1. FULL PROJECT TITLE

NHS managers' use of nursing workforce planning and deployment technologies: a realist synthesis of implementation and impact.

2. SUMMARY OF RESEARCH

Guidance highlights an important task for NHS managers in triangulating information from workforce planning and deployment technologies (e.g. the Safer Nursing Care Tool) with their 'local knowledge' of what is required to achieve better outcomes for their patients (Chief Nursing Officer for England & National Quality Board 2013). Examples of these workforce planning technologies (WPTs) include the Safer Nursing Care Tool, and many other strategies, frameworks and tools which seek to efficiently manage nursing workforce resources and care needs. However, the evidence base focuses predominantly on the development and predictive reliability of the WPTs. There is limited knowledge of what WPTs are effective in predicting workforce requirements at different levels of the NHS, and how they work to support safe patient care (RCN, 2010). How WPTs are used and interpreted may vary across different organisations; there may be other more subtle resources in the workforce that managers can identify to support the evaluation and deployment of nurse staffing with greatest impact on patient care.

This evidence synthesis will investigate the types of WPTs that are currently being employed within different NHS organisations, and identify and explain what particular features about workforce planning are more likely to promote high quality care for patients. The synthesis will fill a gap in the evidence-base by focusing on the implementation, use and impact of nursing WPTs. We are specifically interested in uncovering how and why WPTs may impact, and on whom, to guide the efficient and effective deployment of nursing workforce resources. As far as we aware, this would be the first evidence synthesis addressing this issue.

2.1. Synthesis question & aims

Synthesis question:
NHS Managers' use of workforce planning and deployment technologies and their impacts on nurse staffing and patient care: what works, for whom, how and in what circumstances?

Aim of the synthesis:
Our aim is to engage stakeholders to produce of an evidence-based, realist programme theory that explains the successful implementation and impact of nursing WPTs by NHS managers. The programme theory will complement the evidence-base about technology validity and reliability, and be able to guide the development of management training programmes to support on-going implementation.

Objectives:
1. To identify the different WPTs that could be used to deploy the nursing workforce resource in the NHS, paying attention to the ways in which they are assumed, and are observed to work.
2. To explore the range of observed impacts of these technologies in different healthcare settings, and for other public services, paying attention to contingent factors.
3. To investigate ways which can help NHS managers identify, deploy and evaluate the nursing workforce resource to have greatest impact on direct patient care.
4. To generate actionable recommendations for management practice and organisational strategy.
5. To contribute to the wider public debate about, and understanding of the nature of the nursing workforce, nursing work and the quality of patient care.

2.2. Approach

We will undertake a realist synthesis to address the review question and aims. As an experienced team in realist enquiry we are well placed to conduct this review. Realist enquiry is based on causal and contingent explanations that identify underlying attributes contributing to a particular outcome in a number of specific (but not identical) phenomena. As the implementation, use and impacts of nursing WPTs will be context dependent and complex, a realist synthesis will facilitate an understanding of how different approaches may work in different settings to result in particular impacts.

Our realist synthesis will be conducted in four phases over 18 months with embedded stakeholder engagement throughout:

Phase 1: Programme theory development

We will construct a theoretical framework, i.e. the review's programme theories, from the underpinning literature on the management of the nursing workforce in consultation with stakeholders, including managers, healthcare professionals and patients. The programme theories will provide an initial explanation of the complexity of using WPTs by bringing together different domains of the literature, including:

- The identification of patient needs and acuity
- The nature of nursing work
- Workforce planning strategies (supply vs. needs based)
- Contracting and rostering practices,
- Deployment, skill mix and nursing workload tools
- Human capital (e.g. knowledge and skills) and their positioning in organisations

The synthesis will draw on and meld different theoretical perspectives (e.g. Human Resource Management; Organisational Sociology; Organisational learning; Strategic Management; Implementation and Knowledge Mobilisation and Technology Adoption).

Phase 2: Retrieval, review and synthesis

Guided by the programme theories we will search for relevant research related to nursing WPTs. Initially, we will target evidence specific to a nursing context, and then expand our search to evidence from workforce research in related service fields that use similar approaches. The review process will involve screening for relevance, data extraction and charting to identify what appears to work, for whom, how and in what contexts.

Phase 3: Testing and refining programme theories

In addition to engaging with stakeholders throughout the synthesis process, we will use semi-structured interviews of various stakeholders including patients, managers, policy makers, practitioners and researchers to 'test out' our synthesis findings and refine the programme theories, and establish their practical relevance/potential.

Phase 4: Actionable recommendations and knowledge mobilisation

Using our synthesis findings, we will recommend a series of improvements to the resources and support available to NHS managers in this aspect of their work. These will likely involve the following issues:

- Frameworks and tools which support the integration of quantitative and qualitative data on workforce resource availability for more effective workforce deployment.
- Frameworks that make the real-time triangulation of different data, and learning about professional judgements more transparent and effective.
- ‘How to’ guide which address common challenges in the implementation of WPTs in management practice.
- Understanding the cognitive, attitudinal and instrumental impacts of WPTs.
- Guiding the development of new context-specific and comprehensive WPTs which address impacts and outcomes for the workforce, patients, organisations and policy.

We will work with relevant stakeholders to tailor our synthesis and its outputs towards managers (in the NHS and beyond), patients, educators, nurses and their colleagues so they can be used to improve existing management practice.

2.3. Benefits to the NHS

This synthesis will address gaps in knowledge about nursing WPTs to ensure that nurse staffing is both responsive to local needs and patterns of work, and focused on quality of nursing input that match the patient's needs at given times, as opposed to focusing 'just' on ratios/numbers. As a realist synthesis, particular attention will be paid to the implementation of WPTs in different NHS organisations across the UK, and in the explanation of how particular features of these are more likely to promote high quality care for patients. Through development of programme theory, synthesis findings will support the effective implementation of existing and new nursing WPTs to improve nursing-related patient safety. The synthesis findings will bring evidence and theory together to show how NHS managers can obtain maximum impact from the implementation of WPTs. The review's findings will also identify and explain what particular features about workforce planning approaches are more likely to promote high quality care for patients. This will be achieved in the generation of a causal chain of evidence that spans the selection of specific workforce tools and approaches; their implementation and use; and their role in ensuring critical patient safety outcomes. The team is ideally placed to carry out this work being experts in realist synthesis, health policy, nursing and healthcare, nursing management, human resource management, implementation / service improvement, practice development, education/learning, and patient and public involvement. The research team will be steered by a Project Advisory Group chaired by Professor Jean White, Chief Nursing Officer for Wales, and advised by stakeholders, including patient and public involvement to maximise political and practical relevance and impact of the synthesis.

3. BACKGROUND AND RATIONALE

NHS organisations have a responsibility to ensure that nurse staffing is sufficient for the provision of safe and high quality care for patients (National Quality Board, 2014). Similarly, NHS managers are required to effectively deploy the nursing resource to ensure safe, high quality care. Little attention has been paid to the implementation and use of nursing WPTs by NHS managers and others, or investigated their impacts which may be context specific. Workforce planning typically employs top-down approaches (e.g. benchmarking approaches), bottom-up (e.g. mathematical modelling), or consensus approaches, reliant on judgement and intuition for determining anticipated nursing requirements (RCN, 2010; NHS Education for Scotland, 2013). Within this evidence synthesis we are interested in the full range of WPTs that support planning by estimating nursing resources (numbers and / or skill-mix); patient needs / dependency; nursing activity / workload; and the quality and safety of nursing care singly, or more usually in combination. This includes estimates of nursing intensity, which may be based on:

- Patient profile based approaches: descriptions of patient types, associated with needs – e.g. Shelford Group Safer Nursing Care Tool
- Critical Indicators of Care – different levels of care used to classify patients, and
- Task based approaches – e.g. Nursing Information System for Change Management.

Whilst having potential to inform workforce modelling and establishment setting, these WPTs provide a crude prediction of (some) resource availability, which may not reflect real-time resource delivery, which can be eroded by a wide range of factors (RCN, 2010). In addition, these approaches neglect the more subtle, human resources in the workforce that managers can identify and reposition to ensure greatest impact on care quality.

Correlational links have been made that articulate links between higher nurse staffing levels and some patient safety outcomes such as falls, medication administration errors, and missed nursing care (Griffiths, 2014). NICE (2014) highlight that insufficient evidence is currently available to show the impact of using particular WPTs. Whilst there has been progress in developing more comprehensive staff mix decision-making tools, there are still gaps to show how tools and processes take account of factors across patient groups, staff groups and organisational systems (Harris & McGillis-Hall, 2012). There is insufficient evidence to show links between tools and approaches to assess nurse staffing and patient outcomes (NICE, 2014). Current evidence focuses on acute care (RCN, 2012), and most research to date is from North America (West et al, 2014). In addition, the uptake and implementation of these WPTs has been shown to vary across organisations (NHS Education for Scotland, 2013).

Whilst there are a considerable number of WPTs available to NHS organisations and managers to determine nurse staffing requirements, there is a requirement to improve their accuracy as a basis for resource allocation (Griffiths *et al.,* 2014). It is acknowledged that the use of WPTs must take into account factors which can influence their effectiveness, including changes in patient acuity (NQB, 2012) and structural characteristics (e.g. ward layout) and organisational systems (e.g. bed management) (Scott, 2003). Guidance from the Chief Nursing Office for England and the National Quality Board (2013) highlights an important leadership task for NHS managers in triangulating information from these predictors with 'their local knowledge' of what is required to achieve better outcomes for their patients. The Shelford Group (2013, p3) indicate that *"no national workforce tool can incorporate all factors and so combining methods (triangulation) is recommended to arrive at optimal staffing levels. This should include quantitative assessments such as those encapsulated in the SNCT and other more qualitative and professional judgement methods to increase confidence in recommended staffing levels and provide balanced assurance"*. This reinforces the fact that the impact of these WPTs in every day practice will be shaped by their real-time implementation, and through the capabilities and capacities of NHS managers. This highlights the leadership role of NHS managers' in seeking out, and triangulating additional real-time information to appropriately manage the nursing resource on an on-going basis. This will be achieved by identifying the contingencies on which the information that workforce technologies provide can successfully influence the required changes in clinical practice or the health organisation more broadly.

Policy guidance indicates that a wide range of factors can mediate the impacts of WPTs, including: executive buy-in; staff involvement; organisational learning; and transparency in applying the outcomes of technology use and evaluation at the front-line (RCN, 2010). In this way, the use of nursing workforce technologies will be dependent on context, and may be transformative, so making a more traditional 'logic model' of their action and impact problematic. For example, managers' learning about workforce planning, observations of impacts of different approaches and tools, and improvements over time in the quality of managers' professional judgements around staffing, all may transform context through individual and organisational feedback loops. However there is a narrative in the literature where professional judgements may become entrenched and uncritical over time (Proctor 1992).

Adopting a realist synthesis approach enables the consideration of additional contextual influences on the impact of workforce planning technologies, and at other levels within the healthcare system.

For example, the impact of WPTs may also be variable and contingent on organisational and workforce flexibility; some influences may only emerge through implementation. These influences on the implementation and impact of these WPTs will be associated with the "complex interdependencies between nursing, midwifery and care staffing capacity and

capability, and other parts of an organisation's structure and functions" (NQB, 2013). This demonstrates how policy and practice around nurse staffing should be integrated with other aspects of organisational practice. Specifically, the use of WPTs should be conceived as part of a much broader and complex system of management practice to ensure quality and patient safety: "*safe staffing relies on good management so that budgeted posts are filled, and deployed effectively, and the staff employed are available to work*" (RCN, 2010 p5). Moreover, it challenges those producing and reviewing evidence to understand this system complexity through more nuanced consideration of contextual influences on implementation and impact.

Why the research is needed now

Our proposal responds to the commissioned work stream 14/194, and specifically the priority area of managers' use of nursing staff data in NHS organisations. However, our focus on implementation will also complement research funded in any other priority areas, including the validation and refinement of measures of nursing input, activity and workload, and the quality and safety of nursing care. We have included extensive stakeholder engagement, including from patient and public representatives, to ensure that we are able to generate a rich understanding of contextual influences on this aspect of healthcare quality, including individual, organisational, environmental and political factors, and from both professional and lay perspectives.

There have been a recent series of investigations and high profile cases which have focused attention on the quality of nursing care, including the professional preparation, structure and development of the nursing workforce. Our work will be of direct benefit to health and social care services in providing a resource to inform development programmes for NHS managers to address the implementation of nursing WPTs.

Nursing input is essential for high quality patient care (Kane et al, 2007). This review is important for patients, families, NHS managers and organisations as the association between nurse staffing levels and patient outcomes is acknowledged as a political imperative. Recent high profile reports which focus on the association between nurse staffing and patient safety outcomes, and which associate insufficient nurse staffing numbers with compromised care make this issue an increasingly public imperative. To date, the links between their use and important patient outcomes has not been easy to explain. For example, there are gaps in the current evidence base that explains the mechanisms by which staffing levels directly impact on patient outcomes (Ball et al, 2013). There is limited information on which patient safety outcomes are appropriate to consider (and the credibility of case ascertainment); poor attention to risk adjustment; and little attention is generally paid to organisational factors which may mediate the link between the numbers of nurses and high quality care. A number of recent reports suggest that, even if attention is paid to the quality of nurse staffing predictor tools through national accreditation, they risk not paying attention to important nursing resources, and poor implementation may limit any benefit from investment in their use. Predictors tend to be quantitative and crude, neglecting other human resources, such as expertise and clinical leadership, which are important in ensuring nursing care quality.

Transferability of research outputs will be enhanced through developing theoretically informed statements about 'what works' in workforce planning within this context. Attention to implementation and the contextual influences on the impacts of WPTs will mean that barriers and enablers can be identified, and subsequently used to enhance managers' professional judgments and decision-making processes. Knowledge mobilisation will be embedded in our approach to the review and through end of grant dissemination activities (see dissemination section).

The HS&DR Programme is developing a body of research concerning the structure of the nursing workforce. This work has so far generally focused on further investigation of the links between nurse staffing and workforce structure, patient care needs, and quality outcomes; and organisational and learning supports for the nursing workforce. No studies have explicitly addressed the issue of WPT implementation. As with the strategic links around implementation between NIHR HS&DR 12/129/32 that we have created with NIHR HS&DR 12/129/10 (PI Arthur), we would be keen to work in collaboration with other commissioned studies to share relevant project findings on an on-going basis.

4. AIMS AND OBJECTIVES

Whilst correlational links have been made between higher nurse staffing levels and some patient safety outcomes such as falls, medication administration errors, and missed nursing care (Griffiths, 2014), little attention has been paid to supporting the implementation of WPTs in clinical management practice. We argue that, whilst current WPTs provide NHS managers with a degree of predictive information, ensuring patient safety and quality of care requires managers to triangulate information from other sources.

The principal aim of this realist synthesis is to generate evidence and theory that will equip NHS managers and organisations with the resources to more effectively implement nursing WPTs, and so ensure patient safety and other quality outcomes. As a realist synthesis, the output generated will be in the form of a programme theory, populated with evidence that describes 'what works' about WPTs, and the contextual factors which influence their impact on important outcomes. We will interview and work with NHS managers to translate this programme theory into actionable recommendations, populated with practical examples from the evidence, to improve this important part of their role to contribute to the patient safety and quality agenda. Informed by preparatory searching and discussions with relevant stakeholders, we will address the following synthesis aim and objectives.

Aim:
Our aim is to engage stakeholders to produce of an evidence-based, realist programme theory that explains the successful implementation and impact of nursing WPTs by NHS managers. The programme theory will complement the evidence-base about technology validity and reliability, and be able to guide the development of management training programmes to support on-going implementation.

Objectives:
1. To identify the different WPTs that could be used to deploy the nursing workforce resource in the NHS, paying attention to the ways in which they are assumed, and are observed to work.
2. To explore the range of observed impacts of these technologies in different healthcare settings, and for other public services such as social work and policing, paying attention to contextual influences.
3. To investigate ways which can help NHS managers identify, deploy and evaluate the nursing workforce planning resource to have greatest impact on direct patient care.
4. To generate actionable recommendations for management practice and organisational strategy.
5. To contribute to the wider public debate about, and understanding of the nature of the nursing workforce, nursing work and the quality of patient care.

Stakeholder engagement is embedded within the synthesis, including through the Project Advisory Group (see Section 8), co-production workshops (Phase 1), and interviews in Phases 1 and 3. We will adopt a systematic approach to stakeholder identification to ensure the most appropriate people are contributing to the synthesis based on our previous experience of using an impact and influence matrix (Post et al, 2002).

5. RESEARCH PLAN

5.1. Review approach

A realist synthesis will be conducted because it is the most appropriate approach to answer the synthesis question and aims. Conventional, Cochrane-style reviews tend to focus on evidence of effectiveness with narrowly focussed questions; in contrast, realist synthesis draws on a heterogeneous evidence base to establish whether interventions work or not, in what contexts and for whom (Pawson, 2006; Rycroft-Malone et al., 2012). Realist synthesis methods have been developing (Greenhalgh et al., 2011) including through the work of members of this project team (Rycroft-Malone et al., 2012; Rycroft-Malone et al., 2014), and are becoming increasingly popular because of the potential to unpack complex, contextually contingent issues, such as in the case of this proposal about workforce planning. Realist synthesis also offers the potential to provide practical solutions to, and/or explanations about, challenging problems and issues.

The analytical task within this synthesis will be to construct a programme theory of causal explanations of WPTs, and how they operate to impact on delivering safe and high quality care services. These causal explanations are expressed as relationships between context, mechanisms, and outcomes (often abbreviated to *C-M-O*) – i.e. how particular contexts have triggered or fired off mechanisms to generate an observed pattern of outcome. Therefore a realist synthesis produces recommendations such as - in situations a, complex intervention b, modified in this way and taking account of contingencies, may be appropriate in achieving x,y,z outcomes (Greenhalgh et al., 2011).

Our review will be conducted in 4 phases over 18 months:
1. Programme theory development.
2. Evidence search, retrieval, review and extraction.
3. Programme theory testing and refinement through evidence synthesis.
4. Development of actionable recommendations.

Whilst these phases are described sequentially, in practice there is considerable iteration between them; furthermore stakeholder engagement is embedded throughout the project.

5.2. Theoretical framework

Realist syntheses are systematic and theory-driven. The review will test a programme theory, which will be a mid-range explanatory account of how WPT interventions work through the application of theories of learning, staff and workforce development approaches. An initial theoretical framework will guide the scoping review and consultation with stakeholders. The framework will provide a provisional explanation of the impact of WPTs by bringing together separate but interlinked disciplines, each with their own literature, theory and approaches, around two theory areas: the workforce planning systems themselves, and their implementation, including:

Workforce planning systems *(Theoretical domains which may explain how systems work)*	Implementation *(Theoretical domains which may explain how implementation of systems may be related to impacts)*
- The identification of patient needs and acuity (e.g. Malloch & Conovaloff, 1999; Van Slyck & Johnson, 2001) - The nature of nursing work (e.g. Allen, 2014) - Workforce planning strategies (supply vs. needs based) (e.g. Buchan & Calman, 2005; Birch et al., 2009)	- Technology adoption (e.g. Rogers, 2003) - Professional decision-making and judgement (e.g. Thompson & Dowding, 2001) - Organisational and other contextual influences – structural factors affecting the implementation of learning and practices

- Contracting and rostering practices (e.g. Burke et al., 2004; Duffield et al., 2011; Twigg et al., 2012; Blay et al., 2014) - Deployment, skill mix and nursing workload tools (e.g. RCN, 2010) - Human resources and strategic management (e.g. Teece, Pisano & Shuen A (1997; Barney & Clarke, 2007)	(e.g. Easterby-Smith, 1997; Raelin, 1997; Dewing 2008) - Organisational learning and knowledge management (e.g. French et al., 2009) - Implementation and Knowledge Mobilisation (e.g. Rycroft-Malone et al., 2004; Ferlie et al., 2015; Crilly et al., 2013)

Additionally, we are interested in identifying the full range of impacts that WPTs could potentially have, and which extend beyond dimensions of quality of healthcare for patients. These impacts may also relate to the workforce (e.g. nursing staff satisfaction) and organisation (e.g. organisational learning). However we recognise that, for example, an increase of knowledge about an issue may not result in a change of behaviour but may be a pre-curser to behaviour change. Therefore, in this review we will conceptualise impact as a continuum ranging from conceptual to instrumental or direct impacts: i.e. from awareness, knowledge and understanding, attitudes and perceptions, to changes in behaviour (Nutley et al., 2007).

5.3. Review Strategy

The following sections provide details of the proposed approach to this review using the accepted phases of realist synthesis (Pawson, 2006; Rycroft Malone et al., 2014), which includes information about the search strategy, inclusion and exclusion criteria, quality appraisal, data extraction and approach to synthesis and programme theory refinement.

Phase 1: Development of programme theory

The development of programme theory is a deliberative process including a mixture of desk work and discussion, and is expressed as plausible hypotheses in the form of contexts, mechanisms and outcomes (C-M-O) threads. Programme theory (i.e. the hypotheses about what works for whom, how and in what context) is fundamental to realist synthesis. Using our theoretical framework as a basis, programme theories / plausible hypotheses about 'what works' will be developed with stakeholders through co-production workshops, and a scope of the literature.

To develop an understanding of the complexity of the contexts in which systems and technologies are used, we will draw on soft systems thinking to structure 2 co-production workshops with NHS managers and other stakeholders. These will use soft systems principles to understand the work in anticipating, identifying and deploying the nursing resource. We have used this approach to the design of co-production workshops in a realist synthesis (HS&DR project 12/129/32) in order to generate a deeper understanding of the contexts of workforce development in older people's services. Each workshop will comprise a purposive sample of up to 20 participants from across stakeholder constituencies, and combine a range of discussion and practical activities designed to illuminate the systems in which workforce planning operates.

Soft systems methodology provides an epistemological approach for analysing messy, real-world problems, which may combine multiple cognitive, social and cultural perspectives (Checkland, 1999), and is eminently suited to the investigation of implementation challenges (Dopson & Fitzgerald, 2005). Within a 'soft' approach there is an acceptance that there may be more contested issues which surround that complex interventions and their implementation, which reflect different stakeholder perspectives, and so may be more problematic to unpick. In this sense, the configuration of people, systems and technologies, and resources around nursing workforce planning can be characterised as a soft, human

adaptive system, and which is open to differing interpretations about purpose, value and impact.

Soft systems thinking has the idea of the 'root definition' of the activity embodied by the system (in this case workforce planning) as the core to evaluate current challenges, and identify action for improvement. This comprises six dimensions, which when combined with explanation of how the activities embodied within the system are effective and efficient, ensures that analysis of the system is grounded in the real world of its operation (Checkland, 1999). In this research, an overarching root definition a workforce planning system will be developed in the co-production workshops.

Our realist syntheses work to date has included semi-structured interviews with stakeholders primarily to validate the emerging programme theory, and to advise on knowledge mobilisation. In this proposal we also plan to include 10 semi-structured, audio-recorded interviews with a purposive sample of NHS managers to build on the co-production workshops, and explore variations in workforce planning systems across organisational settings and health services. The interview spine will be structured around the findings from the co-production workshops.

Output from phase 1: the identification of contexts, mechanisms and outcomes (i.e. theories), which are then tested and refined in Phase 2 and 3. At this stage we will also submit the review protocol for open access publication.

Phase 2: Retrieval, review and synthesis

In the first instance we will target evidence specific to the nursing workforce in the context of UK and comparable health systems. We will also target different public service literatures where similar workforce planning challenges can be found, such as in social care and policing. Realist synthesis provides an ideal approach for testing emerging findings from one body of literature to another, and in providing the opportunity to see if other literatures offer different learning and mechanisms. Our approach will be to target evidence specific to the nursing workforce in the first instance across hospital, community and third sector care sectors. The range of mechanisms identified from the scoping sweep of the literature in this proposal will be complemented by further searches, including for the impacts of workforce planning technologies in related service fields; social care and policing.

Search strategy

One strength of realist synthesis is that the evidence base to be reviewed and synthesised can be broad and eclectic (Pawson, 2006). In fact, a diversity of evidence provides an opportunity for richer mining and greater explanation. The potential of including different types of evidence is important when we consider the potential sources of information that will be relevant to answering the question and aims of this review. We theorise that there will be transferable lessons from other public services where the challenges of workforce planning and workforce developments (e.g. the development of support / assistant roles) are similar, including social care and policing, therefore we will be searching these different evidence bases, prioritising social care. Additionally, it is also likely that much relevant evidence exists in unpublished form, and therefore we will seek to maximise opportunities for identifying this literature, through for example, communication with relevant organisations.

Our search will be limited to material from 1983 to date. 1983 saw the commission of the NHS Management Inquiry to evaluate methods of estimating staffing levels, and the classification of workload analysis approaches by the Operational Research Service of the then Department of Health and Social Security (Scott, 2003). All synthesis material will be managed in Endnote. We intend to include material indexed in the major health and related databases:

Health and Social care: Cochrane Library, Campbell Collaboration, ZETOC, MEDLINE, EMBASE, CINAHL, AMED, National Research Register IBSS, HMIC, ASSIA, CSA Sociological Abstracts, Social Work Abstracts, Social Policy and Practice, Social Care Online.

Policing: National Criminal Justice Reference Service Abstracts, Association of Chief Police Officers in England, Association of police officers, National policing improvement agency, Police Oracle.

Cross-referencing from previous reviews, with forward citation analysis for key research studies (defined in terms of theory relevance) will be completed via Science Citation Index.

Keywords will be developed from previous systematic reviews and adapted for each information source. The search terms for workforce planning systems and technologies will be constructed from a mix of database specific 'keywords' identified in the scoping work completed to underpin this proposal. The search for references will be augmented by searches for generic quality improvement and organisational development programmes which make specific reference to workforce planning; internet-based searches for grey literature, such as workforce planning project reports relating to national and local initiatives; evaluative information about these initiatives held in the public domain will be requested. We will also use snowballing techniques and draw on the expertise of the project steering group, other key researchers, and organisations to ensure we have not missed evidence that might be relevant, but not visible through traditional and hand searching methods.

Findings from preliminary searching

We have engaged with an Information Scientist (Co-App BH – with previous experience of realist synthesis) in the clarification of the breadth of the resources available to support this synthesis in the following ways:

1. Targeted searches of key databases
2. Scoping the grey and allied literatures, including in key areas immediately available to the research team (for example, UK Mental Health Services and from human resource management respectively)
3. Citation tracking of key papers highlighted in two UK based workforce planning and deployment reports
4. We have amended the primary data collection aspects of the proposal to extend beyond stakeholder interviews to validate the emerging programme theory.

Examples of the types of evidence that we anticipate screening for inclusion in the synthesis is presented in Appendix 1.

Key database searches

We have searched CINAHL and MEDLINE databases using a selection of the proposed search terms and searching for these words in the title or abstract ("workforce planning" OR "workforce meas*" OR "workforce management tool" OR "patient acuity system" OR "nurse to patient ratio" OR "skill mix" OR "nurse staffing levels" OR "personnel staffing and scheduling"). The search was limited to papers in English and published from 1995-2015.

Initial scoping searches (CINAHL)	1167, estimate 606 UK and Ireland
Initial scoping search (MEDLINE)	1275, estimate 318 UK and Ireland
Initial scoping search of HMIC (workforce planning/ or Workload/ Service provision/; Nurse rostering/ staffing tools; nurse to patient ratio; ward staffing)	25-30 texts of potential relevance

Further exploration MEDLINE: (MH "Personnel Staffing and Scheduling/OG") AND (MH "Health Care Evaluation Mechanisms+")	1,157 hits, estimated 145 from the UK and Ireland
Further exploration MEDLINE: tool* AND (staffing or workforce or workload) AND nurs*	731 hits, estimated 65 from the UK and Ireland
Further exploration MEDLINE: (staffing or workload or rota* or shift* or rostering) AND (acuity or "patient need*")	2620 hits, estimated 28 from UK are Ireland

Grey literature
We have drawn on the direct experience of our project team in the identification of programmes to implement WPTs within UK mental health services. These include the All Wales Mental Health Acuity Group Project Report of the piloting of an acuity tool in 6 Health Boards. We have also scoped internet resources and identified several repositories of technical reports from relevant funded research. For example, the National Technical Information Service (of the US Department of Commerce) indicates 9,000 results for "nursing workforce planning". Relevant policies, tools and case studies are also located on the websites of the World Health Organisation; European Observatory on Health Systems and Policies; and US Agency for Healthcare Research and Quality (Innovations Exchange).

Citation tracking
Drawing on the RCN (2010) Guidance on safe nurse staffing levels in the UK and the Sheldon report, we have identified the following key papers and their citation in other evaluations of workforce planning technologies citation searching through Web of Science citation searching;

- Rafferty *et al.* (2007) cited by 167, an estimated 58 of these from UK and Ireland
- Flynn & Mckeown (2009) cited by 10, an estimated 3 of these from UK and Ireland
- Fagerström & Rainio (1999) cited by 13, an estimate 3 of these from UK and Ireland

Inclusion/Exclusion Criteria
Our search strategy will be purposive in order to test and refine the programme theories from phase 1, requiring an inclusive (all types of research and non-research, including policy and guidelines) and pragmatic approach to finding and evaluating evidence. Therefore we will be interested in finding evidence relevant to the following:

Reports of:
- Workforce technologies based on a scoping search of the literature. Examples include workforce planning; workforce measurement; workforce management; patient acuity; staffing ratios; and skill mix. Additional search terms will enable concentration on issues of utilisation, implementation and impact.
- Setting – recognising the shifting patterns of healthcare, and the importance of enabling patient flow and quality across systems of care, it would not be helpful to only sample the evidence base entirely from the hospital setting. However, analytical approaches will prioritise those setting specific to older people and test the transferability of findings to the wider health service context. In contrast to other review processes, in a realist synthesis evidence is not excluded (unless it does not relate to the programme theory or theories), however in this review we will not search for or include evidence that may have limited transferability to the NHS such as nursing workforce issues within low income countries. We will search for evidence from different international contexts where these have health systems comparable to the United Kingdom. We will pay attention to whether evidence is UK specific.

- Additional searches will also be conducted of the implementation and impacts of workforce planning technologies in the following public service fields; social care and policing.

Our review process will involve screening for relevance to the programme theory/ies and data extracted on bespoke extraction forms so that the CMO's are populated with evidence. Outcomes vary according to how interventions have been implemented; therefore the synthesis will include the conditions that make for successful implementation. We will use a systematic approach to determining relevance developed in a current realist synthesis (Burton et al., 2014). Consistent with Pawson's (2006) suggestion, the test for inclusion will be:

- Linkage with programme theory and explanatory potential
- Discernible 'nuggets' of evidence within the source material
- Evidence trustworthiness

Discrepancies in opinions about the relevance of articles will be resolved through discussion amongst the project team.

Review and extraction

The programme theories being 'tested' through the review are made visible through the data extraction forms (Rycroft-Malone et al., 2012). A bespoke set of data extraction forms will be developed based on the content of the programme theory, which thereby provides a template to interrogate the theories. If the evidence meets the test of relevance (described above), data will be extracted using the bespoke form and then checked by a second member of the team.

Synthesis

The analytical task is in synthesising, across the extracted information the relationships between Mechanisms (e.g. underlying processes, structures, and entities), Contexts (e.g. conditions, types of setting, organisational configurations) and Outcomes (i.e. intended and unintended consequences and impact). Through our previous experience of realist synthesis (Rycroft-Malone et al., 2012; Rycroft-Malone et al., 2014), and building on the suggestions of Pawson (2006) and principles of realist enquiry we have developed an approach to synthesis that includes:

1. Organisation of extracted information into evidence tables representing the different bodies of literature (e.g. health care, social care and policing)
2. Abduction and retroduction (Meyer & Lunnay, 2012) across the evidence tables in relation to emerging demi-regularities (patterns) around plausible C-M-Os – seeking confirming and disconfirming evidence.
3. Linking these demi-regularities to develop programme theory which provides an explanation of the implementation, utilisation and impacts of nursing workforce planning systems and technologies.

This aspect of the review process is resource intensive and reliant on discussion and deliberation, including consultation with a wider group of stakeholders (including patients and the public), both of which are built into our project plan.

The resultant hypotheses act as synthesised statements of findings around which a narrative can be developed, summarising the nature of the context, mechanism and outcome links, and the specific characteristics of the evidence underpinning them. However, a key challenge within realist synthesis is to present the findings as a coherent whole, rather than presenting a set of C-M-O statements which are connected to greater or lesser degree.

Outputs from Phase 2: 1) a comprehensive evidence base related to nursing workforce systems and technologies, which we will make publicly available, 2) a set of hypotheses supported by relevant evidence to be refined in Phase 3.

Phase 3: Test and refine programme theory/ies (validation)

To enhance the trustworthiness of the resultant hypotheses and to facilitate the development of a final review narrative we will conduct up to 10 semi-structured audio-recorded telephone interviews with NHS nursing workforce and other managers. These participants will be purposively sampled to obtain different perspectives relevant to the review question, including different national contexts, and service settings. An interview schedule will be developed based on the findings that have emerged from the synthesis process and will aim to elicit stakeholder's views on their resonance.

Additionally PPI participants will be asked to assess the relevance of the mechanism-context-outcome threads (i.e. hypotheses) from a service user perspective. This activity will be undertaken on an on-going basis by view of their involvement in this project on the project team and the advisory group

Outputs from Phase 3: a refined set of hypotheses with accompanying evidence-based narrative.

Phase 4: Actionable recommendations

We will work with the Project Advisory Group including PPI participants to develop a set of actionable recommendations and the development of an evidence informed framework of what works for whom and in what context in relation to the implementation and use of WPTs. This will be achieved through one face to face meeting, and virtual meetings via teleconference.

Using our synthesis findings, we will recommend a series of improvements to the resources and support available to NHS managers in this aspect of their work. These will likely involve the following issues:

- Frameworks and tools which support the integration of quantitative and qualitative data on workforce resource availability for more effective workforce deployment.
- Frameworks that make the real-time triangulation of different data, and learning about professional judgements more transparent and effective.
- 'How to' guides which address common challenges in the implementation of workforce planning systems.
- Understanding the cognitive, attitudinal and instrumental impacts of workforce planning systems.
- Guiding the development of context-specific and comprehensive workforce planning approaches with multiple impacts and outcomes for the workforce, patients, organisations and policy.

During this phase we will hold a knowledge mobilisation event with a group of stakeholders to ensure the recommendations we develop are both relevant and actionable.

Outputs from Phase 4: a report of the review including relevant and actionable findings, and preparation of papers for publication.

6. DISSEMINATION AND OUTPUTS

6.1. Integrated knowledge mobilisation:

Knowledge mobilisation is integral to our proposal and way of working; this will be facilitated throughout the project life time in the methods and approaches we will use. To ensure maximum impact we will also draw on our national and international networks, and link with investigators of other relevant NIHR funded projects. Knowledge mobilisation is facilitated through engagement in the research process, this is also consistent with realist enquiry, in that stakeholder engagement (including with the assistant care workforce) takes place throughout the conduct of the review. Engagement with relevant stakeholders from start to finish should increase the potential of this research to be relevant and potentially usable. Stakeholders will include practitioners, managers, patients and the public, researchers and policy makers.

End of grant dissemination:
A number of products will be produced and processes engaged in as part of end of grant dissemination activity, including the following:

- A final and full research report, illustrated with vignettes of different practical examples / case studies to make findings relevant to NHS managers, and a new framework for skills development and learning for NHS managers around workforce planning.
- An executive summary of the final report, suitable for use as a separate report for briefing NHS managers.
- A lay summary of the final report, suitable for use as a separate report for briefing the public.
- Benchmarking or quality assurance framework for workforce planning interventions and their implementation.
- 2 open access publications: 1) a review protocol, and 2) a findings paper that sets out an implementation plan of nursing workforce planning systems and technologies across all care sectors.
- Conference presentation at a UK national conference.
- A YouTube presentation of the main findings, including a discussion with stakeholders about their relevant to practice and policy.
- Open access articles in professional and academic journals.

Through this review we will answer questions that have practical relevance to service delivery and decision makers, including identifying what the core ingredients of nursing workforce planning systems and technologies should be, how they should be implemented and what should be the expected impacts on organisational efficiency, care standards and quality. Specifically we will:

1) Provide a clear description of the nursing workforce planning and deployment technologies that have been used and evaluated for improving the quality of nursing care. This will include how they work in practice and their intended and unintended outcomes to enable NHS managers and policy makers to have an understanding of the range of technologies available, and the core assumptions about how they are supposed to work.
2) Provide a clear explanation of the contextual influences underlying the challenges of effective use of technologies in ensuring efficiency in the management of the nursing resource. Understanding context is not a central feature of traditional reviews in contrast, for realist inquiry it is central. How programmes and interventions are affected by the context in which they are implemented is critical to the outcomes they achieve, a detailed explanation of this will provide service managers and policy makers with the information they need to address these issues locally.

3) Develop an evidence informed framework of what works for whom and in what context in relation to workforce technologies for improving the quality of nursing care. This could be used by organisations to reform and enhance this aspect of the management function by helping identify appropriate professional development strategies to improve implementation and impact. Our stakeholder engagement means that NHS managers will be able to co-produce these development strategies with the project team.

7. PLAN OF INVESTIGATION AND TIMETABLE

Phase	Tasks	Month																	
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**
1	***Initial Programme Theory Development (Months 1-5)***																		
	Theory building workshop																		
	Interviews with managers																		
	Project Advisory Group (MS1)																		
	Study protocol published (MS2)																		
2	***Retrieval, Review and Synthesis (Months 4-15)***																		
	Stakeholder involvement																		
	Monthly targets for retrieval																		
	Project Advisory Group (MS3)																		
3	***Test and Refine Programme Theory (Months 13-16)***																		
	Stakeholder involvement																		
	Semi-structured interviews																		
	Project Advisory Group (MS4)																		
4	***Actionable Recommendations and Write-up (Months 16-18)***																		
	Knowledge mobilisation event																		
	Project Advisory Group (MS5)																		
	Project Report for NIHR (MS6)																		
	Scientific paper for publication																		

8. PROJECT MANAGEMENT

Bangor University will act as the sponsor for the study, and it will be conducted from the School of Healthcare Sciences – a research group engaged in generating high quality evidence and syntheses about health services and healthcare interventions, funded by the NIHR, EU and various Charities. The Research Officer will be supervised by the Chief Investigator (CB), through weekly meetings, and on-going contact in between as necessary. The team has a history of working together and CB has a track record in leading projects and in supervising staff and students.

The ***Project Management Group*** comprising the Chief Investigator, co-investigators and research fellow, and two PPI representatives, will be responsible for managing the project, and meeting milestones. This group will be chaired by CB and will meet via teleconference monthly to review progress against milestones, plan work, discuss methods/analyses, keep a risk register and anticipate/resolve any problems. To do this, the group will receive and review reports from the Chief Investigator.

A ***Project Advisory Group*** will meet every six months to advise on policy and organisational engagement, the development and progress of research plans, dissemination and implementation. Professor Jean White, Chief Nursing Officer for Wales, has agreed to chair this group. In addition to the project team, membership of this group will be by invitation to relevant organisations including: National Leadership and Innovation Agency for Healthcare (Wales); NHS Education for Scotland; Royal College of Nursing; and representatives from the Independent Care Home Sector. Representatives from non-health organisations include North Wales Police (with whom we are currently working on an effective policing project).

9. ETHICS

NHS Ethical approval will not be required to undertake this review. The interviews to be conducted as part of Phases 1 and 3 will be undertaken with staff. However, we will seek approval from the University Ethics Committee and will follow best practice in accessing and consenting participants for the study. We will obtain organisational approvals for approaching participants for interview where required.

10. PATIENT AND PUBLIC INVOLVEMENT

We have engaged in the development of this proposal with patient and public representatives who are currently collaborating on a NIHR realist synthesis of workforce development for the Older People's Support Workforce (HS&DR project 12/129/32). The impacts of this engagement for this review proposal have included the development of the review theoretical territory, and specifically the conceptualisation of impacts that are important to patients and family carers. Discussions highlighted challenging public narratives around health service quality and nursing, for example around high profile system failures, and public understanding of the nursing role and work. Patient and public representatives felt that an important contribution of PPI in the proposed review would be the reframing of messages about nursing workforce deployment and quality to contribute to on-going debate. Other discussions related to the need to ensure both personal experiences and advocacy group constituencies were addressed in patient and public engagement, and practical strategies through which representatives could contribute to different synthesis activities. As our proposal shows, stakeholder engagement is integral to each phase of the project, and patients and the public are included as key stakeholders.

11. EXPERTISE AND JUSTIFICATION OF SUPPORT REQUIRED

The research team is a highly productive multi-disciplinary collaborative group, with unique expertise and a track record in understanding training and development issues within health and social care, public service improvement, and a growing track-record in realist synthesis.

Prof. Christopher Burton, Chief Investigator (CB)
Prof Jo Rycroft-Malone, Bangor University (JRM)
Dr Lynne Williams, Bangor University, Research Fellow (LW)
Dr Anne McBride, Manchester Business School (AMB)
Dr Beth Hall, Bangor University, Information Scientist (BH)
Anne-Marie Rowlands, Betsi Cadwaladr University Health Board (AMR)

CB will be Chief Investigator, with responsibility for project management and supervision. CB has experience of realist synthesis (including 2 NIHR funded realist syntheses – HSDR and HTA programmes), and in the evaluation of complex rehabilitation interventions. In addition, he has a track record in supporting stroke service development within the NHS (Health Foundation Improvement Science Fellow; National Clinical Guidelines; National Stroke Strategy, Stroke Specific Education Framework). JRM and CB are research programme directors and have worked together successfully for a number of years including on projects related to realist enquiry.

JRM is an internationally recognised health services and implementation researcher having conducted theory development research, trials and process evaluations, including realist evaluation (funded by NIHR, EUFP7 and CIHR). She has successfully delivered numerous projects on time and within budget. She is an experienced researcher in using realist evaluation (e.g. SDO project 08/1405/078), and realist synthesis, including: Rycroft-Malone et al. 2012, McCormack et al. 2013, NIHR HS&DR Improving skills and care standards in the clinical support workforce: a realist synthesis of workforce development interventions; NIHR HTA Programme: Intervention Now to Eliminate Repeat Unintended Pregnancies in Teenagers (INTERUPT); NIHR HTA Programme: Managing Faecal Incontinence in people with advanced dementia resident in Care Homes, a realist synthesis of the evidence (FINCH study); NIHR HTA Programme: Managing diabetes in people with dementia.

LW is an experienced nurse from a primary and community care background, with a developing a research profile drawing on realist enquiry. Her doctoral research was funded by RCBC Wales (Wales' national research capability building programme for nurses and AHPs), and used realist evaluation. She has experience of conducting realist synthesis and is currently project manager on NIHR HS&DR project 12/129/32.

BH is an academic librarian / information scientist with experience of conducting realist syntheses NIHR HS&DR project 12/129/32.

AMB will be advising on issues of HR and workforce planning. AMB has provided literature reviews for the Department of Health, Policy Research Programme and the Centre for Workforce Intelligence. She also has experience of process evaluations related to workforce changes. She is currently a team member of NIHR GM-CLAHRC (Greater Manchester Collaboration for Leadership in Applied Health Research and Care). This has involved work with nurse practitioners in a variety of settings. She is also a Team member of a European FP7 project looking into workforce planning in relation to new professional roles and skill mix changes.

AMR brings a NHS management perspective to the team, and is Deputy Director of Nursing in one of the UK's largest NHS organisations with responsibility for workforce planning and development.

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13. FLOW DIAGRAM/PROJECT PLAN

See Gantt chart above.