmes found that the residencies with a successful research programme reported availability of support from programme directors, including allowing time for research, faculty involvement, a research curriculum, professional support and opportunities for

---

[109] Davis, J. H., Schoorman, F. D. and Donaldson, L. (1997). 'Toward a Stewardship theory of management', 22(1): 20–47.

[110] Hernandez, M. (2012). 'Towards an understanding of the psychology of stewardship', Academy of Management Review 37(2): 188.

[111] Davies, H. T., Nutley, S. M. and Mannion, R. (2000). 'Organisational culture and quality of health care', Quality in Health Care 9(2): 111–119.

[112] Cheung-Judge, M., and Holbeche, L. Organization Development. (2011). A practitioner's guide for OD and HR, London: KoganPage.

[113] Morgan Jones, M., Wamae, W., Fry, C., Kennie, T. and Chataway, J. (2012). The National Institute for Health Research Leadership Programme. An evaluation of programme progress and delivery. Cambridge, UK: RAND Europe.

[114] *Ibid.*

[115] Hines S., Luna, K., Lofthus J., et al. (2008). Becoming a High Reliability Organization: Operational Advice for Hospital Leaders. (Prepared by the Lewin Group under Contract No. 290-04-0011) AHRQ Publication No. 08-0022. Rockville, MD: Agency for Healthcare Research and Quality.

presenting research.[116] The research concluded that in order to be successful in research, the residencies must make research a priority. Furthermore, Schwartz and Pogge (2000) highlight that surgeons should acquire competencies that will enable them to become leaders in the transformation process of academic medical centres, which will go over and beyond their role as research leaders.[117]

Verhoef et al. (2010) identified the importance of working in an environment that promotes and fosters a 'spirit of inquiry'.[118] Through role-modelling, making resources and funding available, and encouraging inquiry-based practice, leaders can impact the extent to which research is both part of core practice and fosters an inquiring nature among employees. The latter may also require the development of research training and skills, and for the leaders to act as research advocates.[119]

Tamkin et al. (2010) empirically explored the principles of outstanding leadership based on over 250 interviews in a two-year study.[120] They demonstrated that a highly people-centred approach results in performance that surpasses expectations. They categorised their findings into three main principles of outstanding leaders compared to good leaders:

- Outstanding leaders think and act systemically; they focus on the whole rather than the individual parts.
- Outstanding leaders see people as the route to performance; they give significant amounts of time and focus to people.
- Outstanding leaders are self-confident without being arrogant; they see themselves as conduits to performance and are highly motivated to achieve excellence.

The outstanding leaders are much more focused on their 'need to act consistently to achieve excellence through their interactions and through their embodiment of the leadership role'.[121]

Jung et al. (2003) found that transformational leadership by the top manager can enhance organisational innovation directly and also indirectly, by creating an organisational culture in which employees are encouraged to discuss freely and try out innovative ideas and approaches.[122] Leaders encouraging a culture

---

[116] DeHaven, M. J., Wilson, G. R. and O'Connor-Kettlestrings, P. (1998). 'Creating a research culture: what we can learn from residencies that are successful in research.' Family Medicine-Kansas City 30: 501–507.

[117] Schwartz, R. W., and Pogge, C. (2000). 'Physician-leadership: Essential skills in a changing environment', American Journal of Surgery 180(3): 187-192.

[118] Verhoef, M. J., Mulkins, A. Kania, A. Findlay-Reece, B. and Mior, S. (2010). 'Identifying the barriers to conducting outcomes research in integrative health care clinic settings – a qualitative study', BMC Health Services Research 10(14): http://www.biomedcentral.com/1472-6963/10/14 Accessed 16 February 2014. p. 5

[119] *Ibid.*

[120] Tamkin, P., Pearson, G., Hirsh, W. and Constable, S. (2010). Exceeding Expectation: The principles of outstanding leadership, The Work Foundation. http://www.theworkfoundation.com/Reports/233/Exceeding-Expectation-The-principles-of-outstanding-leadership

[121] *Ibid.*

[122] Jung, D. I., Chow, C. and Wu, A. (2003). 'The role of transformational leadership in enhancing organizational innovation: Hypotheses and some preliminary findings', The Leadership Quarterly 14(4): 525–544.

of innovation place people and ideas at the heart of their management philosophy, give people room to grow, to try to learn from mistakes, build a strong sense of openness and trust and community, and facilitate the internal mobility of talent.[123] It has been found that by increasing the number of trained and experienced family medicine researchers and enhancing the value of research to practising family physicians, they, their patients, and the public will accept the role of research as part of the family medicine profession.[124]

Developing good leadership in a healthcare setting has wider positive impacts. Leaders shape the culture, and can potentially enhance both research capability and access to funding. In addition, leaders can help normalise the role of health practitioners as researchers. Finally, there is strong evidence that proactive leadership enabling knowledge sharing is related to increased absorptive capacity. Absorptive capacity refers not only to the acquisition or assimilation of information by an organisation but also to the organisation's ability to exploit it.[125] It is found that even undertaking basic R&D internally in an organisation may lead to an increased ability to bring in innovations from outside, thus enhancing the absorptive capacity.

4.2. International examples

Development programmes and training are generally seen to increase levels of competence in the areas that they target. There is a potential gap in training for research capacity. For example Shaller (2004) found the lack of trained capacity in the field to conduct needed research and development in child health research.[126]

The overall potential impacts of improving leadership capability may include facilitation of networks and building internal capability,[127] enhancing innovation in teams,[128] enabling knowledge sharing, which is related to increased absorptive capacity,[129] and normalisation of the role of researcher in practice.[130] The cases below address, in different ways, approaches to target research leadership development.

---

[123] Leavy, B. (2005). 'A leader's guide to creating an innovation culture', Strategy & Leadership 33(4): 38–45.

[124] Yawn, B. (2002). 'What does it mean to build research capacity?', Family Medicine 34(9): 678–684.

[125] Cohen, W. M. and Levinthal, D. A. (1990). 'Absorptive capacity: a new perspective on learning and innovation', Administrative Science Quarterly 35(1).

[126] Shaller, D. (2004). 'Implementing and using quality measures for children's health care: perspectives on the state of the practice', Pediatrics 113(Suppl. 1): 217–227.

[127] Tamkin et al. (2010).

[128] Apekey, T. A, McSorley, G., Tilling, G. and Siriwardena, A. N. (2011). 'Room for improvement? Leadership, innovation culture and uptake of quality management in general practice', Journal of Evaluation in Clinical Practice 17: 311–318.

[129] Greenhalgh, T., Robert, G. Bate, P. and Macfarlane, F. (2005). Diffusion of Innovations in Health Service Organisations: A Systematic Literature Review. Oxford: Blackwell Publishing, 2005.

[130] Yawn (2002).

Case 1: The National Institute for Health Research Leadership Programme[131]

Delivery of the health agenda in the UK requires an effective research base and leadership supporting it. A leadership programme was set up at Ashridge Business School to develop the skills and capabilities of NIHR leaders and to enable them to make a real difference to the health research environments in which they work. The NIHR Leadership Programme began delivering to researchers in January 2009. It was commissioned against a backdrop of an increasing emphasis on high-quality clinical research in the NHS in the wake of *Best Research for Best Health*[132] and the Cooksey Report,[133] and a need to deliver high-quality research within the NHS.

The NIHR leadership programme delivered by Ashridge Business School offers leadership development at all levels, from senior leaders through to trainees. The various programmes include workplace development, leadership practice, focused skills development in a research setting and both individual and group support. Within these four overarching streams, a range of specific activities or 'interventions' are offered to participants according to their leadership group, and include learning conferences, 360 degree feedback, virtual workshops and learning guides.

Each programme is tailored to the level of the participants of the leadership programme cohort as well as the individuals being supported, although there are some common features shared across all groups. Senior leaders receive greater group and individualised coaching support, while trainee leaders follow a more structured programme centred on group learning and targeted workshops. The action learning groups are common to all levels of leader and are meant to be one of the main vehicles for participant learning during the programme, where insights and learning on the programme are converted into actionable solutions tested out in the real world. The length of the programme varies depending on the seniority of the participant, with the trainee programme being the most structured and lengthy (undertaken over a period of 18 months).

RAND Europe evaluated the leadership programme in 2012, and found that although the programme had a positive impact, they recommended paying further attention to improving research leadership in addition to the improving personal leadership. Furthermore, RAND Europe saw the programme as an attempt at a 'science policy intervention', since investing in the leadership skills of senior researchers and future leaders within NIHR could improve the ability of the research base to deliver a strong, robust and globally competitive UK health research sector. Finally, RAND Europe recommended that networks of community research leaders should be strengthened, highlighting the importance of networks in the wider health research system, as well as the benefit of continued personal development within a sustained leadership community.

---

[131] http://www.nihrtcc.nhs.uk/Leadership%20Flyer%202014%20Oct%20Launch.pdf

[132] Department of Health (2005). Best research for best health: a new national health research strategy. London: Department of Health.

[133] Cooksey, D. (2006). A review of UK health research funding. December 2006. London: HM Treasury.

Case 2: Community Leaders Institute

Since 2010, the University of Cincinnati's Center for Clinical and Translational Science and Training (CCTST) in the US has offered a community engagement programme that provides community leaders in the area with the training they need to increase support for their organisational missions and engage in community-based research as part of a wider improvement of community engagement. The Community Leaders Institute (CLI) is a six-week programme designed to improve community research capacity and address social, educational, environmental and physical health disparities in the Greater Cincinnati community. The programme is offered to community leaders, health advocates and programme administrators. This focus appears to be on developing research capacity within community leadership, rather than leadership capability within a researcher. According to Monica Mitchell, the co-director of the CCTST Community Engagement Core, the CLI offers a unique opportunity for programmes to broaden their skill set to ensure sustainability, including grant writing, survey development, data analysis and evaluation.[134] The training programme includes modules on generic research skills, including accessing public databases, developing surveys and evaluating programmes – as well as aspects related to funding access, eg grant writing.

An evaluation of the programme by Crosby et al. (2013) found that a research training programme for community leaders can be an effective method for increasing academic-community partnerships for health.[135] They proposed that a model that engages the community with academia can work towards integrating expertise from the community into academia. They also identified that, given that community leaders and the academic health centres engaged with the programme often operate in silos, the CLI helps to build a common language that can be used to advance community health research. The development of a shared language and culture for health research through training were seen as an effective step toward establishing mutual trust, respect, and expertise, as well as enhancing integration and collaboration among academic and community partners. Lessons learnt through the evaluation highlighted the need to consider expenses and time associated with attending the training, including ensuring opportunities to transfer learning upon returning to their organisation following training. The latter recommendation applies more widely to optimising the impact of training interventions.[136]

Case 3: The Executive Training for Research Application (EXTRA) Programme[137]

The EXTRA programme was set up in 2004 to address 'evidence-informed management is a key element in the renewal of leadership in health care organizations and systems'.[138] Twenty-eight fellows are

[134] http://cctst.uc.edu/programs/community/cli

[135] Crosby, L. E., Parr, W., Smith, T. and Mitchell, M. J. 'The community leaders institute: an innovative program to train community leaders in health research', Academic Medicine, 88(3): 335–342.

[136] Grossman, R., and Salas, E. (2011). 'The transfer of training: what really matters', International Journal of Training and Development 15(2): 103–120..

[137] https://www.cna-aiic.ca/~/media/cna/files/en/extra_fact_sheet_dec2013_e.pdf

accepted onto the training programme annually. The programme is managed by the Canadian Health Services Research Foundation (CHSRF) and funded by a grant from Health Canada. Overall, the bilingual programme aims to improve evidence-informed improvements. Over 14 months, the EXTRA programme supports teams of up to four health leaders in the design, implementation and evaluation of an improvement project in their own organisation or ministry, or across multi-site teams. The programme offers teams training in management and use of evidence for quality and performance improvement,[139] in addition to developing wider skills and leadership in Canadian health system managers and policy-makers related to the use of health systems evidence.[140] The programme includes both residency sessions and online learning, and includes an element of network building across its participants.

The programme is designed to have benefits across individual, organisation and system levels. According to the early review of the EXTRA programme by Denis et al. (2008), the programme appeared to have greater impact on the individual level (ie skills acquisition) compared to the organisational level. The authors speculate that the latter is likely to be due to the lack of opportunity and time to bring about major organisational change within the timeframe.

Case 4: CBS Research Management Course

The Copenhagen Business School (CBS) in Denmark offers an executive research management course. The course is aimed at equipping research leaders in academia, hospitals, and private and public research environments in Scandinavia to better navigate the challenges they face. Participants receive a diploma at the end of the course. More than 500 research leaders (over 15 cohorts) from Norway and Denmark have participated in the programme to date. The course runs in three modules, each of three days, over a period of six months. The first module looks at group dynamics, working with high-quality knowledge workers, the development and organisation of the research environment, and different understandings of leadership. The second module looks at cultural aspects of research, norms and authority, conflict management, reflexive leadership, priorities and time management. The third module focuses on change management, creating communities (competition and collaboration at the same time), the strategic development of research leadership and portfolio leadership, common goals, behaviours and preferences, and wider perspectives for universities. Finally, the programme enables participants to participate in alumni networks with the wider CBS alumni. The course focuses on developing leadership capability that is productive, oriented towards opportunities and adjusted towards the individual employees, team or situation. This type of leadership is referred to as '*mulighedsledelse*' in Danish, which can be loosely translated as leadership of opportunities, and requires the development of the skills of analysis, critical

---

[138] Denis, J. L., Lomas, J. and Stipich, N. (2008). 'Creating receptor capacity for research in the health system: the Executive Training for Research Application (EXTRA) program in Canada', Journal of Health Services Research & Policy 13(Suppl. 1): 1.

[139] http://www.cfhi-fcass.ca/WhatWeDo/EducationandTraining/EXTRA.aspx#sthash.s3RQnyH1.dpuf

[140] Ellen, M. E, Léon, G. Bouchard, G. Lavis, J. N., Ouimet, M. and Grimshaw, J. M. (2013). 'What supports do health system organizations have in place to facilitate evidence-informed decision-making? A qualitative study', Implementation Science 8(84). http://www.implementationscience.com/content/8/1/84

reflection, negotiation, collaboration and dialogue, including communication using a wide range of means.[141] The course has been run 16 times to date, with up to 40 participants on each course. The participants have come from different research organisations. The course, however, has only undertaken satisfaction evaluations, but these report high levels of satisfaction from participants.[142]

4.3. Absorptive capacity

In addition to considering leadership capability, it is important to consider capacity building across the system in question. The interplay between leadership, research capacity (in terms of understanding research as well as being able to participate in it) and developing a research culture can be seen as a virtuous circle where each element feeds into and supports the next. Leaders able to engage in – and who are favourable to – research will support further development of capacity; the benefits eventually accrued from research and the facilities that encourage such research will help to cement a positive environment and perceptions of research amongst a wider set of stakeholders.

Innovation, the introduction of new products, services and processes to society, involves the creation of new knowledge and/or the use of existing knowledge in new ways. The ability to innovate will depend to an extent on an organisation's ability to detect, absorb, comprehend and utilise information and knowledge.[143] This ability is labelled absorptive capacity, and depends on the knowledge held by individuals within an organisation, their ability to interpret knowledge from other sources, as well as the organisation's structure and capacity (ie institutional knowledge retention, and mechanisms to increase/maintain its members' knowledge base).[144] Absorptive capacity includes relative absorptive capacity in areas of 'related variety'. Related variety describes sectors or knowledge disciplines that are different from each other, but which still have similarities in the kind of knowledge (eg science, technology, procedures, methods) that they use. Relative absorptive capacity involves the ability to understand the knowledge holdings (and potential contributions) of different disciplines that may have overlapping knowledge points with others (ie a situation of related variety); as innovation may depend on the convergence of two different bodies of knowledge, this kind of absorptive capacity can be important.[145] Increasing absorptive capacity will therefore require actions at individual, organisational, and system (ie a regional or national jurisdiction) levels, depending on the organisation's environment and

---

[141] http://vbn.aau.dk/da/projects/ledelseskommunikation(cf3c9581-7e73-4fab-a1b9-cb645c6ef49d).html Accessed 19 February 2014.

[142] Barlebo Rasmussen (2014), personal communication.

[143] Cohen, W. M. and Levinthal, D. A. (1990). 'Absorptive capacity: a new perspective on learning and innovation', Administrative Science Quarterly 35(1).

[144] *Ibid.*

[145] Lane, P. and Lubatkin, M. (1998). 'Relative absorptive capacity and interorganizational learning', Strategic Management Journal 19: 461–77.

needs.[146] The table below (Table 4.1) discusses some actions that can be used to increase absorptive capacity at each level. More specifically, a successful partnership between academia, hospitals and local healthcare organisations may require different skills development in each area. A needs assessment for each may be appropriate[147] to identify which specific skills are required, whether these are research skills, leadership capabilities and/or a more general building up of wider absorptive capacity across the system.

Table 4.1 Selected Actions for Increasing Absorptive Capacity

Individual	Organisational	System
• Further training in field, and/or staying up to date • Learning by doing, through R&D • Exposure to related fields, or other disciplines • Network building opportunities, and mentorship for informal knowledge exchange and exposure[148] • Ability to communicate with peers and competitors • Ability to identify knowledge brokers or holders, and act as one themselves	• Providing training and time for individuals to explore external knowledge. Provide exchange opportunities through own organisation to get sense of complete picture • Network connections with other organisations, of same type, but also up and down their 'chain' • Network connections with organisations outside their immediate field[149] • Maintain R&D capacity to push knowledge boundaries and keep up to date • Create institutional memory, and have more than one expert in an area	• Provide sources of training and support for skills development through either policy support or meeting demand • Provide network connections and outreach to different stakeholder organisations, in either formal or informal manner (eg San Diego Connect; regional conferences on key topics) • Fund and support public and private R&D capacity through funding, fiscal incentives, and building public sector/ university capacity • Encourage environment of knowledge sharing through requirements/incentives of transparency, benefits of evidence-sharing[150]

[146] Frenken, K., Van Oort, F. and Vergurg, T. (2007). 'Related variety, unrelated variety, and regional economic growth', Regional Studies 41(5).

[147] Goytia, C. N., Todaro-Rivera, L., Brenner, B., Shepard, P., Piedras, V. and Horowitz, C. (2013). 'Community capacity building: a collaborative approach to designing a training and education model', Progress in Community Health Partnership 7(3): 291–299.

[148] Lichtenthaler, U. and E. Lichtenthaler (2010). 'Technology transfer across organizational boundaries: absorptive capacity and desorptive capacity', California Management Review 53(1): 154–170.

[149] *Ibid.*

[150] Denis, J. L., Lomas, J. and Stipich, N. (2008). 'Creating receptor capacity for research in the health system: the Executive Training for Research Application (EXTRA) program in Canada', Journal of Health Services Research & Policy 13(Suppl. 1): 1–7.

4.4. Issues and Ideas

Simultaneous change across all the different aspects of organisational culture is unlikely to be possible and could potentially impact existing cultural traits that may need to be retained. For instance, in healthcare, expectations are often around high reliability, and the provision of effective and safe healthcare. A cultural transformation should aim to balance renewal and continuity of existing culture, and take into account effective sub-cultures and draw on these to shape behaviours within the overall system. Cultures are equally likely to be influenced by external factors, eg professional values embedded within healthcare education,[151] and attempts at transformational cultural change need to consider these as well, and monitor both desired outcomes and any unexpected impacts of change. One aspect that is likely to help deliver a health research system and then to act as its stewards is the collective leadership of senior stakeholders throughout the system. With this in mind, investing in and developing the leadership capacity – in the universities and colleges, hospitals and municipalities – that improves both the delivery of research and innovation in a complex system, as well as the capacity to receive and absorb new knowledge, is an idea that may be worth adopting.

Table 4.2 Issues and ideas on culture, values and leadership

Issues	Ideas
• Research culture and leadership development often forgotten in science policy • Different needs for hospitals, municipalities and universities	• Consider develop a high quality leadership programme that will enhance the stewardship of the health research system

[151] Scott, T., Mannion, R., Davies, H. and Marshall, M. (2003b). 'Implementing culture change in health care: theory and practice', International Journal for Quality in Health Care, 15(2): 111–118.

5. Supply and demand side policy instruments

5.1. Overview

It is widely accepted that there is a role for public policy to support innovation-related activities.[152] This is because there is generally thought to be a link between investments in research and economic growth,[153] which in many cases has led to ambitious R&D targets. This is the case in Norway, where there is a three per cent target for R&D as a share of GDP.[154,155] The reason that public policy is needed, it is argued, is that under ordinary market conditions, there may be a tendency for firms to underinvest in R&D due to a number of market failures. Firstly, it is argued that firms have difficulty in appropriating all of the benefits associated with an innovation, meaning that society benefits from innovation more than the innovators, reducing the incentive for firms to innovate. Secondly, the gap between the private return to the innovator and the cost of capital from external sources is thought to be too high.[156] Hall explains it as follows: '[…] some innovations will fail to be provided purely because the cost of external capital is too high, even when they would pass the private-returns hurdle if funds were available at "normal" interest rates.'[157]

A large range of incentives can be employed to stimulate innovation. Supply-side measures include those intended to remove barriers for producers of innovation and can be financial or service oriented (ie focused on information exchange or networks). Demand-side incentives are defined as measures to increase the demand for innovations, improve the conditions for the uptake of innovations and improve

[152] Brutscher, P. B., Cave, J. A. and Grant, J. (2009). Innovation Procurement: Part of the Solution, Cambridge, UK: RAND Europe.

[153] Hægeland, T. and Møen, J. (2007a). 'Input additionality in the Norwegian R&D tax credit scheme' Statistisk sentralbyrå, Reports 2007/47; Czarnitzki, D., Hanel, P., Rosa, J. M. (2011). 'Evaluating the impact of R&D tax credits on innovation: A microeconometric study on Canadian firms', Research Policy 40: 217–229.

[154] Three per cent of GDP is also the target set by the Europe 2020 strategy and has been adopted by most member states. However, in 2011 only Denmark, Sweden and Finland reached or exceeded this target. Hægeland, T. and Møen, J. (2007b). 'The relationship between the Norwegian R&D tax credit scheme and other innovation policy instruments' scheme' Statistisk sentralbyrå, Reports 2007/45.

[155] Hægeland and Møen (2007b).

[156] Czarnitzki, Hanel and Rosa (2011).

[157] Hall, B. H. (2002) 'The financing of research and development', Oxford Review of Economic Policy 18(1): 36.

the articulation of demand to spur innovation and the diffusion of innovations.[158] Mazzucato (2013) talks of an 'Entrepreneurial State' where governments actively pursue policy to attract skilled human resource and foreign companies, while fostering its own high tech companies.[159] As such, technology push and pull techniques are employed. The remainder of this chapter discusses these incentives in more detail, firstly supply-side incentives, with a focus on R&D tax credits and science parks, and then demand-side incentives, with a particular focus on public procurement and prizes.

5.2. Supply-side policies for innovation

In order to achieve 'socially desirable' levels of innovation (ie levels which result in benefits for society), government interventions are needed to correct market failures such as those summarised above. There are a large number of supply-side incentives (not all of which will be explored here), including:

- equity support, eg public venture capital funds or loss underwriting
- fiscal measures, eg R&D tax credits
- support for public sector research, eg university or laboratory funding
- government grants for industrial R&D
- support for training and mobility, eg entrepreneurship training
- information and brokerage support, eg contact and patent databases or brokerage events
- networking measures, eg support for clubs or science parks.[160]

Perhaps the most obvious measure for addressing market failures related to innovation is direct government R&D grants, which appear to have the advantage of being able to directly address market failures as they occur. However, a number of problems have been identified in the process of administering these grants. Czarnitzki et al. (2011) suggest that ignorance, information asymmetries between the innovator and the government agency,[161] and moral hazard on the part of the inventor or inventing firm[162] may make it difficult if not impossible to distribute the grants so as to reduce or eliminate the gap between the social and private return to R&D.[163] Although grants are desirable in theory, given that they can be allocated to projects or organisations based on their social rate of return (ie innovations that will be of most benefit to society), in practice governments are unable to determine how

[158] Edler, J. (2009). Demand policies for innovation (No. 579). Manchester Business School Working Paper.

[159] Mazzucato, M. (2013). The Entrepreneurial State: Debunking Public vs Private Sector Myths. London: Anthem Press.

[160] Edler, J. and Georghiou, L. (2007). 'Public procurement and innovation—Resurrecting the demand side', Research Policy 36(7): 949–963.

[161] In this case, the government agency does not have as much information as the innovator, in order to distribute the grants effectively.

[162] In this case, moral hazard refers to the idea that innovators may be more likely to take risks given that they are risking money from a government grant, rather than their own. Therefore the innovator does not feel the ill effects of a risky decision.

[163] Czarnitzki et al, 2011.

the grants should be distributed. It has been suggested that this 'government failure' may be more of a hindrance than the market failure it was intended to address.[164]

The problems incurred with the administration of government grants in relation to R&D in the private sector have led many countries, including Norway, to move to a system of R&D tax credits. These address many of the issues presented in the administration of grants, although fail to adequately address the barriers to innovation caused by market failures. The use of R&D tax credits, along with their effectiveness, is explored in more detail below.

This review will also explore networking measures initiated through the establishment of science parks. Establishing and/or further developing existing science parks such as the Oslo Innovation Centre and the Rogaland Science Park may be an interesting approach for Norway to consider, given that it aims to improve and expand collaboration with the private sector. Science parks can offer a way to attract multinational companies to the country and connect them with local industry, universities and the public sector more broadly. As noted in the working group report for research quality and internationalisation, Norway offers an interesting prospect to international companies in the area of health innovation, since it has a 'stable and uncomplicated population with good national registers and diagnostic biobanks' as well as an 'ability to pay for pharmaceuticals and new technical medical products in the health and care sector'.[165] However, it is important to be aware of the barriers and constraints of science parks, and the fact that their success is very context specific.

It is also important to note that capacity building can be conceived of as a supply-side incentive for innovation, since it creates the environment for innovation to flourish. Given that capacity building cuts across all of the themes discussed in this report, in terms of infrastructure, culture and capacity through collaboration, it will not be discussed in further detail here.

5.2.1. R&D Tax Credits

R&D tax credits are widely regarded as a desirable alternative to direct R&D government grants. This is because they are considered to be a neutral form of encouragement for R&D since all firms that incur eligible R&D expenditures, irrespective of the size and the objective of innovation activity can claim them. This means that the government is not responsible for their distribution, unlike direct R&D grants. The effect and efficiency of R&D tax credits can be evaluated in a number of ways, and indeed a number of approaches exist in the literature. Hall and van Reenan[166] group evaluation techniques into four major types:

---

[164] Winston, C. (2006). Government Failure Versus Market Failure: Microeconomics Policy Research and Government Performance. Washington, DC: AEI-Brookings Joint Centre for Regulatory Studies.

[165] HelseOmsorg21 (2014) Group report, Research quality and internationalisation. http://www.forskningsradet.no/prognett-helseomsorg21/Nyheter/Arbeidsgruppenes_delrapporter_er_na_tilgjengelige/1253992879080?WT.mc_id=nyhetsbrev-helseomsorg21

[166] Hall, B. and Van Reenan, J. (2000). 'How effective are fiscal incentives for R&D? A review of the evidence', Research Policy 29: 449–469.

- Event studies: these compare behaviour before a surprise change in policy is announced with behaviour after the announcement in order to ascertain the effect of the policy change. It would be difficult to apply this approach to Norway because, among other reasons, the change in policy was not a surprise.
- Case studies: retrospective event studies, which rely on qualitative data regarding whether R&D spending has been affected by R&D tax credits at the firm level. These are problematic because it can be difficult for firms to ascertain what the level of investment in R&D would have been without R&D tax credits.
- R&D demand equation with shift parameter for existence of a tax credit scheme: regression equation that predicts R&D investments at the firm level, including a variable that indicates whether the firm had access to the tax credit, in addition to other variables. This can only be performed at the micro level.
- Demand equation with user cost of R&D: Similar to the above approach, but instead of just including a variable indicating existence of or access to a fiscal measure for R&D, it calculates the user-cost of R&D investments. This model allows for the calculation of price elasticity for R&D but it does not take into account adjustment costs incurred by a firm in changing its R&D investments.

Evaluating the effects of R&D tax credits is therefore not easy, and different approaches may yield different results.

Czarnitzki et al. (2011) assessed the impact of R&D tax credits on innovation and economic performance on firms in Canada.[167] The study focused on innovation output rather than economic impact, and found that tax credits increased the innovation output of the recipient firms. However, Garcia-Quevdeo (2004) undertook a meta-analysis of 39 studies reporting 74 different results and concluded that the econometric evidence is ambiguous.[168] Therefore the value of R&D tax credits and indeed the way in which they should be assessed is not wholly clear, which presents problems when trying to improve the R&D tax credit system.

5.2.2. Science Parks

Science parks can be important instruments for supporting economic growth and innovation, as well as providing links with industry, both nationally and internationally. Norway currently has two science and technology parks, which is relatively few compared to its regional counterparts (Finland has 24, Denmark has 5 and Sweden has 12 – although the number of science parks alone does not provide a reliable comparator measure). In the case of Norway, it may be possible to stimulate health innovation through using science parks to engage pharmaceutical and biotechnology companies, and facilitate links with existing expertise in universities. However, in looking at science parks more generally, it is important to

[167] Czarnitzki et al., 2011.

[168] Garcia-Quevedo, J. (2004). 'Do Public Subsidies Complement Business R&D? A meta-analysis of the Econometric Evidence', Kyklos 57: 87–102.

analyse and understand them in the context of their location and associated technological base. Ultimately, their purpose and growth trajectories depend on the region, technological or business sectors and the national context, ie the wider innovation system. With this in mind, it is not always easy to understand the factors which contribute to the success of a science park, and many evaluations of science parks around the world have found contrasting results, ranging from science parks being nothing more than a 'glorified business park'[169] and having no impact on firm profitability[170] to science parks facilitating informal and human resource linkages between firms and universities.[171]

In reviewing recent literature on science parks, it is clear that there are numerous approaches and configurations internationally. It is also not the case that particular configurations correlate with certain locations or regions. Moreover, Link et al. (2003) found that park directors use different success criteria in evaluating their parks, including profitability, contributions to the local and regional economy, and the ability to interact successfully with universities.[172] As a result, it is very difficult to understand how a successful science park should be established, and indeed to know how to approach this endeavour in Norway, although the local context and R&D conditions need to be taken into account. The remainder of this review will outline the approach and success of science parks in the US and Sweden. Considerations which should be taken into account for Norway to further establish successful science parks are outlined under the applications for Norway section below.

The United States

Appold (2004) reviewed university research parks (a term he considers to be interchangeable with science parks or science cities) between 1960 and 1985 in the US and found that they grow at an average of 8.4 per cent per year.[173] However, he found that they grow faster when they:

- are located closer to the university
- are operated by a private organisation (rather than a university)
- have a specific technology focus, information technology in particular.

He also found that establishing a science park has three possible outcomes. Firstly, they could prove to be effective and independently attract research activity into the area, which may be located on or off the park. This success may be due to offering operational benefits (such as increased access to technical knowledge,

---

[169] Massey, D., Quintas, P and Wield, D. (1992). High-tech Fantasies. London: Routledge.Massey, D., Quintas, P and Wield, D. (1992) *High-tech Fantasies* London: Routledge

[170] Löfsten, H. and Lindelöf, P. (2001) 'Science parks in Sweden – industrial renewal and development?' R&D Management 31: 309–322.

[171] Vedovello, C. (1997). 'Science parks and university-industry interaction: Geographical proximity between the agents as a driving force', Technovation 17(9) 491–502.

[172] Link, A. N. and Link, K. R. (2003). 'On the growth of US science parks', Journal of Technology Transfer 28(1): 81–85.

[173] Appold, S. J. (2004). 'Research parks and the location of industrial research laboratories: an analysis of the effectiveness of a policy intervention', Research Policy 33: 225–243.

or perhaps in the case of Norway access to new technical medical products), or symbolic benefits in terms of the attractiveness of the location. Secondly, parks may be counter-productive in that they can decrease the amount of research activity in an area due to negative signalling. Appold refers to Spence's work on market signalling[174] and states that '[t]he effect of attending a "country club" university on a bright student's subsequent earnings might be similar. As a university graduate, the student's future earnings would be above labour market average but the observed positive effect would be less than what the person would have earned with a better education'.[175] However, it is unclear how Spence's work (which focuses on the interactive elements of a market structure) explains a decrease in research activity through a science park. Thirdly, research parks could be found to be superfluous to increases in research activity in an area. In such cases, research development would have occurred anyway. Mistakes in conflating correlation with causation in terms of increases in research and innovation have led to misjudged attempts to try to recreate successful science parks in the past.[176]

In addition, the role of exogenous variables in contributing to the success of science parks is not always clear, but it has been pointed out frequently in the literature that part of the success of US science parks may in part be due to the fact they have been able to exploit strong US universities, which have a history of large investments. Indeed it has been suggested that the role of Stanford University was critical in the early phases of the establishment of Silicon Valley.[177] However, how far the growth of Silicon Valley would have happened without Stanford University has been debated, given that 'Silicon Valley already contained significant private research activity and knowledge-intensive manufacturing before the Stanford Park was established'.[178] Therefore, the factors contributing to a successful science park and the role of universities remain relatively unclear, as does the reproducibility of this approach.

Sweden

The Mjärdevi Science Park in Linköping is one of Sweden's leading science parks. It is considered to be a success, where success is defined as 'contributing significantly to regional economic growth through the creation (or incubation) of new technology-based firms (NTBFs) – especially university-based start-ups, which represent an important channel for the commercialization of academic research'.[179] Hommen et al. (2006) undertook a review of the Mjärdevi Science Park and found the following factors to be important for its emergence and growth:

---

[174] Spence, A. M. (1974). Market Signaling: Informational Transfer in Hiring and Related Screening Processes. Cambridge, MA: Harvard University Press.

[175] Appold (2004). p. 226.

[176] See Miller, R. and Cote, M. (1987). Growing the Next Silicon Valley: A Guide for Successful Regional Planning. Lexington: Lexington Books.

[177] See Rogers, E. M. and Larson, J. K. (1984). Silicon Valley Fever. New York: Basic Books.

[178] Appold, S.J., (2004), p. 233.

[179] Hommen, L., Doloreux, D. and Larsson, E. (2006). 'Emergence and Growth of Mjardevi Science Park in Linkoping, Sweden'. European Planning Studies 14(10): 1332.

- *R&D infrastructure*: the presence in the area of R&D and educational institutions that are at the forefront of technological development
- *industrial infrastructure*: the existence of a constellation of complementary industrial activities
- *skilled labour*: a pool of technologically skilled workers
- *culture*: a general familiarity with entrepreneurial behaviour
- *institutions*: the presence of adequate economic and especially financial infrastructures.[180]

Unlike the US, which has tended to rely on large universities in establishing science parks, the Mjärdevi Science Park was facilitated first and foremost by high-tech industry. SAAB, a large national defence contractor specialising in aerospace, was established in Linköping in the 1930s, making the area 'an important centre for industries associated with mechanization and electrification'.[181] Linköping University was created largely due to proximity to SAAB, and it has since become one of Sweden's leading technical universities. SAAB was thus at the heart of the area's growth, and the decision to build a science park in the region. During the 1960s, SAAB tried to develop innovations in the medical sector, and promoted the establishment of a new university hospital in Linköping, which provided the basis for the Health Sciences Faculty of Linköping University. This provides an example of how a science park or a certain area could try to promote innovation within a particular sector.

It is important to note that the Mjärdevi Science Park was primarily a local development. Although it had financing from the National Development Fund, and the Swedish state had located SAAB, a regional university and a number of government laboratories and research institutes in the region, the main government actor was the Municipality of Linköping. This relieved some of the short-term pressures that can afflict national government agendas, and Hommen et al. advocate thinking about the establishment and subsequent performance of a science park from a bottom-up perspective. This may be of particular significance for Norway, given fragmentation across the municipalities.

5.3. Demand-side policies for innovation

Traditionally, supply-oriented interventions, supporting capacities to produce new knowledge and innovation such as the ones outlined above, formed the basis of innovation policy across Europe and beyond.[182] However, stimulating new innovations and the diffusion of existing innovations through

[180] *Ibid.*

[181] Klofsten, M., Jones-Evans, D.and Scha¨rberg, C. (1999). 'Growing the Linkoping Technopole—a longitudinal study of triple helix development', Sweden, Journal of Technology Transfer 24: 125–138Klofsten, M., Jones-Evans, D.and Scha¨rberg, C. (1999) Growing the Linko¨ping Technopole—a longitudinal study of triple helix development in Sweden, Journal of Technology Transfer, 24, pp. 125–138 p. 126. Cited in Hommen et al., (2006).

[182] Edler, J., Georghiou, L., Blind, K. and Uyarra, E. (2012). 'Evaluating the demand side: New challenges for evaluation' Research Evaluation, 21(1): 33–47.

demand-side interventions, which broadly correspond to the user-driven perspective of innovation, still tends to lack recognition in government policy.[183]

Demand-side policies aim to restructure incentive systems through public measures that influence market conditions, which could be achieved through both technology push and pull. These measures are intended to enlarge the market for innovations, improve conditions for the uptake of innovations, and improve the articulation of demand to spur innovation and the diffusion of innovations.[184] According to Edler and Georghiou (2007), four types of instruments can support the development of innovative activities from the demand side:

- Public authorities can intervene by shaping the regulatory framework to remove products and processes that no longer meet social and societal concerns from the market and induce firms to innovate, or to promote lead markets. They can do so through revising standards or by adopting measures in areas subject to regulation, such as environment, radio-waves, competition, or consumer protection.[185]
- The public sector can influence market structure and create incentives in areas where it is an important customer, through a strategic use of public procurement. A successful example of this has been found in the health systems of Nordic countries, where health authorities and 'superhospitals' became important customers of healthcare innovation.[186] Another way of funding innovation in products and services is represented by prizes, which are progressively gaining visibility in the debate on incentivising innovation.[187]
- Demand-side measures can be used as a tool for long-term signalling. By defining long-term perspectives on strategic priorities and the procurement intentions of public authorities, they can underpin market expectations on future demand for certain goods.[188] Ultimately, rising expectations about future public demand for new technologies increases the incentives for investments in innovation by enlarging payoffs to successful innovations.[189]
- Government can intervene at the spatial or systemic level, by promoting lead markets, offering technology platforms for cooperation and intervening at the level of the supply chain. These

[183] Von Hippel, E. (1976). 'The dominant role of users in the scientific instrument innovation process', Research Policy 5: 212–239.

[184] Edler, J. (2009).

[185] Edquist, C. (2001). 'Innovation policy–a systemic approach', in The Globalizing Learning Economy. Oxford: Oxford University Press, 219–237.

[186] Edler, J. and Georghiou, L. (2007). 'Public procurement and innovation—Resurrecting the demand side', Research Policy 36(7): 949–963.

[187] McKinsey & Company (2009). And the Winner is… Capturing the promise of philanthropic prizes. McKinsey & Company Report.

[188] Simonsen, G. and Rolfstam, M. (2013). Public Procurement of healthcare innovation in the ScanBalt area. ScanBalt HealthPort Report.

[189] Tsipouri, L., Georghiou, L. and Lilischkis, S. (2013). Report on the 2013 ERAC Mutual Learning Seminar on Research and Innovation Policies. http://www.consilium.eu.int/media/1937941/20130321-report-research.pdf

> interventions may also include insuring procurement, and actions that optimise transparency and flow of information between buyers and suppliers.[190]

In this section, we will concentrate on two examples of creating incentives for innovation that have recently gained increasing attention in policy debates about successful innovation policies: public sector procurement and innovation prizes.

5.3.1. Public sector procurement

Public authorities in the EU spend around 15–20 per cent of total GDP annually on public procurement (approximately 11 per cent of GDP in Norway) therefore they represent a key source of demand.[191] As governments in developed countries spend a significant portion (29 per cent across the OECD and 26.5 per cent in Norway) of their total resources this way, procurement is an important tool for pursuing strategic policy priorities.[192] In some markets, such as transportation, education and health, government is a particularly important customer with the power to steer markets.[193]

Public procurement has gained visibility as a strategic tool for addressing societal and socio-economic challenges. The 2006 report *Creating an Innovative Europe,* by the Aho group, identified that demand-side initiatives and procurement were important initiatives for supporting innovation.[194] At the same time, strategic procurement has also emerged as a way of addressing the perceived under-investment by businesses in R&D, and as such is promoted by European policy initiatives.[195] In particular, an expert group of the European Commission (2005) pointed to fragmentation in procurement demand between and within public authorities, a lack of early engagement with suppliers, and difficult-to-understand intellectual property regimes as hampering the realisation of these objectives.[196] The Glover Committee's 2008 report for the UK Treasury led to the formulation of an all-government approach to Small and Medium Enterprise (SME) involvement in procurement for innovation. It advocated higher transparency, simplicity and the adoption of a strategic approach to procurement by ministries.[197]

---

[190] Edler and Georghiou (2007).

[191] Timmermans, B. and Zabala-Iturriagagoitia, J. M. (2013). Coordinated unbundling: A way to stimulate entrepreneurship through public procurement for innovation. Science and Public Policy 40(5): 674–685.

[192] OECD (Organisation for Economic Cooperation and Development) (2013). Government at a Glance 2013. OECD Publishing. Data for 2011

[193] Edler and Georghiou (2007).

[194] Aho, E., Cornu, J., Georghiou, L. and Subira, A. (2006). 'Creating an innovative Europe', Report of the Independent Expert Group on R&D and Innovation (held in Brussels following the Hampton Court Summit and chaired by Esko Aho).

[195] Edler and Georghiou (2007).

[196] European Commission (2005). Expert Group Report 'Developing procurement practices favourable to R&D and innovation', European Commission, EUR 21793 EN.

[197] HM Treasury (2008) Report of the Glover Commission: Glover report http://webarchive.nationalarchives.gov.uk/+/http:/www.hm-treasury.gov.uk/d/pbr08_economicengine_2390.pdf

The current financial climate has intensified pressure on governments to innovate themselves and provide 'more for less'. Innovation in this context can also support governments in addressing the societal 'Grand Challenges', as outlined in the EU's Innovation Union flagship programme.[198] According to Timmermans and Zabala-Iturriagagoitia (2013), public procurement can address this lack of investment and the other challenges through the direct procurement of innovative goods and services, the public procurement of R&D, and by encouraging innovative approaches to procurement in the private sector.[199] Moreover, public demand for innovative solutions and products has the potential to improve delivery of public policy and services, often resulting in additional benefits from improved innovative processes and spillovers.[200]

Direct procurement of innovative goods and services can span the stages of market development and the technology life cycle of initiation, escalation and consolidation. In the initiation stage, the procurement initiative inserts itself in a context where there is not yet a market for the procured technology. It is also possible that the goods and services related to the procurement do not yet exist or require new features, and hence require research and innovation to realise the requirements.[201] In these cases, procurement may also be equivalent to creating a new market or to assuming a large portion of the risk involved in these investments. Learning and feedback from these early initiatives in turn benefits the innovators and reduces risks in subsequent phases of development.[202] Escalation refers to a scenario in which there is already a market in place for the procured technology, but it is in need of support and promotion for growth. For instance, the conditions established through framework contracts have a role in overcoming systemic failures in the marketplace. Finally, public procurement in the consolidation stage refers to procuring mature technologies from existing markets, potentially with the intention of further promoting leading areas at a regional or national level or bundling existing niche markets.[203]

The role of public procurement has also been a prominent feature of the debate around enhancing the competitiveness of SMEs. An example of this is the formulation of procurement policies in the support of SMEs that has been taken up by almost 70 per cent of OECD countries.[204] While SMEs can help drive the innovation agenda by creating competition and variety, they also benefit from the credibility offered by a government contract.

A highly influential approach to linking procurement policy to the objectives of promoting SME competitiveness and innovation is represented by the US Small Business Innovation Research (SBIR).

---

[198] European Commission (2010). Europe 2020 Flagship Initiative Innovation Union Communication No.6.

[199] Timmermans and Zabala-Iturriagagoitia (2013).

[200] Edler and Georghiou (2007).

[201] European Commission (2005).

[202] Edler and Georghiou (2007).

[203] Edler, J., Ruhland, S., Hafner, S., Rigby, J., Georghiou, L., Hommen, L., Papadakou, M., et al. (2005). Innovation and Public Procurement–Review of Issues at Stake. ISI Fraunhofer Institute Systems and Innovation Research, Karlsruhe.

[204] OECD (2013).

Established in 1982 and administered in a decentralised manner by government agencies, it aims to encourage small businesses to engage in Federal Research/ Research and Development. The programme requires agencies with a certain external R&D budget to set aside 2.5 per cent of their funds for SBIR funding. By the end of the 2009 financial year, over 112,500 awards had been made totalling more than $26.9 billion.[205] The SBIR operates as a public-private partnership, providing grants and contracts, through a competitive awards-based procurement programme, to fund private sector R&D projects that complement the results and support the commercialisation of federal research. The SBIR provides funding across three distinct phases:

- The objective of Phase I is to develop a proof of concept and a feasibility study of the proposed project, with funding of up to $150,000 total costs for six months.
- The bulk of the research effort takes place in Phase II. Funding is based on the results achieved in Phase I and the scientific and technical merit and commercial potential of the project proposed in Phase II, with up to $1m total costs for two years.
- The objective of Phase III is for the small business to pursue commercialisation through external funding. The SBIR programme does not fund Phase III.[206]

Empirical evidence has shown that the programme has been largely effective in pursuing these objectives, with approximately one in four projects resulting in the commercialisation of a product or a process.[207] Some of the success factors of the SBIR include its ability to encourage novel and high-risk research, and the positive impact on employment and sales growth in grant winners. The fact that SBIR grant applications are assessed through peer review and that the initiative places a strong emphasis on co-funding with other sources of venture capital were identified as additional success factors.[208] As a consequence, winning an SBIR grant serves as a certificate of competence for the firm,[209] hence the SBIR facilitates links with angel and venture capital investors and between academia and business. The size and breadth of the programme mean that a large number of companies have access to the funding, a third of whom are new to the programme each year. Finally, the programme is conceived in sufficiently flexible terms to meet the needs of the different agencies.[210] The success of the programme has inspired similar initiatives in Japan, the UK and the Netherlands. However, in some cases, such as the UK's SBIR

[205] SBA, SBIR overview: http://www.sbir.gov/about/about-sbir

[206] SBA, SBIR overview: http://sbir.gov/sites/default/files/sbir_sttr_program_overview_tips_for_applicants.pdf

[207] Link, A. N., and Scott, J. T. (2010). 'Government as entrepreneur: Evaluating the commercialization success of SBIR projects', Research Policy 39(5): 589–601.

[208] Tredgett, E. and Coad, A. (2013). The Shaky Start of the UK Small Business Research Initiative (SBRI) in Comparison to the US Small Business Innovation Research Programme (SBIR). SSRN January 2013.

[209] Lerner, J. (1996). The government as venture capitalist: The long-run effects of the SBIR program (No. w5753). National Bureau of Economic Research.

[210] National Research Council, US (2009). Committee for Capitalizing on Science, Technology, and Innovation: An Assessment of the Small Business Innovation Research Program, Policy and Global Affairs. Edited by Charles W Wessner. Washington D.C.: National Academies Press.

programme, the implementation encountered limited success in its initial phase, due to a lack of involvement of government agencies, a smaller scale of funding and because links to technical development were rare.[211]

Stern et al. (2011) found a significant initiative in procurement for innovation in services in the Finnish programme ran by the Finnish funding Agency for Technology and Innovation (Tekes). The objective is to improve market access for services developed by SMEs in particular and also to improve the productivity and effectiveness of public services. Its Smart procurement programme, with a budget of €60 million, focuses on sectors addressing society's major challenges, and where the public sector has a significant role in market development. These include energy and the environment, ICT, social and healthcare services, the built environment and security.[212] Public procurement units and public utilities can apply to the programme for funding for public procurement of innovations. In the first stage, where the planning of procurement takes place, the government funds between 25 per cent and 75 per cent of the project. In the second stage, where the procurement takes place, Tekes provides support for the procurer and for suppliers' R&D expenditures.

One of the flagship programmes of Tekes aims to renew health services by fostering innovation in the healthcare sector, through procurement and supporting growth and internationalisation of leading companies. Launched in 2008, the programme was revised in 2011. For the 2012–2015 phase, it has a total funding of approximately €100m, half of which comes from Tekes funding. The programme has a strong focus on new criteria for innovation procurement, beyond cost-effectiveness of solutions, and for implementing a prevention- and patient-oriented approach in all steps of policy implementation.[213]

The Nordic region is also home to a regional innovation procurement initiative. The Ministry of Trade and Industry in Norway owns the programme Innovation in the Health Sector through Public Procurement and Regulation. Tekes, together with the Swedish Governmental Agency for Innovation Systems (VINNOVA), the Danish Business Authority, Innovation Norway, Nordic Innovation and The Icelandic Centre for Research, have funded five projects for the period 2011–2013 with a total of NOK 10 million with the explicit goal of making the Nordic region a global frontrunner in the field of innovation procurement in the health sector.[214] This initiative stems from the acknowledged difficulty of establishing a culture of leveraging procurement as a tool to foster innovation.

However, several challenges have been identified in leveraging public procurement for innovation. Some of the risks associated with the SBIR programme include the risk of public funding crowding out private

---

[211] Connell, D. and Probert, J. (2010). Exploding the myths of UK innovation policy: How 'soft companies' and R&D contracts for customers drive the growth of the hi-tech economy. Cambridge: Centre for Business Research, University of Cambridge.

[212] Nordic Innovation: Public procurement and innovation within the Nordic health sector, available at: http://www.nordicinnovation.org/projects/public-procurement-and-innovation-within-the-nordic-health-sector/

[213] Kuusisto, J. (2012). Service Innovation Policy Benchmarking, EPISIS.

[214] Nordic Innovation: Public procurement and innovation within the Nordic health sector, available at: http://www.nordicinnovation.org/projects/public-procurement-and-innovation-within-the-nordic-health-sector/

funding, and not contributing to an overall increase in R&D or employment but simply transferring costs from the private to the public sector.[215] At the same time, the length of the application process and periods between awarding grants for the different phases of funding may put strains on small firms with limited monthly cash flow. The programme has also been found to be exposed to lobbying efforts by participating firms with links to officials, while a lack of evaluation of outcomes may hamper the assessment of the initiative's real economic impact. Finally, the structure of the funding, where no support is provided to firms for the commercialisation phase, has been criticised as leading to developing technologies only to a certain level. In fact, some agencies have implemented supplementary awards for the commercialisation phase.[216]

In other contexts, where innovation-focused procurement projects are less embedded, such as the 15 European country-level procurement systems reviewed by Edler et al.(2005), one of the most significant hurdles has been found to be a lack of experience and proactive attitude within the agencies that are involved, often accompanied by a risk-avoidance attitude towards choosing projects.[217] Indeed, government bodies often perceive the innovation funds that have to be set aside from their general budget as a 'tax' imposed on their resources.[218] While some of the activities of the Finnish Tekes in connecting the knowledge infrastructure with the private and public sectors (eg in promoting energy efficiency in buildings) have been evaluated positively, its mandate of promoting procurement innovation has also been found to be limited by a lack of clearly defined goals from the ministries that ultimately own the procurement processes.[219] Stern et al. (2011) emphasised that innovation in services presents additional challenges compared to innovation in technology, due to the fact that services (going beyond the concept of public services) are less prioritised in policy planning than R&D or prototype development. Timmermans and Zabala-Iturriagagoitia (2013) emphasise the potential of unbundling contracts into smaller elements that make participation accessible for SMEs in order to enable a wider reach of procurement initiatives.

Finally, Simonsen and Rolfstam (2013) suggest that a lack of skills, qualifications and appropriate professional education among the personnel employed to manage and lead innovation-focused procurement initiatives may also limit the success of these programmes.

---

[215] Wallsten, S. J. (2000). 'The effects of government-industry R&D programs on private R&D: the case of the Small Business Innovation Research program', RAND Journal of Economics 31(1): 82–100.

[216] National Research Council (2008). An Assessment of the SBIR Program, http://www.ncbi.nlm.nih.gov/books/NBK23747/#a200168efddd00068

[217] Edler et al. (2005).

[218] Connell and Probert (2010).

[219] Van der Veen, G., Arnold, E. et al. (2012). Tekes evaluation, Ministry of Economy and Innovation, Finland. https://www.tem.fi/files/33176/TEMjul_22_2012_web.pdf Accessed 24 February 2014.

5.3.2. Inducement Prizes

While forms of competition, in particular inducement prizes granting monetary awards to inventors, have been used for centuries to stimulate innovative solutions to problems, they have only recently regained visibility in the public policy debate surrounding incentives for innovation in procurement.[220] For instance, prizes have been incorporated at the international level, the European Union's Horizon2020 flagship initiative,[221] and the national level, UK Department of Health[222] and Department for International Development. [223]

Inducement prizes are emerging as a potential tool for pursuing innovation policy objectives as they offer a new system of incentives, being less likely to under-incentivise than some other forms of innovation policy (such as grants and programme investments), where competition is limited by design. The value of inducement prizes has increased significantly in the past 20 years, both in number and value.[224] Prizes are organised as competitions with rules regarding achieving pre-specified challenges or targets before a deadline and the means through which competitors can collaborate and compete. The prize challenge originates with the prize sponsor (in this case a government body), who generally offers a fixed monetary reward to the first entrant to achieve it, or to the solution responding in the best way to the specific criteria. The prize challenge links the competition with certain technological fields and/or market segments and represents a technological gap that has to be closed by the competitors.

Some recent examples of inducement prizes being included in the policy framework can be found in the work of the UK's Centre for Challenge Prizes, established in 2012 and situated within NESTA, a UK innovation charity. It serves as a platform to gather prize challenges, such as the Open Data Challenge Series, funded by the Department for Business and Innovation and the Technology Strategy Board. This initiative consist of seven prizes of £40,000 each over two years, connected to a challenge related to open data in connection to eg Crime and Justice, Education, and Energy and the Environment.[225] In the private sector, large-scale competitions such as the $1m Netflix Prize, aimed at improving the Netflix, Inc. online movies recommendation system, formed a problem-solving community of more than 34,000 developers worldwide.[226]

---

[220] Besharov, D. J. and Williams, H. (2012). 'Innovation Inducement Prizes: Connecting Research to Policy', Journal of Policy Analysis and Management 31(3): 752–776.

[221] Salmelin, B. (2013). 'The Horizon 2020 framework and Open Innovation Ecosystems', Journal of Innovation Management 1(2): 4–9.

[222] http://www.nhschallengeprizes.org/

[223] http://unsdn.org/?p=6488

[224] McKinsey & Company (2009). And the Winner is… Capturing the promise of philanthropic prizes. Mc Kinsey &Company Report.

[225] http://www.nesta.org.uk/project/open-data-challenge-series

[226] McKinsey & Company (2009). And the Winner is… Capturing the promise of philanthropic prizes. McKinsey & Company Report.

Prizes offer a set of advantages over other forms of incentives to innovation.[227] Firstly, they mobilise a wide range of talent. Recent prizes have been built on a model of open innovation and crowd sourcing, enabling individuals, organisations and actors to come together in ways that transcend national, market, social and disciplinary boundaries. These systems can be particularly appropriate in stimulating research into solutions related to grand challenges. Such challenges, by definition, often require fundamental breakthroughs, which rely on harnessing unusual stakeholders across unexpected bodies of expertise, often not reached by traditional policies such as patents and procurement.[228] Prize entrants are teams of diverse composition and may include companies, universities, entrepreneurs, or simply individuals who are incentivised by the challenge. This kind of open innovation allows government to harness the vast expanse of knowledge and creativity, but also emphasises and builds on the need to move beyond boundaries in order to address some of society's biggest challenges.[229]

Secondly, prizes are particularly efficient in leveraging funds. Prizes motivate participants to invest their own resources to solve a problem. Inducement prizes, in particular, are performance-based and awarded once a viable solution is identified. When these prizes are designed well, they can produce value and investment that is exponentially greater than the cash rewards that they offer, which aligns well with the increasing pressure on public authorities to do 'more with less'. By involving a wide range of stakeholders, they also spread the burden of financing the incentive to innovate over a broader range of people.

Thirdly, prizes can also influence and increase the speed of diffusion of innovations. The results of prize competitions can garner public attention and influence key decision makers. As an outcome, the newly discovered information can be made widely available at very little social cost.

On the downside, prizes cannot guarantee that entrants with the best ideas are motivated to participate or, if that happens, that the best idea is selected or implemented at the minimum cost.[230] Neither can they guarantee that the winner of the prize will keep engaging with the problem and support the commercialisation of outcomes.[231]

Therefore, the design of prizes requires careful consideration of the market failures that originally led to the need for innovation, the size of the purse, and the requirements to arrive at truly socially desirable outcomes and targets.[232] Sponsors also need to reflect on the likely cost of delivering and whether the

---

[227] Wagner, E. B. (2011). 'Why Prize? The Surprising Resurgence of Prizes to Stimulate Innovation', Research-Technology Management 54(6): 32–36.

[228] Murray, F., Stern, S., Campbell, G. and MacCormack, A. (2012). Grand Innovation Prizes: A theoretical, normative, and empirical evaluation. Research Policy 41(10): 1779–1792.

[229] Kay, L. (2011). 'The effect of inducement prizes on innovation: evidence from the Ansari XPrize and the Northrop Grumman Lunar Lander Challenge', R&D Management 41: 360–377.

[230] Scotchmer, S. (2005). Innovation and Incentives. Cambridge, MA: MIT Press.

[231] Wei, M. (2007) 'Should Prizes Replace Patents? A Critique of the Medical Innovation Prize Act of 2005', Boston University Journal of Science and Technology Law 13: 25–45.

[232] Besharov, D. J. and Williams, H. (2012). 'Innovation Inducement Prizes: Connecting Research to Policy', Journal of Policy Analysis and Management 31(3): 752–776.

proposed incentives (cash and non-financial) are sufficient to drive participation. Lastly, the obstacles that may inhibit the desired outcome need to be assessed, to see if they can be adjusted to allow for more creative and responsive approaches without risking public safety and long-term feasibility.[233]

5.4. Issues and Ideas

Traditionally Norway granted R&D subsidies as direct grants to firms, primarily as 'matching grants' whereby firms finance 50 per cent of the project they apply for. However, in 2002 Norway introduced a tax credit scheme called SkatteFUNN as part of a series of measures to stimulate R&D investment in the country, at least in part due to the problems associated with direct government R&D grants. This review has highlighted the problems with evaluating R&D tax credits. However, the Norwegian literature shows that it is aware of all of these problems and Statistics Norway (SSB) has undertaken sophisticated evaluations of the SkatteFUNN scheme. In 2007, Statistics Norway found that the scheme was generally positive, in that firms that previously did not invest in R&D were more likely to do so under the scheme. However, it also identified that this finding was likely to be driven by firms that did little or no R&D before the scheme, that this effect is strongest in small, low-tech and relatively low-skilled firms, and that the scheme had not had a strong impact on R&D cooperation with universities, colleges and research institutes. Moreover, self-reported additionality estimations were found to be consistent with econometric results. This suggests that the scheme is working reasonably well, although data for aggregate R&D investments in Norway suggest that the scheme is not achieving government targets.

Given the small size of the private sector in Norway, the notion of constraining concentration to two areas may be the most optimal solution in terms of generating innovation and growth. This may particularly be the case given that there are numerous barriers to the success of a science park.

The review highlighted that there are considerable constraints in establishing new clusters, and if impacts do occur they are likely to do so over a long time period, thus it is unrealistic to expect immediate gains. It is also essential to understand that to attract the private sector from abroad, there must be local skills and capacity for them to tap into. Therefore, a cohort of personnel in Norway with skills in the health research and innovation sector would be needed for a new, focused science park to work.

While supply-side incentives have traditionally formed the basis of innovation policy in Europe, demand-side measures may offer an alternative solution to stimulating innovation. Demand-side policies have the potential to encourage investment in technologies by enlarging markets for them. In addition, demand-side policies can stimulate health innovation as they are typically policies addressing social and societal concerns where the government is a central research user or needs to regulate markets.[234]

There may be an opportunity for Norway to create an initiative similar to the Small Business Innovation Research (SBIR) to encourage the private sector to engage in national health R&D. Mechanisms such as

[233] Wagner, E. B. (2011). 'Why Prize? The Surprising Resurgence of Prizes to Stimulate Innovation', Research-Technology Management 54(6): 32–36.

[234] Tsipouri, L., Georghiou, L. and Lilischkis, S. (2013). Report on the 2013 ERAC Mutual Learning Seminar on Research and Innovation Policies. http://www.consilium.eu.int/media/1937941/20130321-report-research.pdf

'Innovation Norway', which supports Norwegian companies in developing comparative advantages and enhancing innovation,[235] may be a useful vehicle for establishing a procurement initiative to incentivise health innovation.

Prizes are becoming an increasingly significant component of demand-side measures for innovation policy as they can stimulate innovation through granting monetary awards to inventors. Prizes are also less likely to under-incentivise than some other forms of innovation policy, such as grants and programme investments where competition is limited by design.[236] Prizes could be used as a mechanism to incentivise health R&D in Norway, either through strengthening existing incentives or by creating new incentives that appeal to a broader range of stakeholders.[237] This could be important given the differing interests of researchers in university/college, hospital and municipality sectors. However, in implementing a prize mechanism to stimulate health R&D, designing the prize requires careful consideration. In addition to a good understanding of who will be incentivised, attention must be paid to the timing and value of the prize.

Issues	Ideas
• R&D tax credits are hard to evaluate • SkatteFUNN is generally working but: ➢ has not provided as much additional innovation activity as the government aimed for ➢ is likely to be driven by small, low-tech and relatively low-skilled firms • Demand-side incentives are under-used in public policy	• Consider supporting science and technology park(s) that are focused on the health sector, although: ➢ as the private sector is small in Norway it may be optimal to constrain concentration to the two existing science parks ➢ there would need to be an existing cluster of personnel and skills for a health focused science park to tap into • Explore the development of an SBIR-like initiative through Innovation Norway • Considering using prizes as a mechanism to incentivise Norway's health R&D ➢ either to strengthen current incentives or create new incentives ➢ prize design is crucial to its success

[235] http://innovasjonnorge.no/no/contact-us/

[236] Brutscher, P. B., Cave, J. A. and Grant, J. (2009). Innovation Procurement: Part of the Solution, Cambridge, UK: RAND Europe.

[237] Ling, T. (2011). 'A Prize Worth Paying? Non-standard ways to support and reward excellence in health research and development in the UK NHS', Santa Monica, CA: RAND Corporation. http://www.rand.org/pubs/occasional_papers/OP338.

6. Conclusion

Table 6.1 below presents a summary of the issues and ideas presented in this report for each review area. These ideas are then drawn together in Figure 6.1, which presents an indicative model of the Norwegian Health and Care research system emerging from this review. This figure and the accompanying description also brings together some of the key ideas around capacity building, which as discussed in the previous chapters, cuts across the four other themes explored in this report.

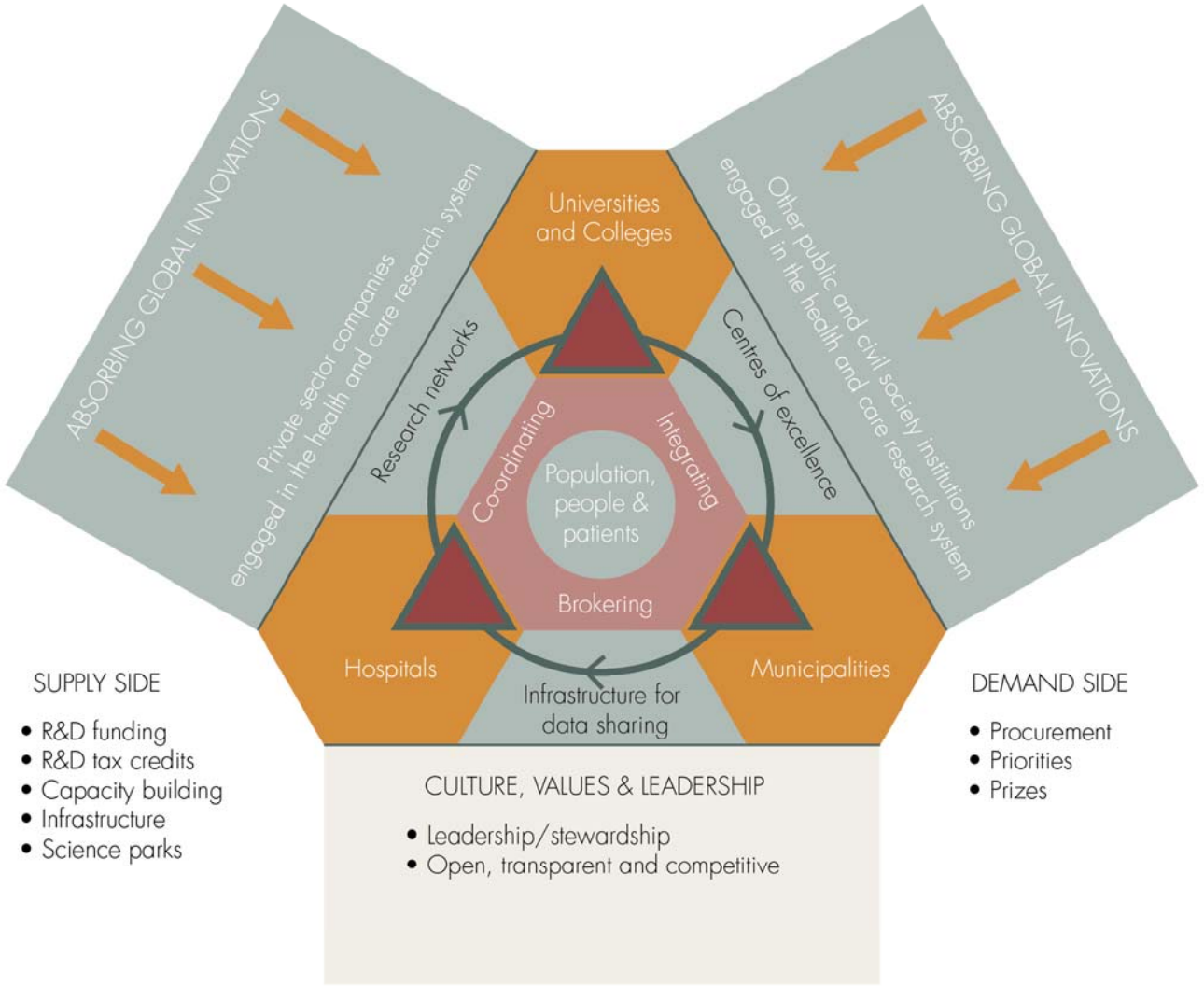
Table 6.1: Summary of issues and ideas

Networks and collaboration	
Issues	**Ideas**
• Engagement of stakeholders is crucial • GP engagement is low internationally • Trade-off between Primary Care Research Networks and Centres of Excellence	• Consider establishing a central coordinating function to help integrate health research agendas across ministries and other stakeholders • Consider establishing Primary Care Research Networks as a mechanism to engage municipalities in research
Data linkage and exchange	
Issues	**Ideas**
• Primary health registers: o Functionality o Accuracy o Validity o Completeness of data o Ambiguous coding o Transparency • National EHR system: o Adaptability o Interoperability o Timelines in implementation	• Aim to position Norway as a unique global resource for research through the linkage of diverse data sources, such as EHR and registries, across all health providers

• Relationship building at all levels (particularly given fragmentation of municipalities)	
Culture, values and leadership	
Issues	**Ideas**
• Research culture and leadership development often forgotten in science policy • Different needs for hospitals, municipalities and universities	• Consider develop a high quality leadership programme that will enhance the stewardship of the health research system
Supply and demand side policy instruments	
Issues	**Ideas**
• R&D tax credits are hard to evaluate • SkatteFUNN is generally working but: ➢ has not provided as much additional innovation activity as the government aimed for ➢ is likely to be driven by small, low-tech and relatively low-skilled firms • Demand-side incentives are under-used in public policy	• Consider supporting science and technology park(s) that are focused on the health sector, although: ➢ as the private sector is small in Norway it may be optimal to constrain concentration to the two existing science parks ➢ there would need to be an existing cluster of personnel and skills for a health focused science park to tap into • Explore the development of an SBIR like initiative through Innovation Norway • Considering using prizes as a mechanism to incentivise Norway's health R&D ➢ either to strengthen current incentives or create new incentives ➢ prize design is crucial to its success

Figure 6.1 below suggests an indicative view of the Norwegian Health Research System. It should be stressed that it focuses on the ideas and suggestions captured in this report and that there are inevitably other elements and interventions (such as user engagement, monitoring and evaluation) that are not included but should subsequently be integrated. The purpose of presenting this figure is twofold: first to emphasise the need to conceptualise a new health research strategy as a system, with many different stakeholders connected through a complex set of relationships with at times different incentives and missions; and secondly, to illustrate the benefit of representing the system in a single figure both in terms of communicating a new strategy and also to test its coherence. No one part of the system can operate in isolation.

Figure 6.1 Norwegian Health Research System



At the centre of the figure are population, people and patients. The primary objective of any health research system should be to improve the health of the general public and the health outcomes of patients through research. The public sector institutions that are responsible for delivering this objective are hospitals, universities and colleges, and municipalities (orange hexagons). However, the mission of each of these institutions is not exclusively research. For example, the mission of a hospital will be to provide high-quality healthcare; universities and colleges to train and develop students; and municipalities to provide a range of local services. In addition each institution has a different master: the hospitals report to the Ministry of Health and Care Services, the universities and colleges to the Ministry of Education and Research, and the municipalities the Ministry of Local Government and Modernisation. At the same time the institutions are united by a common purpose to support health research (this is captured by the red triangles within the orange hexagons) and thus are key stakeholders in the health research system. At the risk of over-simplification, the universities will tend to support basic research, the hospitals clinical research, and the municipalities primary care and public health research.

Given these inherent complexities of different missions, multiple objectives and different masters, a key idea for the Norwegian Health Research System would be to establish a 'co-ordinating, integrating and broker function' – the light red space at the centre of the figure. As discussed in Section 2.1.4 the aim would be to convene the leadership of all the stakeholders engaged in the health research system, thereby taking on its strategic ownership. To ensure that this co-ordinating, integrating and broker function is embedded in the system, three key areas of intervention are identified: the first is to establish primary care research networks, including CLAHRC-like functions, linking research activities in hospitals, universities and colleges, and municipalities (Section 2.2.1); the second is to develop Centres of Excellence around different priority areas with a clear focus on delivering high quality patient-oriented research (Section 2.2.2); the third is to establish data linkage and exchange activities across the health research system, providing a unique research (and care) resource, differentiating Norway in a global health research market (Section 3.3). The three areas of activity are captured in the figure by the circular arrow connecting the three institutions.

At the bottom of the figure is the key influence of culture, values and leadership on the health research system. As discussed in Chapter 4, given the complexity of the system and the competing objectives and incentives, it is important to actively shape the behaviours and norms at play within the system. This can be done through articulating, implementing and monitoring key values (such as openness, competitiveness etc.) and through leadership training to develop a cohort of researchers and health managers who are co-owners or stewards of the system (see Section 4.1).

In addition to the relatively novel idea of leadership training as a science policy intervention, more traditional policies are also required. For example, on the bottom left of the figure are a series of supply side instruments (Section 5.2) that include R&D funding for the public and private sector (through R&D tax credits), capacity building and the provision of infrastructure (including science parks). On the bottom right of the figure are a set of demand-side instruments (Section 5.3) that include the use of public procurement to stimulate innovation, prizes and priority setting.

Crucially, and as depicted in the top half of the figure, the health research system is part of a wider research and social system at a local, national and global level. The private sector undertakes research and

needs to be integrated through active participation in the co-ordinating, integrating and broker function at the centre of the figure. The private sector can also be incentivised through various instruments (such as R&D tax credits, innovation procurement and prizes). Similarly there are other public and third sector institutions which have an active stake in the health research system and should be part of the community of stewards helping to shape, own and implement the system.

At the global level, it is essential that the Norwegian Health Research System is set up to scan, contextualise, localise and implement relevant ideas that are generated from outside Norway. That absorptive capacity should arise as a natural by-product of having a coherent, functioning, high quality health research system, but should not be lost as one of the system's key aims.

Finally, it is important to know whether intended outcomes are being realised, particularly in an integrated system built around various interdependencies which may reinforce one another, but also might generate competing incentives or unintended consequences. In the same way that science aims to understand the world around us, the 'science of science' aims to understand how science works.[238] In exploring how to improve the effectiveness and efficiency of health and care research, we need to understand what we mean by research success, how we can measure it and what the factors are that contribute to it – for example, by continually asking what kind of science, what kind of scientists, what kind of setting and what kind of funding mechanism are most successful in promoting the translation of research from bench to bedside and the realisation of a strategy's goals. An important part of building this evidence base is the evaluation of policy changes and initiatives, but as noted at various points throughout this report, there is often a lack of rigorous evidence on what works and it can be unclear how a particular policy or practice will translate into different contexts. As such, ongoing assessments of impact are needed both to monitor progress towards objectives, and to add to the national and international evidence base on promoting effective and efficient health and care research.

[238] Grant, J. and Wooding, S. (2010). In search of the Holy Grail: Understanding research success. Cambridge, UK: RAND Europe.

References

Aalborg Universitet (2014). http://vbn.aau.dk/da/projects/ledelseskommunikation(cf3c9581-7e73-4fab-a1b9-cb645c6ef49d).html Accessed 19/02/2014.

The Academy of Medical Sciences (2013). 'Realising the Potential of Stratified Medicine', London: The Academic of Medical Sciences. http://www.acmedsci.ac.uk/index.php?pid=118&pressid=113 Accessed 19/02/2014.

Aho, E., Cornu, J., Georghiou, L. and Subira, A. (2006). 'Creating an innovative Europe', Report of the Independent Expert Group on R&D and Innovation (held in Brussels following the Hampton Court Summit and chaired by Esko Aho).

Aksnes, D., Benner, M., Borlaug, S. B., Hansen, H. F., Kallerud, E., Kristiansen, E., ... and Sivertsen, G. (2012). Centres of Excellence in the Nordic countries: A comparative study of research excellence policy and excellence centre schemes in Denmark, Finland, Norway and Sweden. NIFU.

Andersen, J. S., Olivarius, N. deF., Krasnik, A. (2011). 'The Danish National Health Service Register', Scandinavian Journal of Public Health 39(Suppl. 7): 34–37.

Apekey, T. A, McSorley, G., Tilling, G. and Siriwardena, A. N. (2011). 'Room for improvement? Leadership, innovation culture and uptake of quality management in general practice', Journal of Evaluation in Clinical Practice 17: 311–318.

Appold, S. J. (2004). 'Research parks and the location of industrial research laboratories: an analysis of the effectiveness of a policy intervention', Research Policy 33: 225–243.

Askew, D. A., Clavarino, A. M., Glasziou, P. P. and Del Mar, C. B. (2002). 'General practice research: attitudes and involvement of Queensland general practitioners', Medical Journal of Australia 177(2): 74–77.

Bakken, S., Lantigua, R. A., Busacca, L. V. and Bigger, J. T. (2009). 'Barriers, enablers, and incentives for research participation: a report from the Ambulatory Care Research Network (ACRN)', The Journal of the American Board of Family Medicine 22(4): 436–445.

Barlebo Rasmussen, (2014). Personal communication.

Besharov, D. J. and Williams, H. (2012). 'Innovation Inducement Prizes: Connecting Research to Policy', Journal of Policy Analysis and Management 31(3): 752–776.

Birtwhistle, R., Keshavjee, K., Lambert-Lanning, A., Godwin, M., Greiver, M., Manca, D. and Lagacé, C. (2009). 'Building a pan-Canadian primary care sentinel surveillance network: initial development and moving forward', The Journal of the American Board of Family Medicine 22(4): 412–422.

Bleeker, J. M., Stalman, W. A. and van der Horst, H. E. (2010). 'Evaluating primary care research networks: a review of currently available tools', The Journal of the American Board of Family Medicine, 23(4): 465–475.

Brutscher, P. B., Cave, J. A. and Grant, J. (2009). Innovation Procurement: Part of the Solution, Cambridge, UK: RAND Europe. http://www.rand.org/pubs/documented_briefings/DB580. Accessed 19/02/2014

Canadian Foundation for Healthcare Improvement (2014).

http://www.cfhi-fcass.ca/AboutUs.aspx Accessed 02/02/2014

Cappelen, A., Raknerud, A. and Rybalka, M. (2012). 'The effects of R&D tax credits on patenting and innovations', Research Policy 41:334–345.

Cheung-Judge, M. and Holbeche, L. Organization Development. (2011). A practitioner's guide for OD and HR, London: KoganPage.

Clement, S., Pickering, A., Rowlands, G., Thiru, K., Candy, B. and de Lusignan, S. (2000). 'Towards a conceptual framework for evaluating primary care research networks', The British Journal of General Practice 50(457): 651-652.

Cohen, W. M. and Levinthal, D. A. (1990). 'Absorptive capacity: a new perspective on learning and innovation', Administrative Science Quarterly 35(1): 128-152.

Connell, D. and Probert, J. (2010). Exploding the myths of UK innovation policy: How 'soft companies' and R&D contracts for customers drive the growth of the hi-tech economy. Cambridge: Centre for Business Research, University of Cambridge.

Cooksey, D. (2006). A review of UK health research funding. December 2006. London: HM Treasury.

Coorevits, P., Sundgren, M., Kelin, G. O., Bahr, A., Claerhout, B., Daniel, C., Dugas, M., Dupont, D., Schmidt, A., Singleton, P., De Moor, G. and Kalra, D. (2013). 'Electronic health records: new opportunities for clinical research', Journal of Internal Medicine 274: 547–560.

Creswell, K. M., Robertson, A., Sheikh, A. (2012). 'Lessons learned from England's national electronic health record implementation: implications for the international community.' Paper presented at the Proceedings of the 2nd ACM SIGHIT International Health Informatics Symposium, Miami.

Crosby, L. E., Parr, W., Smith, T. and Mitchell, M. J. 'The community leaders institute: an innovative program to train community leaders in health research', Academic Medicine, 88(3): 335–342.

Crozier, K., Moore, J. and Kite, K. (2012). 'Innovations and action research to develop research skills for nursing and midwifery practice: the Innovations in Nursing and Midwifery Practice Project study', Journal of Clinical Nursing 21(11-12): 1716–1725.

Czarnitzki, D., Hanel, P., Rosa, J. M. (2011). 'Evaluating the impact of R&D tax credits on innovation: A microeconometric study on Canadian firms', Research Policy 40: 217–229.

Davies, H. T., Nutley, S. M. and Mannion, R. (2000). 'Organisational culture and quality of health care', Quality in Health Care 9(2): 111–119.

Davis, J. H., Schoorman, F. D. and Donaldson, L. (1997). 'Toward a Stewardship theory of management', 22(1): 20–47.

DeHaven, M. J., Wilson, G. R. and O'Connor-Kettlestrings, P. (1998). 'Creating a research culture: what we can learn from residencies that are successful in research.' Family Medicine-Kansas City 30: 501–507.

Denis, J. L., Lomas, J. and Stipich, N. (2008). 'Creating receptor capacity for research in the health system: the Executive Training for Research Application (EXTRA) program in Canada', Journal of Health Services Research & Policy 13(Suppl. 1): 1–7.

Department of Health (2005). Best research for best health: a new national health research strategy. London: Department of Health.

Edler, J. (2009). Demand policies for innovation (No. 579). Manchester Business School Working Paper.

Edler, J. and Georghiou, L. (2007). 'Public procurement and innovation—Resurrecting the demand side', Research Policy 36(7): 949–963.

Edler, J., Georghiou, L., Blind, K. and Uyarra, E. (2012). 'Evaluating the demand side: New challenges for evaluation' Research Evaluation, 21(1): 33–47.

Edler, J., Ruhland, S., Hafner, S., Rigby, J., Georghiou, L., Hommen, L., Papadakou, M., et al. (2005). Innovation and Public Procurement–Review of Issues at Stake. ISI Fraunhofer Institute Systems and Innovation Research, Karlsruhe.

Edquist, C. (2001). 'Innovation policy–a systemic approach', in The Globalizing Learning Economy. Oxford: Oxford University Press, 219–237.

Electronic Health Records for Clinical Research: http://www.ehr4cr.eu/index.cfm Accessed 25th February 2014.

Ellen, M. E, Léon, G. Bouchard, G. Lavis, J. N., Ouimet, M. and Grimshaw, J. M. (2013). 'What supports do health system organizations have in place to facilitate evidence-informed decision-making? A qualitative study', Implementation Science 8(84). http://www.implementationscience.com/content/8/1/84. Accessed 19/02/2014

European Commission (2005). Expert Group Report 'Developing procurement practices favourable to R&D and innovation', European Commission, EUR 21793 EN.

European Commission (2010). Europe 2020 Flagship Initiative Innovation Union Communication No.6

Fisher, D., Atkinson-Grosjean, J. and House, D. (2001). 'Changes in academy/industry/state relations in Canada: The creation and development of the networks of centres of excellence', Minerva 39(3): 299–325.

Foresight, (2006). 'Infectious Diseases: Preparing for the Future – S3: State-of-Science Review – Intelligent Sensor Networks', London: Office of Science and Innovation.

Frenken, K., Van Oort, F. and Vergurg, T. (2007). 'Related variety, unrelated variety, and regional economic growth', Regional Studies 41(5): 685-697.

Fridholm, T., Melin, G., Arnold, E. (2012). 'Evaluation of the Research Council of Norway: Background report No 3. Ministry Steering of the Research Council of Norway', Technopolis Group.

Garcia-Quevedo, J. (2004). 'Do Public Subsidies Complement Business R&D? A meta-analysis of the Econometric Evidence', Kyklos 57: 87–102.

Gardner, F. and Nunan, C. (2007). 'How to develop a research culture in a human services organization', Qualitative Social Work 6: 335–351.

Golding, J., Greenwood, R., Birmingham, K., Mott, M. (1992). 'Childhood cancer, intramuscular vitamin K, and pethidine given during labour'. BMJ 305: 341–6.

Goodyear-Smith, F., York, D., Petousis-Harris, H., Turner, N., Copp, J., Kerse, N. and Grant, C. (2009). 'Recruitment of practices in primary care research: the long and the short of it', Family Practice 26(2): 128–136.

Goytia, C. N., Todaro-Rivera, L., Brenner, B., Shepard, P., Piedras, V. and Horowitz, C. (2013). 'Community capacity building: a collaborative approach to designing a training and education model', Progress in Community Health Partnership 7(3): 291–299.

Graham, I. D., Logan, J., Harrison, M. B., Straus, S. E., Tetroe, J., Caswell, W. and Robinson, N. (2006). 'Lost in knowledge translation: time for a map?', Journal of Continuing Education in the Health Professions 26(1): 13–24.

Grant, J. and Wooding, S. (2010). In search of the Holy Grail: Understanding research success. Cambridge, UK: RAND Europe. http://www.rand.org/pubs/occasional_papers/OP295. Accessed 19/02/2014.

Greenhalgh, T., Robert, G. Bate, P. and Macfarlane, F. (2005). Diffusion of Innovations in Health Service Organisations: A Systematic Literature Review. Oxford: Blackwell Publishing, 2005.

Grossman, R. and Salas, E. (2011). 'The transfer of training: what really matters', International Journal of Training and Development 15(2): 103–120.

HelseOmsorg21 (2014) Group report, Research quality and internationalisation. http://www.forskningsradet.no/prognett-helseomsorg21/Nyheter/Arbeidsgruppenes_delrapporter_er_na_tilgjengelige/1253992879080?WT.mc_id=nyhetsbrev-helseomsorg21

Hægeland, T. and Møen, J. (2007a). 'Input additionality in the Norwegian R&D tax credit scheme' Statistisk sentralbyrå, Reports 2007/47.

Hægeland, T. and Møen, J. (2007b). 'The relationship between the Norwegian R&D tax credit scheme and other innovation policy instruments' scheme' Statistisk sentralbyrå, Reports 2007/45.

Hall, B. H. (2002) 'The financing of research and development', Oxford Review of Economic Policy 18(1): 35–51.

Hall, B. and Van Reenan, J. (2000). 'How effective are fiscal incentives for R&D? A review of the evidence', Research Policy 29: 449–469

Heath, I., Evans, P. and van Weel, C. (2000). 'The specialist of the discipline of general practice: semantics and politics mustn't impede the progress of general practice', BMJ 320(7231): 326.

Hernandez, M. (2012). 'Towards an understanding of the psychology of stewardship', Academy of Management Review 37(2): 172–193.

Hines S., Luna, K., Lofthus J., et al. (2008). Becoming a High Reliability Organization: Operational Advice for Hospital Leaders. (Prepared by the Lewin Group under Contract No. 290-04-0011) AHRQ Publication No. 08-0022. Rockville, MD: Agency for Healthcare Research and Quality.

HM Treasury (2008) Report of the Glover Commission: Glover report http://webarchive.nationalarchives.gov.uk/+/http:/www.hm-treasury.gov.uk/d/pbr08_economicengine_2390.pdf

Hoerbst, A. and Ammenwerth, E. (2010). 'Electronic Health Records: A Systematic Review on Quality Requirements', Methods of Information in Medicine 49(4): 320–336.

Hommen, L., Doloreux, D. and Larsson, E. (2006). 'Emergence and Growth of Mjardevi Science Park in Linkoping, Sweden'. European Planning Studies 14(10): 1331–61.

HSR-Europe (2011). Health Services Research into European Policy and Practice. Final report of the HSREPP project. Utrecht: NIVEL. http://www.healthservicesresearch.eu/mediaFiles/upload/publications/HSR-Europe_2011_-_Final_report_-_Health_Services_Research_into_European_Policy_and_Practice_Policy.pdf

Hudelson, P. M., (2004). 'Culture and quality: an anthropological perspective', International Journal for Quality in Health Care 16(5): 345–346.

Hummers-Pradier, E., Scheidt-Nave, C., Martin, H., Heinemann, S., Kochen, M. M. and Himmel, W. (2008). 'Simply no time? Barriers to GPs' participation in primary health care research', Family Practice 25(2): 105–112.

Innovation Norway (2014). http://innovasjonnorge.no/no/contact-us/ Accessed 21/02/2014

Jung, D. I., Chow, C. and Wu, A. (2003). 'The role of transformational leadership in enhancing organizational innovation: Hypotheses and some preliminary findings', The Leadership Quarterly 14(4): 525–544.

Kamper-Jørgensen, F., Arber, S., Berkman, L., Mackenbach, J., Rosenstock, L. and Teperi, J. (2005). 'Part 3: International evaluation of Swedish public health research', Scandinavian Journal of Public Health 33(Suppl. 65): 46–84.

Katz, J. S. and Martin, B. R. (1997). 'What is research collaboration?' Research Policy 26(1): 1–18.

Kavanagh, K. E., O'Brien, N., Glynn, L. G., Vellinga, A. and Murphy, A. W. (2010). 'WestREN: a description of an Irish academic general practice research network', BMC Family Practice 11(1): 74.

Kay, L. (2011). 'The effect of inducement prizes on innovation: evidence from the Ansari XPrize and the Northrop Grumman Lunar Lander Challenge', R&D Management 41: 360–377.

Klofsten, M., Jones-Evans, D. and Schärberg, C. (1999). 'Growing the Linkoping Technopole—a longitudinal study of triple helix development', Sweden, Journal of Technology Transfer 24: 125–138.

Kraut, R., Egido, C. and Galegher, J. (1988). Patterns of contact and communication in scientific research collaboration. Proceedings of the 1988 ACM conference on Computer-supported cooperative work, 1–12.

Kush, R. D., Helton, E., Rockhold, F. W., Hardison, D. (2008). 'Electronic Health Records, Medical Research, and the Tower of Babel', The New England Journal of Medicine 358(16): 1738–1740.

Kuusisto, J. (2012). Service Innovation Policy Benchmarking, EPISIS.

Lane, P. and Lubatkin, M. (1998). 'Relative absorptive capacity and interorganizational learning', Strategic Management Journal 19: 461–77.

Lavis, J. N., Lomas, J., Hamid, M. and Sewankambo, N. K. (2006). 'Assessing country-level efforts to link research to action', Bulletin of the World Health Organization 84(8): 620–628.

Le Grand, J., Mays, N. and Mulligan, J. (1998). Learning from the NHS Internal Market. London: King's Fund.

Leavy, B. (2005). 'A leader's guide to creating an innovation culture', Strategy and Leadership 33(4): 38–45.

Lee, S. and Bozeman, B. (2005). 'The impact of research collaboration on scientific productivity', Social Studies of Science 35(5): 673–702.

Lerner, J. (1996). The government as venture capitalist: The long-run effects of the SBIR program (No. w5753). National Bureau of Economic Research.

Lichtenthaler, U. and E. Lichtenthaler (2010). 'Technology transfer across organizational boundaries: absorptive capacity and desorptive capacity', California Management Review 53(1): 154–170.

Ling, T. (2011). 'A Prize Worth Paying? Non-standard ways to support and reward excellence in health research and development in the UK NHS', Santa Monica, CA: RAND Corporation. http://www.rand.org/pubs/occasional_papers/OP338

Ling, T., Soper, B., Marjanovic, S., Celia, C., Yaqub, O., Reding, A. and Hanney, S. (2011). Delivering the aims of the CLAHRCs: evaluating CLAHRCs' strategies and contributions. Cambridge, UK: RAND Europe. http://www.rand.org/pubs/working_papers/WR820.

Link, A. N. and Scott, J. T. (2010). 'Government as entrepreneur: Evaluating the commercialization success of SBIR projects', Research Policy 39(5): 589–601.

Link, A. N. and Link, K. R. (2003). 'On the growth of US science parks', Journal of Technology Transfer 28(1): 81–85.

Lionis, C., Stoffers, H. E. J. H., Hummers-Pradier, E., Griffiths, F., Rotar-Pavlič, D. and Rethans, J. J. (2004). 'Setting priorities and identifying barriers for general practice research in Europe. Results from an EGPRW meeting', Family Practice 21(5): 587–593.

Löfsten, H. and Lindelöf, P. (2001) 'Science parks in Sweden – industrial renewal and development?' R&D Management 31: 309–322.

Lomas, J. (2000). 'Using "linkage and exchange" to move research into policy at a Canadian foundation', Health Affairs (Project Hope) 19(3): 236–240.

Mant, D. (1997). R&D in primary care: national working group report. Westminster, UK: Department of Health.

Mason, V. L., Shaw, A., Wiles, N. J., Mulligan, J., Peters, T. J., Sharp, D. and Lewis, G. (2007). 'GPs' experiences of primary care mental health research: a qualitative study of the barriers to recruitment', Family Practice 24(5): 518–525.

Massey, D., Quintas, P and Wield, D. (1992). High-tech Fantasies. London: Routledge.

Mazzucato, M. (2013). The Entrepreneurial State: Debunking Public vs Private Sector Myths. London: Anthem Press.

McEwen, J., Boyer, J. T. and Sun, K. Y. (2013). 'Evolving Approaches to the Ethical Management of Genomic Data', Trends in Genetics 29(6): 375–82.

McKinsey & Company (2009). And the Winner is… Capturing the promise of philanthropic prizes. McKinsey & Company Report.

Miller, R. and Cote, M. (1987). Growing the Next Silicon Valley: A Guide for Successful Regional Planning. Lexington: Lexington Books.

Morgan Jones, M., Wamae, W., Fry, C., Kennie, T. and Chataway, J. (2012). The National Institute for Health Research Leadership Programme. An evaluation of programme progress and delivery. Cambridge, UK: RAND Europe.

Morgan Jones, M., Hall, A., Brooker, D., Castle-Clarke, S., Winpenny, E., Jahagirdar, D., Exley, J. and Chataway, J. (2013). The future of public health: A horizon scan. Cambridge, UK: RAND Europe.

Morris, Z. S., Wooding, S. and Grant, J. (2011). 'The answer is 17 years, what is the question: understanding time lags in translational research', Journal of the Royal Society of Medicine 104(12): 510–520.

Murray, F., Stern, S., Campbell, G. and MacCormack, A. (2012). Grand Innovation Prizes: A theoretical, normative, and empirical evaluation. Research Policy 41(10): 1779–1792.

National Institute for Health Research (2014):

http://www.nihr.ac.uk/infrastructure/Pages/CLAHRCs.aspx Accessed 02/02/2014

National Research Council (2008). An Assessment of the SBIR Program, http://www.ncbi.nlm.nih.gov/books/NBK23747/#a200168efddd00068

National Research Council, US (2009). Committee for Capitalizing on Science, Technology, and Innovation: An Assessment of the Small Business Innovation Research Program, Policy and Global Affairs. Edited by Charles W Wessner. Washington D.C.: National Academies Press.

Nelson, R., ed. (1993). National Innovation Systems. A Comparative Analysis. New York and Oxford: Oxford University Press.

NESTA (2014). http://www.nesta.org.uk/project/open-data-challenge-series Accessed 24/02/2014

Nordforsk (2014) 'Sharing data among the Nordic countries': http://www.nordforsk.org/en/news/sharing-data-among-the-nordic-countries?set_language=en Accessed 25/02/2014].

Nordic Innovation: Public procurement and innovation within the Nordic health sector, available at: http://www.nordicinnovation.org/projects/public-procurement-and-innovation-within-the-nordic-health-sector/

Nordic Life Science News (2014). http://nordiclifescience.org/blog/helsemyggordning-a-new-financial-instrument-to-stimulate-health-innovation/ Accessed 19/02/2014

O'Reilly, T., Loukides, M., Steele, J. and Hill, C. (2012). How data science is transforming health care. O'Reilly Media, Inc.

OECD (Organisation for Economic Cooperation and Development) (2013). Government at a Glance 2013. OECD Publishing.

Olivarius N. deF., Hollnagel H., Krasnik A., Pedersen P. A., Thorsen H. (1997). The Danish National Health Service Register. Danish Medical Bulletin 44: 449–53.

Orr, D., Jeager, M. and Wespel, J. (2011). New Forms for Public Research: A Concept Paper on Research Excellence Initiatives. Paris: OECD.

Øvretveit, J. and Klazinga, N. (2013). Linking research to practice: The organisation and implementation of The Netherlands health and social care improvement programmes. Health Policy 109(2): 175–186.

Pace, W. D., Staton, E. W. and Holcomb, S. (2005). 'Practice-based research network studies in the age of HIPAA', The Annals of Family Medicine 3(Suppl 1): S38–S45.

Powell, J. (2005). 'Electronic Health Records Should Support Clinical Research', Journal of Medical Internet Research 7(1): e4.

Regjeringen (2014). ACT 2008-06-20 no. 44: Act on medical and health research (the Health Research Act) Available at: http://www.ub.uio.no/ujur/ulovdata/lov-20080620-044-eng.pdf Accessed 11 February 2014.

Rogers, E. M. and Larson, J. K. (1984). Silicon Valley Fever. New York: Basic Books.

Rosén, M. (2002). 'National Health Data Registers: a Nordic heritage to public health' Scandinavian Journal of Public Health 30: 81–85.

Rossi, S., Zoller, M. and Steurer, J. (2006). 'Research interest by general practitioners: a survey', Praxis 95(49): 1913–17.

Russell, S. C. and Spooner, S. A. (2004). Barriers to EMR adoption in internal medicine and pediatric outpatient practices. Tennessee Medicine 97: 457–460.

Salmelin, B. (2013). 'The Horizon 2020 framework and Open Innovation Ecosystems', Journal of Innovation Management 1(2): 4–9.

Salmon, P., Peters, S., Rogers, A., Gask, L., Clifford, R., Iredale, W. and Morriss, R. (2007). 'Peering through the barriers in GPs' explanations for declining to participate in research: the role of professional autonomy and the economy of time', Family Practice 24(3): 269–275.

SBA (Small Business Administration – US). SBIR Overview. http://www.sbir.gov/about/about-sbir Accessed 24/02/2014

Schwartz, R. W. and Pogge, C. (2000). 'Physician-leadership: Essential skills in a changing environment', American Journal of Surgery 180(3): 187-192.

Science Park Consultancy Scheme (1994). Core Specifications. SPRINT Programme, DGXIII. Luxembourg: European Commission.

Scotchmer, S. (2005). Innovation and Incentives. Cambridge, MA: MIT Press.

Scott, T., Mannion, R. Davies, H. and Marshall, M. (2003a). 'The Quantitative Measurement of Organizational Culture in Health Care: A Review of the Available Instruments', Health Services Research 38(3): 923–945.

Scott, T., Mannion, R., Davies, H. and Marshall, M. (2003b). 'Implementing culture change in health care: theory and practice', International Journal for Quality in Health Care, 15(2): 111–118.

Shaller, D. (2004). 'Implementing and using quality measures for children's health care: perspectives on the state of the practice', Pediatrics 113(Suppl. 1): 217–227.

Simonsen, G. and Rolfstam, M. (2013). Public Procurement of healthcare innovation in the ScanBalt area. ScanBalt HealthPort Report.

Smolinski, M. S., Hamburg, M.A. and Lederberg, J. (2006). Microbial Threats to Health: Emergence, Detection and Response. Washington D.C.: Institute of Medicine of the National Academies

Solomos, J., Hemminki, E., Hillmert, S., Knibbe, R. A., Siegrist, J. and Staudinger, U.M. (2011). FAS Centres of Excellence Mid-Term Evaluation, September 2011. http://ki-su-arc.se/wp-content/uploads/2012/06/2011-FAS-evaluation-of-ARC.pdf

Soos, M., Temple-Smith, M., Gunn, J., Johnston-Ata'Ata, K. and Pirotta, M (2010). Establishing the Victorian Primary Care Practice Based Research Network. Australian Family Physician 39:857–62.

Soper, B., Yaqub, O., Hinrichs, S., Marjanovich, S., Drabble, S., Hanney, S. and Nolte, E. (2013). 'CLAHRCs in practice: combined knowledge transfer and exchange strategies, cultural change, and experimentation', Journal of Health Services Research & Policy, 18(Suppl. 3), 53–64.

Spence, A. M. (1974). Market Signaling: Informational Transfer in Hiring and Related Screening Processes. Cambridge, MA: Harvard University Press.

Stenbeck, M., Jonsson, U., Heimisdottir, M., Melbye, M., Salokannel, M. and Stoltenberg, C. (2014). 'Sharing registry data for health research in the Nordic countries – a proposal for increased collaboration: Report from the Nordic Task Force for Access to national data repositories', NordForsk, N.D.

Subramanyam, K. (1983). 'Bibliometric studies of research collaboration: A review', Journal of Information Science 6(1): 33–38.

Tamkin, P., Pearson, G., Hirsh, W. and Constable, S. (2010). Exceeding Expectation: The principles of outstanding leadership, The Work Foundation. http://www.theworkfoundation.com/Reports/233/Exceeding-Expectation-The-principles-of-outstanding-leadership

Thomas, P., Griffiths, F., Kai, J. and O'Dwyer, A. (2001). Networks for research in primary health care. BMJ 322(7286): 588.

Thomas, V. (2011). '"Think Research" in Everyday Clinical Practice: Fostering Research Culture in Health Care Settings' Oman Medical Journal 26(2): 75–76.

Tierney, W. M., Oppenheimer, C. C., Hudson, B. L., Benz, J., Finn, A., Hickner, J. M., Gaylin, D. S. et al. (2007). 'A national survey of primary care practice-based research networks', The Annals of Family Medicine 5(3): 242–250.

Timmermans, B. and Zabala-Iturriagagoitia, J. M. (2013). Coordinated unbundling: A way to stimulate entrepreneurship through public procurement for innovation. Science and Public Policy 40(5): 674–685.

Tredgett, E. and Coad, A. (2013). The Shaky Start of the UK Small Business Research Initiative (SBRI) in Comparison to the US Small Business Innovation Research Programme (SBIR). SSRN January 2013.

Tsipouri, L., Georghiou, L. and Lilischkis, S. (2013). Report on the 2013 ERAC Mutual Learning Seminar on Research and Innovation Policies. http://www.consilium.eu.int/media/1937941/20130321-report-research.pdf

UK Clinical Research Collaboration (2014). http://www.ukcrc.org/index.aspx?o=1529 Accessed 02/02/2014

Umea University (2014). http://www.globalhealthresearch.net/ Accessed 02/02/2014

University of Cincinnati (2014). http://cctst.uc.edu/programs/community/cli Accessed 15/02/2014

Van der Veen, G., Arnold, E. et al. (2012). Tekes evaluation, Ministry of Economy and Innovation, Finland. https://www.tem.fi/files/33176/TEMjul_22_2012_web.pdf Accessed 24 February 2014.

Van Dyke, M. (2013). Systems Leadership for Children's Services in the USA. National Implementation Research Network.

Van Weel, C., de Grauw, W. (2006). 'Family practices registration networks contributed to primary care research', Journal of Clinical Epidemiology 59:779–83.

Vedovello, C. (1997). 'Science parks and university-industry interaction: Geographical proximity between the agents as a driving force', Technovation 17(9) 491–502.

Verhoef, M. J., Mulkins, A. Kania, A. Findlay-Reece, B. and Mior, S. (2010). 'Identifying the barriers to conducting outcomes research in integrative health care clinic settings – a qualitative study', BMC Health Services Research 10(14): http://www.biomedcentral.com/1472-6963/10/14 Accessed 16 February 2014.

Verma, J. Y., Rossiter, M., Kirvan, K., Denis, J. L., Samis, S., Phillips, K., O'Connor, P., et al. (2013). 'Going far together: Healthcare collaborations for innovation and improvement in Canada', International Journal of Healthcare Management 6(2): 66–76.

Vollset, S. E. and Cappelen, I. (2007). 'Registerepidemiologi', in Laake, P. et al., eds. Epidemiologiske og kliniske forskningsmetoder. Oslo: Gyldendal, 347–72.

Vollset, S. E. (2011). 'Health registries for research in Norway: examples and challenges', Seminar on register-based research in the Nordic countries – Helsinki 5 April 2011.

Von Hippel, E. (1976). 'The dominant role of users in the scientific instrument innovation process', Research Policy 5: 212–239.

Wagner, E. B. (2011). 'Why Prize? The Surprising Resurgence of Prizes to Stimulate Innovation', Research-Technology Management 54(6): 32–36.

Wallsten, S. J. (2000). 'The effects of government-industry R&D programs on private R&D: the case of the Small Business Innovation Research program', RAND Journal of Economics 31(1): 82–100.

Wehrens, R., Bekker, M. and Bal, R. (2012). 'Dutch Academic Collaborative Centres for Public Health: development through time issues, dilemmas and coping strategies.' Evidence & Policy: A Journal of Research, Debate and Practice 8(2): 149–170.

Wei, M. (2007) 'Should Prizes Replace Patents? A Critique of the Medical Innovation Prize Act of 2005', Boston University Journal of Science and Technology Law 13: 25–45.

Western Reseaerch and Education Network (2014). http://westren.nuigalway.ie/ Accessed 02/02/2014

Willison, D., Keshavjee, K., Nair, K., Goldsmith, C., Holbrook, A. M. (2003). 'Patients' consent preferences for research uses of information in electronic medical records: interview and survey data', BMJ 326:373.1

Winston, C. (2006). Government Failure Versus Market Failure: Microeconomics Policy Research and Government Performance. Washington, DC: AEI-Brookings Joint Centre for Regulatory Studies.

Wooding, S., Pollitt, A., Castle-Clarke, S., Cochrane, G., Diepeveen, S., Guthrie, S., Horvitz-Lennon, M., Larivière, V., Morgan Jones, M., Ni Chonaill, S., O'Brien, C., Olmsted, S., Schultz, D., Winpenny, E., Pincus, H. and Grant., J. (2013). Mental Health Retrosight: Understanding the returns from research (lessons from schizophrenia): Policy Report. Cambridge: RAND Europe. http://www.rand.org/pubs/research_reports/RR325

Yawn, B. (2002). 'What does it mean to build research capacity?', Family Medicine 34(9): 678–684.