Healthcare Scientists in Primary Care: Is Now the Right Time for Healthcare Scientists in Primary Care–A Systematic Review

Muhammad SN*

Faculty of Health and Applied Sciences, University of the West of England (UWE), UK

*Corresponding author: Muhammad SN, Faculty of Health and Applied Sciences University of the West of England (UWE), Frenchay Campus Coldharbour Lane, Bristol, England, UK.

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Abstract

Introduction: The UK is seeing a continuing and important shift in the burden of disease, from mortality to morbidity. Much of the health burden is preventable. Much of monitoring in Chronic Kidney Disease (CKD) patients occurs in mild/moderate disease by GPs, with only the final stages of disease managed in secondary care. Patients with Type 2 Diabetes (T2DM) and CKD, are now being promoted to self-care more and take ownership of their health. In turn, this also means that access to education relating to disease management in the NHS face ongoing challenges.

Aims: Conducting a systematic review over 18-year period, this work will seek to describe what the educational and support pathway for CKD could look like with Healthcare Scientist involvement to provide supplementary education surrounding this Long-Term Condition (LTC). This work will also seek to understand if CKD patients could attain more informed education for disease management and laboratory tests and investigations. This work will finally outline if now it is the right time for Healthcare Scientists to be involved in Primary Care to best practice.

Design: A systematic review was conducted over an 18-year period. A Critical Appraisal Skills Programme (CASP) was used to appraise papers.

Results: From the 1,481 papers identified via several databases. 1,493 records removed, 30 papers were further scrutinized after taking out duplicates for integrity and relevance according to Healthcare Scientists, Diagnostics/Screening, Primary Care. 7 papers were further excluded. 23 Full-Text articles further appraised for eligibility. 5 further excluded. Remaining 18 papers were included (refer fig.1). 5 themes were identified

Conclusion: There is a need for a review of the current healthcare scientist workforce in the UK and consideration for these health professionals being available for CKD patients in primary care.

Keywords: Chronic kidney disease; Healthcare scientist; Leadership; Roles; Smarter working, Collaboration; Education; Skill mix; Barriers

Introduction

Healthcare and technology are evolving rapidly, as is the experience that health professionals and patients who have become accustomed to using it in day-to-day living. With the current main challenges faced by the National Health Service (NHS) being costs and the declining numbers of General Practitioners (GPs) and nurses [1]. there is a demand to better utilize Allied Health Professionals (AHPs) (The Kings Fund 2018). Expanding data collection surrounding CKD would allow more detailed understanding of not only which patients are more suspect/high risk of specific co-morbidities but would also allow opportunity for AHP with knowledge-base and expertise to also be involved at the forefront of healthcare. Data integration could pave the way for more transparent for disease management and smarter screening programmes in primary care [2].

Technological advancement is known to have revolutionized many industries including the banking sector which has shown to better staff productivity and performance, reduce errors and increase customer satisfaction [3]. Technology is a valuable resource in supporting health care; it can streamline services and efficiencies, improve workflow and presents better patient reported outcome measures [4]. This can be seen with the use of different systems, from automated dispensing systems to electronic patient health records [5]. However, it’s seen that the healthcare industry is slow in the adoption of technology and so there is considerable room for its development [6].
NHS Long-Term Plan 2019 recognizes developments and technology uptake would transform the NHS so that digital capability is embedded in routine healthcare. This includes the provision of a patient app, online consultations and patient health records [1]. Similarly, technology, especially in empowering patient self-management with mobile applications [5]. At present, technology and data integration in UK is inconsistent. Therefore, integration of data and analytics, will prompt for advancements across several areas of health for LTGs in future, potentially giving rise to more patient choice and which health professionals would best support focus of enquiry [7].

**Aims and Objectives**

Conducting a systematic review over 18-years, the aims and objectives here are to describe how CKD patients currently receive educational support and highlight what support pathway for CKD could look like with Healthcare Scientist involvement, specifically in relating to laboratory parameters, tests and investigations. This work will also seek to understand if CKD patients could attain more informed education for disease management. This work will finally seek to make a few baseline recommendations and outline if ‘now’ the right time for healthcare scientists is to be involved to support primary care and best practice.

### Systematic Review: Design and Methodology

<table>
<thead>
<tr>
<th>Table 1: Keywords</th>
<th>Healthcare Scientists</th>
<th>Diagnostics/ Screening</th>
<th>Primary Care</th>
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<tbody>
<tr>
<td>Healthcare Professional</td>
<td>Point of Care Testing</td>
<td>Primary Care</td>
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<td>Disease Management</td>
<td>Screening</td>
<td>Advisors</td>
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<td>Test Experts</td>
<td>Long-Term Conditions</td>
<td>Test Advisors</td>
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<td>Pathology</td>
<td>Chronic Illness Management</td>
<td>Practitioners</td>
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<td>Health Advisors</td>
<td>Electronic Patient Records</td>
<td>Roles</td>
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<td>Monitoring</td>
<td>Laboratory Practice</td>
<td>Disease Trends</td>
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<td>Healthcare Investigators</td>
<td>Standard Operating Procedures</td>
<td>Community</td>
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<td>Researchers</td>
<td>Near Patient Testing</td>
<td>National Health Service (NHS)</td>
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<td>Multidisciplinary Team</td>
<td>Technology</td>
<td>Commissioning</td>
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<td>Public Health</td>
<td>Chronic Kidney Disease (CKD)</td>
<td>Clinical Commissioning Groups (CCGs)</td>
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<td>Blood Experts</td>
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<td>Chemistry Experts</td>
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<td>Specimens Experts</td>
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<td>Clinical</td>
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<td>Biomedical</td>
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</table>

This table summarizes keywords according to a general grouping of terms relating to Healthcare Scientists, Diagnostics/ Screening and Primary Care. Keywords described here were used in more than one combination of each other so that maximum number of papers can be identified, respectively.

<table>
<thead>
<tr>
<th>Table 2: List of Databases</th>
<th>Database</th>
<th>Number of Papers Identified between 2000 -2018 (18 Year Period)</th>
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<tbody>
<tr>
<td>Embase</td>
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<td>52</td>
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<tr>
<td>PubMed</td>
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<td>322</td>
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<tr>
<td>Medline</td>
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<td>28</td>
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<tr>
<td>EBSCO Host</td>
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<td>622</td>
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<tr>
<td>Web of Science</td>
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<td>12</td>
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<tr>
<td>CINAHL Plus</td>
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<td>44</td>
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<tr>
<td>Cochrane Library</td>
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<tr>
<td>Wiley-Blackwell</td>
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<tr>
<td>Scopus</td>
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<td>172</td>
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<tr>
<td>SciFinder Scholar</td>
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<tr>
<td>BioMed Central</td>
<td></td>
<td>49</td>
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<tr>
<td>Science Direct</td>
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<td>23</td>
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</tbody>
</table>

This table summarizes the databases were used to identify literature accordingly. A combination of keywords as outlined in table 2 were used to perform basic, advanced and refined searches.
Main Findings

Exclusion

Papers published in any language except English were excluded

Excluded papers that had focus on long-term conditions other than chronic kidney disease (CKD)

Duplicate papers across different databases were excluded

All papers that dated before 2000 were excluded

Guidelines, Frameworks, Policy Documents, and NHS Reports were included

Full-Text articles, opinion, book, industry and commentary publications that focused learning disabilities were also excluded

Comments

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Integrity and Relevance

All papers that related to Humans were included (Adults Only)

A Critical Appraisal Skills Programme (CASP) was used to identify papers methodically [8]. Relevant guidelines, frameworks, policy reports were also included where they specifically focused on Healthcare Science and Modernization.

Systematic review literature

This table summarizes the Inclusion and exclusion criteria of different literature.

A retrospective literature review was conducted over an 18-year period. A Critical Appraisal Skills Programme (CASP) was used to identify papers methodically [8]. Key words were arranged according to a general grouping of terms surrounding Healthcare Scientists, Diagnostic/Screening, and Primary Care (Table 1 & 2) results according List of Databases. Table 3 summarizes Inclusion and Exclusion Criteria, respectively. A Critical Appraisal Skills Programme (CASP) was used to identify papers methodically [8] Relevant guidelines, frameworks, policy reports were also included where they specifically focused on Healthcare Science and Modernization.

Systematic review literature

Table 4: Key Summary of the Literature.

<table>
<thead>
<tr>
<th>Citation</th>
<th>Investigation and Methodology</th>
<th>Sample</th>
<th>Main Findings</th>
<th>Comments</th>
<th>Integrity and Relevance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nancarrow SA, et al. [4]</strong>&lt;br&gt;UK Study</td>
<td>Literature Review: The purpose of this paper is to describe four directions in which the existing workforce can change: diversification; specialization and vertical and horizontal substitution, and to discuss the implications of these changes for the workforce.</td>
<td>Educational  No Sample</td>
<td>The past century has seen the growth and transformation of existing professions and the introduction of new workers. These changes are believed to be the result of developments in technology, education, research evidence and new systems of purchasing, organizing and regulating the workforce.</td>
<td>Specific health professions are likely to maintain some market share if they can diversify to deliver new roles or retain ownership over the technology required to deliver them. The groups most at risk within a period of overall workforce boundary changes are likely to be the most specialized. During periods of high demand for services, specialists tend to let go of the less technical or less prestigious tasks. Management of Long-Term Conditions is where the 'monopoly game is being played'. Scientists need to be more active/ progressive and where opportunities lie, need to inform that they are the 'go to specialists' if patients with long-term conditions want to know about trends in disease.</td>
<td>Informative paper and relevant. Authors highlight dynamic role boundaries have the potential to challenge the monopoly of all the healthcare professions. The professions appear to be safe if they can retain a high level of demand for their specialized services; if they can retain sufficient control over their own roles or compete with existing providers based on cost, quality or novelty for the delivery of those tasks.</td>
</tr>
<tr>
<td><strong>Smith JD, et al. [43]</strong>&lt;br&gt;Australian Study</td>
<td>Mixed Methods, Triangulated Research Approach: Three Universities, two health departments and two indigenous organizations collaborated to identify workforce capacity in remote communities through innovative education.</td>
<td>76 semi-structured interviews, 35 surveys of remote staff across Australia and literature searches. 111 total participants.</td>
<td>A need was found to educate the educators in the chronic care model and in using a population health approach. The training needs analysis identified very little difference between the educational and training needs across the rural and remote health disciplines; it was perceived that they managed chronic disease well yet found prevention and early detection to be at the ‘hard end’. The main barriers identified were the demands of acute care over chronic disease management, compounded by high workforce turnover in remote areas.</td>
<td>While it is always important to have more research being undertaken in this important area of chronic disease, authors inform there needs to be more practical ways to alter the acute disease-based practice model that dominates in the health workforce, towards an integrated, systematic, population-based approach. Study informally highlights that scientists have a wider role in community/ the healthcare workforce.</td>
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<tr>
<td>Study</td>
<td>Country</td>
<td>Study Design</td>
<td>Sample Size</td>
<td>Study Details</td>
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<tr>
<td>Canadian Study</td>
<td>Soklaridis S, et al. [30]</td>
<td>Qualitative Research: To learn what educators across the health professions involved in primary health care think about health care think about interprofessional collaboration.</td>
<td>No Sample</td>
<td>36 participants from nursing, pharmacy, speech language pathology, occupational and physical therapy, social work, and family medicine. Participants were invited to join focus groups of 6 to 8 health professionals. Themes were derived from qualitative analysis of data gathered using a ground-theory approach. One of the challenges of interprofessional collaboration is ensuring clear definitions of providers’ roles and expectations regarding shared care. Defining roles and responsibilities will enhance the positive elements of collaborative interprofessional care and reduce misunderstandings regarding protocols, procedures, responsibilities, and authority.</td>
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<tr>
<td>New Zealand Study</td>
<td>Weller J, et al. [44]</td>
<td>Systematic Review: Several challenges exist in the healthcare environment. This work aims to explore these in a framework of educational, psychological and organizational challenges to the development of effective healthcare teams. Educational No Sample</td>
<td>72 independent studies (incorporating 4795 teams) across a range of industries showed that information sharing positively predicted the performance of the team. There are multiple interfaces where transmission of information between members of the healthcare team is needed for safe and effective patient care. Areas where information sharing has been shown to be inadequate are the interface between contexts, such as interdepartmental transfers. With increasing complexity and even more specialization of skills, the current healthcare environment demands effective communication and teamwork to reliably deliver best patient care. Health professionals such as scientists traditionally provide laboratory/diagnostic tests, however, to improve care plans – the scientist’s role could be expanded into primary care.</td>
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<td>UK Study</td>
<td>Osaro E [87]</td>
<td>Narrative Review: The aim of this review was to highlight the challenges associated with the effective laboratory service delivery in the NHS in England. No Sample Educational</td>
<td>Several findings were established in this work. NHS is facing several challenges opportunities to newly qualified rather than closing opportunities for them. Staffing levels in the last few years have become dangerously low, less remunerated, relatively less experienced and predominantly mainstream biomedical scientists, rather than specialty based, associated with working more unsocial hours without adequate recovery time, de-banding of staff, high staff turnaround, profit and cost driven rather than quality. These factors have resulted in burn out, low morale, high sickness absences, increase.</td>
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Informative paper, however, there is no participation from laboratory scientists. Collaborative patient-centered practice is designed to "promote the active participation of each discipline in patient care. It enhances patient and family-centered goals and values, provides mechanisms for continuous communication among caregivers, optimizes staff participation in clinical decision making within and across disciplines, and fosters respect for disciplinary contributions from all professionals."
<table>
<thead>
<tr>
<th><strong>UK Study</strong></th>
<th><strong>Italian Study</strong></th>
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<tbody>
<tr>
<td><strong>Qualitative Research:</strong> This work aimed to highlight patient views and requirements following access to their Electronic Patient Records (EPRs).</td>
<td><strong>Narrative Review:</strong> Author highlights how scientists could be concerned with 'real-life' issues and play an important role in an authoritative manner.</td>
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<td>One hundred patients from a randomized group viewed their on-line electronic records for the first time. Of the first 100 patients who indicated they would like to view their record and were available, 65 of the respondents were women aged between 18 and 84 years of age (mean = 52 years) and 35 of the respondents were men aged between 19 and 81 (mean = 56 years).</td>
<td>Scientists capable of producing first class science are needed, but also those whom are engaged in helping to change what is wrong in the social and political organizations.</td>
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<td>The focus groups sought to address patients' views on the following topics: ease of use; confidentiality and security; consent to access; accuracy; printing records; expectations regarding content; exploitation of electronic records; receiving new information and bad news.</td>
<td>Scientists with the desire to reach beyond the confines of their laboratories and help to make the world a better place.</td>
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<td>Most patients found it easy to understand their records. Where problems arose, it was with the record summaries or consultation details. Many patients requested explanations of medical terms (42%), abbreviations and acronyms (13%), and information on tests or results (17%).</td>
<td>This paper informs that scientists have a wider role to play in society, irrespective of area of expertise. It is a responsibility of the scientist to provide the public with new knowledge.</td>
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<td>Many patients have concerns about receiving new information; for example, test results or correspondence between health professionals. They were especially concerned if the information contained abnormal results or bad news.</td>
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<tr>
<td><strong>Educational No Sample</strong></td>
<td><strong>Educational No Sample</strong></td>
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<tr>
<td><strong>Narrative Review:</strong></td>
<td><strong>Educational No Sample</strong></td>
</tr>
<tr>
<td><strong>Qualitative Research:</strong> This research aimed to elicit the range of perspectives (understandings, motivations, and level of engagement) held by health professionals in primary care concerning the then recently introduced national guidelines and framework for managing CKD.</td>
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<td>Five practices were selected from the 70 practices that had agreed to participate in the active (interventions) arm of the main study. Five practices were located within South London, Surrey, and the East Midlands. Thirty-six health professionals (26 GPs, 9 practice nurses, and 1 practice-based pharmacist) participated in the 5-focus groups that were used to collect the data.</td>
<td>Eight (8) themes emerged from this research. General Responses to Renal Disease Issues Surrounding use of the eGFR measure Labelling Issues: Kidney Disease part of the normal ageing process. Issues surrounding the giving of a CKD diagnosis. Issues surrounding the management of blood pressure in CKD Part of self-management and compliance issues in relation to meeting blood pressure targets Referral Issues Educational requirements of Practice regarding CKD.</td>
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</table>
| This research highlights that primary care teams still have issues relating to primary knowledge/understanding regarding CKD as a LTC, despite access to frameworks and guidelines. There is still a misconception that CKD is a disease process that occurs in older age, thus staff at primary care level and the label 'chronic kidney disease' can induce fear and is stigmatizing for patients. | Important research; it highlights that staff at primary care level do not have 'enough skill mix’ to support/ provide educational and/or layman scientific understanding of what CKD is. Paper is also informative regarding medical division of labour; wherein the team involved GP, Nurse and Pharmacist. Important paper also because it helps to highlight that where gaps in knowledge -providing are. (e.g. It would be interesting to see if scientist involvement can provide more real-time laboratory test facts and understanding of disease trends)
<table>
<thead>
<tr>
<th>Study</th>
<th>Title</th>
<th>Author(s)</th>
<th>Publication</th>
<th>Type</th>
<th>Sample</th>
<th>Key Points</th>
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</thead>
<tbody>
<tr>
<td>USA Study</td>
<td>Narrative Review: Author relates understanding of how the scientist's role can be expanded in our complex and precarious world, introducing the idea of the modern biomedical scientist, scholar-philosopher, and statesman for the scientific community and the larger human rights community.</td>
<td>Carvalo JJ</td>
<td>Am J Biomed Sci &amp; Res</td>
<td>Educational No Sample</td>
<td>Scientists must support new initiatives concerning global health policy and support colleagues who are actively engaging the issues.</td>
<td>What is the role of the scientist in all of this? How is the scientist to collaborate with other professionals working to combat global health problems? How does the scientist engage the global health issue more fully, more productively, and with greater influence and impact?</td>
</tr>
<tr>
<td>Scotland/UK Study</td>
<td>Report A review of the NHS and the Modernization of Pathology and Laboratory Medicine in the UK</td>
<td>Beastall GH, et al</td>
<td>Sample</td>
<td>Educational/Commentary No Sample</td>
<td>The NHS embraces hospital and primary care services and increasingly it is entering into partnership with local authorities to support care in the community for the elderly and those with debilitating chronic disease.</td>
<td>Key drivers for change to pathology and laboratory medicine services identified:</td>
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<td>• Greater need for patient focused services.</td>
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<td>• The need to embrace competitiveness and plurality of provision.</td>
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<td>• A requirement to re-profile the workforce to make it better suited to new technology and modern ways of working.</td>
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<td>• The need for the definition of core data to create a framework to measure efficiency and effectiveness</td>
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<td>• Recognition of the status of a core clinical service in relation to impact on the patient’s journey leading to a requirement for laboratory services to be commissioned and delivered as part of an integrated healthcare system.</td>
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<td></td>
<td></td>
<td></td>
<td>• The need for strong biomedical leadership.</td>
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<tr>
<td>UK Study</td>
<td>Guideline outlines how Pathology services need to develop to ensure timely results for patient care and tighter integration between health sectors.</td>
<td>NHS England</td>
<td>Educational No Sample</td>
<td>While services are currently mainly based in acute trusts, about 40% of work is carried out for patients whose conditions are managed in primary care settings.</td>
<td>Lack of communication between primary and secondary care can further impair the patient experience. Having scientists more involved in primary care and secondary care will support patients with long-term conditions better.</td>
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<td></td>
<td></td>
<td></td>
<td>• The need for strong biomedical leadership.</td>
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<tr>
<td>USA Study</td>
<td>Narrative Review: Describes how primary care has transformed and how it was born out of tension with other forms of medical care.</td>
<td>Howell JD</td>
<td>Sample</td>
<td>Educational No Sample</td>
<td>Technology has an important role to play. The meanings of general practice and specialty care have changed. The meaning of primary care will also change. With an increasingly growing older population, and patients with multiple co-morbidities – the need for a scientist in primary care to support practice on frontline, providing consultation services relating to disease trends will become important. This could lift burden off GPs.</td>
<td>In the future, primary care will be reinvented, and changes will be caused by the sorts of external social, political, and economic forces that previously led to systemic transformation.</td>
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<td>Study</td>
<td>Title</td>
<td>Methods</td>
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<td>UK Study</td>
<td>Jain P, et al. [29]</td>
<td>Mixed Methods Research</td>
<td>Seeks to explore the work of commissioning care for people with long-term conditions and the factors inhibiting or facilitating commissioning care.</td>
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<td>UK Study</td>
<td>Shaw SE, et al. [29]</td>
<td>Retrospective Cohort Research</td>
<td>This study sought to explore how a payment for performance (P4P) initiative incentivizes CKD (stages 3-5) recognition and management in primary care.</td>
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</table>
| USA Study | Pisek PE, et al. [56] | Narrative, Review | The development and application of clinical guidelines, the care of a patient with multiple clinical and social needs, and the coordination of educational and development initiatives throughout a practice or department are all issues that lie in the ‘zone of complexity’.

Informative research, however, does not recognize CKD as a long-term condition. This research suggests that, at least for long-term condition services, decision-makers need to think differently about the way in which commissioning is carried out and about the operation of a healthcare market.

Commissioning for long-term condition services challenges the conventional distinction between commissioners and providers, with a significant amount of work to review and redesign services undertaken in partnership with providers.

The accuracy of practice CKD registers and the relationship between accurate identification of CKD and the achievement of Payment for Performance (P4P) indicators was determined.

Study identified clinically significant discrepancies were identified between biochemical-ly defined CKD and appearance on practice registers, with misclassification associated with sub-optimal care for some people with CKD. Primary care teams, at present struggle to understand CKD classification system. Patients in primary care need to know the difference between stages and importance of disease trends and tests involved.

To cope with escalating complexity in health care linear models of working must be abandoned, accepting unpredictability is good, respect (and utilize) autonomy and creativi-ty, and respond flexibly to emerging patterns and opportunities. New conceptual frameworks that incorporate a dynamic, emergent, creative, and intuitive view of the world must replace traditional “reduce and resolve” approaches to clinical care and service organi-zation. |
### Comparative Case Study: The aim of this research was to explore what NHS commissioners do to commission care for people with long-term conditions, and how this process might be improved. The objectives were to:

1. Identify the organization and processes associated with effective commissioning
2. Identify an appropriate set of outcomes for effective commissioning
3. Draw on experience from other sectors and international health systems
4. Consider how the learning from this research could be more widely applicable in the NHS.

This research identified the following seven themes, which characterize the practice of commissioning care for people with long-term conditions:

1. **The scope of commissioning**
2. **The labour of commissioning**
3. **Identifying the commissioners**
4. **The question of money**
5. **The scale and pace of change**
6. **Directives and guidance for commissioning**
7. **Working in a context of uncertainty.**

There is no specific focus on types of long-term conditions in this report. In all three primary care trust sites, commissioning NHS care for people with long-term conditions was observed to be a very labour-intensive activity, characterized far more by ‘relational’ work (for example developing collaborative relationships and consensus with stakeholders) than harder edge critical challenge of providers. Scientists, where appropriate will need to highlight how they can support patients with long-term conditions from a primary care perspective and how this will reduce costs and ‘general financial burden’ on the NHS.

### Literature Review: Examined the effect of previous Patient and Public Involvement (PPI) initiatives on health care commissioning and draw lessons for future development.

Four main findings:

1. **PPI in commissioning has been constantly encouraged by policy makers in England.** Research shows limited evidence of effective methods and outcomes so far.
2. **Constant reconfiguration of health care structures has had a negative impact on PPI.**
3. **The new structures look hardly better poised to bring about effective public and patient involvement.**

This work stimulates some further reflection. Is PPI desirable for increasing democracy and accountability, conferring legitimacy on policy decisions, improve health service delivery or is it an intrinsic good?

The team inform that unless the scope and intended objectives of PPI are clarified and appropriate resources are devoted to it, PPI will continue to remain empty rhetoric and box ticking.

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From April 2013, the NHS enters a new phase and clinical commissioning groups will have to justify the way in which they commission care for people with long-term conditions. GP-led clinical commissioning groups will take over responsibility for funding, planning and procuring health services for their local communities. As part of this role they will have to justify the way in which they commission care for people with long-term conditions. Clear goals, monitoring and review, with effective challenge of providers (backed up with data) is axiomatic. There needs to be exploration of new forms of contracting and risk-sharing, to ensure that the effort of commissioning is worth the cost.
This table summarizes key summary of the literature accordingly to study type, methods used, sample (where applicable), main findings, integrity and relevance. Comments were added accordingly, and further themes derived to identify patterns in the literature.

From the 1,652 papers identified via several databases (Table 4), 1,634 papers duplicates removed, and 80 papers were further scrutinized after taking out duplicates for integrity and relevance according to Healthcare Scientists, Diagnostics/Screening and Primary Care, respectively. Records Guidelines, Frameworks, Policy Reports that did not have a focus on Healthcare Science and Modernization Guidelines, Frameworks, Policy Reports and focus on long-term health and the NHS were further excised (n = 16). Full-Text Articles and reports further assessed for eligibility (n = 64). Full Text Articles Excluded, with reasons (n = 46). Full-Text articles and reports further scrutinized using CASP tool. Remaining 18 papers were included. Five themes were derived. Table 5 summarizes literature through Systematic Review. Figure 1 summarizes Systematic Review PRISM Diagram.

This is an opportunity for scientists to be involved, providing consultations and investigatory advice in addition to disease trends to suspect/ high-risk patients in primary care. Involving scientists on how to monitor disease trends, providing suspect/high risk patients tailored-entred understanding could be encouraged. Scientists themselves need to perceive roles in primary care as part of integration. Ordering certain diagnostic tests is often restricted to clinicians in an appointment-based setting resulting in patients waiting for this appointment before any tests can be organized. The results of these tests may indicate that an appointment in secondary care is not needed and has introduced delays to the patient seeing the right clinician first time. Scientist involvement in primary care can support 'referral element' by ensuring exactly the right time to request tests, thus help reduce costs.

Different models of accessing specialist advice and care include the partial substitution of hospital clinicians with primary care clinicians (such as GPs with special interests, nurse and extended scope practitioners), the relocation of hospital specialists to the community or virtual setting (e.g. attachment to primary care teams, virtual clinics, telemedicine) and joint working between specialists and primary care practitioners via shared care arrangements and consultation liaison. Key message: By working together the care for people with long-term conditions can only get better. Therefore, there is a need for a review of the current scientist workforce planning in the UK consideration of alternatives.

Figure 1: Systematic Review PRISM Diagram.
Results: Themes Derived

Five (5) themes derived from this literature review, including:

1) Healthcare Science and Leadership.
2) Roles, Smarter Working, Collaboration.
3) CKD Primary Care Education.
4) Skill Mix, and
5) Barriers to Integration.

Table 4 emphasizes key findings of the systematic literature accordingly to study type, methods used, sample (where applicable), main findings, integrity and relevance as well as derived themes. Table 5 summarizes the key gaps in the systematic review.

<table>
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<th>Theme 1 – Healthcare science and leadership</th>
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| Evidence also indicates that primary care teams have ongoing concerns relating basis of CKD as an LTC, despite access to frameworks and guidelines [13]. At present, primary care teams may not have 'enough skillset mix' to provide educational support surrounding CKD owing to 'disease timeline'. It is important that patients are provided with consistency in care. Health Literacy is also key since the more engaged patients are in care—the more empowered they become [14]. The Healthcare Scientist’s role could be expanded, but research is also required to understand Healthcare Scientists foundation relating wider healthcare and health policy. Leadership from Healthcare Scientists in care of CKD patients at present does not exist in primary care [12].
| Laboratory tests, parameters and investigations for CKD patients are validated by Healthcare Scientists as part of routine laboratory biochemistry practice—CKD patients are also becoming more informed owing to access to healthcare results [15]. If electronic systems are integrated smarter, then this could improve areas of leadership [16]. Community-based screening programmes also have the advantage of increasing CKD awareness in the wider population—this is also where Healthcare Scientists could be involved to improve education across several CKD stages. Healthcare Scientist involvement at primary care level could thus enhance joined-up thinking in the care of CKD patients and those with multi-morbidities, especially highlighting the education surrounding laboratory tests, parameters and investigations [17,18].
| One national study seeks to provide an understanding of the factors and processes that lead scientists to engage in public communication [11]. Healthcare Scientists who frequently review journals, healthcare frameworks and guidelines, 'routinely' see comparatively higher representation of healthcare and scientific issues in the public domain, in areas across health and disease. Future understanding of public knowledge requirement relating to health and science will help understand why specific members of the public and why Healthcare Scientists might spend more time online tend to retrieve a heightened understanding relating health and disease [11].

<table>
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<th>Summary of Literature through Systematic Review</th>
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| • Patients suspect/high risk for (or ‘confirmed CKD) not only need access to test results but also the knowledge behind them. The understanding provided by healthcare professionals relating to laboratory tests and investigations can be confusing—patients see many members of the MDT at varying times and can receive misinterpreted results. It could be important to see if scientist involvement can provide more real-time laboratory test facts and understanding of disease trends with an emphasis on baseline science.
| • Primary care teams still have issues relating to baseline knowledge/understanding regarding CKD as an LTC, despite access to frameworks and guidelines. Involving scientists to monitor disease trends, providing suspect/high risk patients-centred understanding is being encouraged.
| • There is a need for a review of the current scientist workforce planning and consideration for professional integration in the UK.
| • Professional integration could open doors to involving scientists more on the front-line as part of an update on a clinical pathway for CKD. |

Table 5: Summary of Systematic Review.

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<th>Theme 4: Summary of Systematic Review</th>
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<td>Owing to the present ‘perception of healthcare scientists’, these AHPs have largely stayed in the background of healthcare. Healthcare Scientists are perhaps required who can integrate between science and disease and bridge gaps in health practices surrounding specific health issues (i.e., laboratory tests, investigations, blood and organ donation). Healthcare Scientists capable of producing first class science, and how such science transpires to real healthcare require ‘mutual-place’ [9]. Literature informs that Healthcare Scientists have a wider role in health with a desire to reach beyond the confines of laboratories and to make healthcare more effective [9]. Research informs Healthcare Scientists are required who can communicate with decision-makers in society, irrespective of area of scientific specialty. One of the wider responsibilities of such AHPs is to provide the public with new knowledge [9,10]. A Healthcare Scientist leader also encourages such AHPs to have more dialogue with their MDT colleagues, for example highlight when it is safe to transfuse patients who may have renal insufficiency [10]. Leadership also relates to understanding where patients may benefit with alternative care or treatment pathways; there is a requirement for more best practice examples, so such examples are translated across wider areas of health [11,12]. There is perhaps an obvious role for such AHP leaders to link Standard Operating Procedures (SOPs) to evidence-based practices [11,12].</td>
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Owing to increasing prevalence of 'primary diseases' including hypertension, T2DM, obesity and CVD risk etc., there is a higher risk of developing CKD and there are also other factors that have an impact on disease state [19], including socioeconomic status, age, gender and ethnicity [20-22]. The rationale for having a sixth CKD stage is explored as an alternative to stages 3A and 3B [23]. Healthcare Scientists who have knowledge of laboratory tests, investigations and parameters–there is perhaps a basis for such AHPs to contribute 'untapped knowledge' to support primary care teams in group consultations at the forefront. This may allow swifter transfer of information and education than through traditional primary care consultations. There perhaps needs to be more integrating perspectives on this important subject [23]. In a report highlighting the modernisation of pathology and laboratory medicine in the UK [12], it has fewer Healthcare Scientists will be working in roles for which they are over qualified and it will be easier to develop specialists and clinical leaders to take on the future development of services [25,26].

Key drivers for change to pathology and laboratory medicine services include:

1) Greater need for patient focused services.
2) The need to embrace competitiveness and plurality of provision.
3) A requirement to re-profile the workforce to make it better suited to new technology and modern ways of working.
4) The need for the definition of core data to create a framework to measure efficiency and effectiveness.
5) Recognition of the status of a core clinical service in relation to impact on the patient’s journey leading to a requirement for laboratory services to be commissioned and delivered as part of an integrated health care system and
6) A need for stronger Healthcare Science leadership [12,24].

Research has highlighted that Healthcare Scientists need to demonstrate leadership [26-27].

Theme 2 - Roles, smarter working, collaboration

Healthcare Scientists are involved in 80% of all tests and investigations in the NHS [27-30]. There is a traditional sense that scientists have ‘always’ been involved in the support of healthcare teams, providing test results and validation in pathology (or blood sciences), and as part of secondary care [31,32]. Understanding economics, and smarter working initiatives would streamline care for CKD patients in primary care [33-35]. At present, however the evidence-base for collaborative working where Healthcare Scientists are physically involved is insubstantial–these AHPs are not traditionally patient-facing professionals. Healthcare sciences as a “hidden” service remains largely unchanged and cross-profession collaborative working is questionable [31,32,36,37].

Whilst web pages, such as Lab Tests Online, provide patients with information on what tests are for and why they are being requested from a healthcare provider, the climate is right for scientists to identify novel ways of working and collaborating with other healthcare teams [37]. Owing to novel technology and/or point of care testing (POCT) or Near-Patient Testing (NPT) kits this could prompt scientists to become more active in community environments, advancing roles to monitor suspect/high-risk patients for specific LTCs such as CKD and/or be involved in the quality assurance of test requests [33]. This can include quality assurance and monitoring specific POCT initiatives. For example, in collaboration with community pharmacists, scientists could provide simple explanations on the purpose of certain tests and how such tests are important in the wider community (Marks et al. 2013; Levey et al. 2003) [40,41].

Healthcare Scientists have a unique role to play in wider community [42]. Healthcare Scientists need to be able to share scientific knowledge in terms that the layman can understand to help bridge gaps in public understanding relating to clinical scenarios, especially to capture Patient Reported Outcome Measures (PROMs) [42]. There is wider evidence to suggest that more health promotion in the community can support the understanding of some of the complexities relating to health and disease (Levey et al. 2003). Scientists will not only collaborate with each other (i.e. between health sectors) but can also do so with colleagues on the frontline; the doctors, government officials, human rights and relief workers who are also looking to drive change (Marks et al. 2013, Miller et al. 2007, NCCCCC 2008, Nelson et al. 2015).

In a mixed method, triangulated research approach: three universities, two health departments and two indigenous organizations collaborated to identify workforce capacity in remote communities through innovative education [43]. A need was found to educate the educators in the chronic care model and in using a population health approach. The training needs analysis identified very little difference between the education and training needs across the rural and remote health disciplines; it was perceived educators managed chronic disease well yet found prevention and early detection to be at the ‘hard end’ [43]. There should be more practical ways to alter the acute disease-based practice model that dominates in the health workforce, towards an integrated, systematic, population-based approach. Study highlights that scientists have a wider role in community/the healthcare workforce [43].

In qualitative research to learn what educators across the health professions involved in primary health care think about interprofessional collaboration, one of the challenges is ensuring clear definitions of providers’ roles and expectations regarding shared care [30]. Defining roles and responsibilities will enhance...
the positive elements of collaborative interprofessional care and reduce misunderstandings regarding protocols, procedures, responsibilities, and authority [30].

Collaborative patient-centered practice is designed to "promote the active participation of each discipline in patient care" [30]. Collaborative working enhances patient and family-centered goals and values, provides mechanisms for continuous communication among caregivers, optimizes staff participation in clinical decision making within and across disciplines, and fosters respect for disciplinary contributions from all professionals [30]. Unfortunately, in this study there is no participation from healthcare scientists.

A meta-analysis of 72 independent studies (incorporating 4795 teams) across a range of industries highlighted that information sharing positively predicted the performance of the team [44]. There are multiple interfaces where exchange of information between members of the healthcare team is needed for safe and effective patient care. Areas where information sharing has been shown to be inadequate are the interface between contexts, such as interdepartmental transfers [44]. Health professionals such as scientists traditionally provide laboratory/diagnostic tests, however, to improve care plans – the scientist's role could be expanded into primary care thus enhancing smarter and collaborative working, especially in the case of patients with LTCs [44].

Evidenced-based knowledge will help in the formulation of policies that could optimize the laboratory service delivery in the NHS in England. With inadequate mix of scientific staff seen in most NHS laboratories there is a growing challenge in meeting diagnostic demands without compromising quality of tests [45]. Roles, Smarter Working, and Collaborative efforts will help reduce challenges in meeting diagnostic demands if healthcare scientists are involved in primary care. This will also reduce fatigue, increase streamline flow of services and reduce service strain/s [45-49].

**Theme 3 – CKD and Primary care education**

Professional integration has been highlighted in several papers relating to the care of patients with LTCs/CKD [50-54]. Where there is a gap in healthcare/professional integration is scientist involvement at 'face value' in the care for patients with LTCs. Modern healthcare is delivered by teams rather than individuals and requires momentum of healthcare professionals from various disciplines [44]. It is understood that failures in professional integration and teamwork lead directly to compromised patient care and inefficiencies [44]. Professional integration is as much about smarter working as it is about professionals developing best practice. There are multiple interfaces where route of patient care between members of the healthcare team is needed for safe and effective practice [44].

In a mixed-method study, one team seek to examine the work of commissioning care for patients with LTCs and the factors inhibiting or facilitating commissioners making service change [29]. This research suggests that, at least for LTC services, decision-makers need to think differently about the way in which commissioning is carried out and about the operation of the healthcare market. This research did not include analysis of the costs associated with commissioning work but has revealed it to be an area deserving of closer examination in future. Therein it would be advantageous to underline if there is value for money where patients with LTCs, like CKD have access to a healthcare scientist in primary care to support clinical diagnosis and disease trends, especially wherein GPs, and nurses may have incongruities relating to CKD terminology [29].

In a retrospective cohort study, using data from 426 primary care practices (population 2,707,130) in the UK, the age standardized prevalence of stages 3–5 CKD were identified using two consecutive eGFRs seven days apart [23]. For patients with confirmed CKD, inclusion in a practice register was associated with increasing age, male sex, diabetes, hypertension, CVD and increasing CKD stage. This team highlighted that robust estimation of the prevalence of stage 3–5 CKD uncovers significant misclassification and subsequent sub-optimal management of CKD in primary care [23].

Professional integration could bridge the gaps where there is healthcare scientist involvement.

In a commissioning report, authors inform that new models of contracting, such as accountable lead provider or alliance contracting need exploring to help the integration of services [29]. Healthcare Scientists, where appropriate will need to highlight how they can support patients LTCS from a primary care perspective and how this will reduce costs and 'general financial burden' on the NHS [29]. Healthcare professionals have seen several new acronyms, lots of activity and several new processes aimed at constructing, or indeed reconstructing, the ways in which services are purchased and delivered [56].

PPI to help understand where healthcare service improvement/enhancements are needed are still key when it comes to integration and joined-up thinking [29,55,57]. PPI in on health care commissioning and draw lessons for future development [29,55,57-59]. The potential benefits of integrated care where Healthcare Scientists can be involved has not been assessed for CKD patients.

**Theme 4 - skillset mix**

Healthcare Scientists are trained to have a good level of skillset mix to apply knowledge, fulfill test requests, audit, validate and authorize tests. What is presently witnessed in most NHS laboratories ‘today’ is a systematic re-profiling of skillset mix in the laboratory [45]. Most laboratories are now employing more support staff (laboratory assistant and associate practitioners) in preference to qualified specialist scientists, who are trained to...
apply skill base across pathology—these professionals have now been ‘downsized’ [45]. This means that there are now more issues relating to staff cover, time delays, access to more qualified staffs, processes being compromised, more risk management and general culture and re-alignment issues [45]. Less experienced or lower cadre laboratory support staffs are now required to carry out task for which they are not licensed, certified, trained, qualified and competent to perform [45].

Healthcare Scientists play a key role in the diagnosis of diseases such as anaemia, diabetes, malignancies, emergency blood transfusions services, meningitis, hepatitis, chronic liver disease, CKD, haematological malignancies [60]. The UK Department of Health and Institute of Biomedical Sciences (IBMS) advocates that patient safety must always underpin the modernization of careers in healthcare science despite emphasis on competitiveness and cost efficiency advocated by the national reviews of pathology services [45]. The IBMS emphasizes the need to maintain a robust relationship between laboratory workload and staff numbers [45].

Given that most NHS laboratories have now become more automated, routine tasks are now undertaken by support staff and delegated to wider allied health professionals [61]. The knowledge and skill base Healthcare Scientists acquire through training become specialized or advanced in healthcare delivery that extends beyond the core, pre-registration training for a given area of practice [61]. Skillset required by the health workforce change, depending upon the core, pre-registration training for a given area of practice [61]. Specialized or advanced in healthcare delivery that extends beyond the core, pre-registration training for a given area of practice [61]. The knowledge and skillset to ensure they have a strong basis for shared decision making at levels of their care [4,62-64,67].

**Diversification can take several forms, including:**

1. The identification of new markets or new settings for the delivery of certain services.
2. New ways of providing existing services.
3. The introduction of new types of technology such as medication or new therapies.
4. The adoption of new language to describe existing treatment; and
5. New philosophies of care [61].

Healthcare Scientists who have trained to acquire variable skills across practice (and across specialties) there should perhaps be wider opportunities to apply skill-mix and apply knowledge base to support patients with LTCs/CKD in primary care; this will bring a much-needed healthcare professional asset into this sector and more use of technology integration will allow for this [12,65,87]. As hardware and software continue to develop, there could be more advantageous to widen skillsets providing education.

More and more POCT initiatives have been developing owing to clinical need in both primary and secondary care sectors [12,65]. This being the case the skill sets required to provide an accurate and decisive POCT service requires a good level of skillset mix. An approach that can be varied with local circumstances is to be preferred [12,65]. It is considered imperative that wherever POCT is operated, it must be monitored and supervised by qualified staff of a clinical laboratory that is accredited [12,65]. Whilst at present non-laboratory staff are trained to operate CKD POCT programmes, to bridge the gap between diagnoses and referral of suspect/high risk patients in primary care specialist’s scientists could be involved regarding quality assurance and test accuracy ensuring the translation of data from practice to laboratory in a more quantified manner.

Greater use of skillset mix will be key to releasing capacity if UK healthcare is to offer for patients with LTCs choice through services [66]. In healthcare today, the aim is to equip the patients with the tools and skillset to ensure they have a strong basis for shared decision making at levels of their care [4,62-64,67].

**Theme 5 - barriers to integration**

Several health professional bodies worldwide have come out with recent statements to define roles and the characteristics of a successful team [42]. Patients are undoubtedly interested in self-care and must be part of the communication process too; early involvement has been also shown to minimize errors and potential adverse events [42]. There is still a misconception that CKD is a disease process that occurs in older age; thus, the label ‘CKD’ can induce fear and is stigmatizing for patients [62]. Patients will benefit from one-to-one consultations with a Healthcare Scientist in primary care to help provide understanding of disease trends [42].

Professional integration will enhance patient access to care [38]. With new healthcare initiatives on the horizon, facilities could be utilized further, allowing to have more clinical involvement based on community need. Healthcare Scientists will have to become acquainted with these to ensure services are integrated, supporting care of CKD patients [68]. It is a responsibility of Healthcare Scientist to provide the public with new knowledge [9] and this too is important in primary care. At present, Healthcare Scientists are not integrated into the care of CKD patients effectively. They are at the back of healthcare.

Senior staff within specific healthcare professions are confident to provide guidelines where expertise is needed, less senior staff may not feel they can challenge decisions or offer suggestions or alternative diagnoses and so may conceal their concerns [42]. Some of the strategies to overcome barriers to integration have been summarized as

- teaching effective communication
- train teams together
- train teams using simulation
- define inclusive teams,
e. develop organizational culture supporting of wider healthcare teams [42]. These points will improve help open the barriers to interprofessional collaboration.

Critical Analysis

Patients seek understanding of laboratory tests/information via online support groups, web portals, and smart-phone apps and often this is non-evidence based [26]. Health literacy is/can be a barrier; studies inform online portals are not currently designed to present test results to patients in a meaningful way [26,68,76]. Little is known about patients’ understanding of results received via EPRs - having access may not guarantee that patients know how to utilize this context [26,68,76]. Patients/carers still want more face to face understanding of test results (or at least have professionals be part of online support group discussions where they can get more rounded care) [38,52,69-75,85].

Whilst providing patients with access to laboratory test results via EPRs is advantageous [77], it is insufficient by itself to meet patient requirements - interpretations differ. To facilitate patient engagement, this step could be accompanied by strategies to support patients interpret and manage test results [78]. 'Digital Scientists' might be another progressive proposition, where Healthcare Scientist could be involved via online consultations with patients providing basic science of tests for patients to prompt shared-decision making [79]. There is now more scope where Healthcare Scientists can be professionally integrated into primary care to support best practice, bringing service for patients with CKD closer to home [62,63,78,80].

Strengthening Practice

This avenue could open doors to involving scientists more so on the front-line, supporting care more so for patients with LTCs [81]. With an increasingly growing older population, and patients with multiple co-morbidities – the need for Healthcare Scientist in primary care to support practice on frontline, providing consultation services relating to disease trends could become important owing to patients with LTCs being prompted to self-care [82]. This will lift further ‘technical’ burden off GPs [5,83]. At present there have been numerous studies relating to exchanging CKD eGFR thresholds for different stages of disease between laboratories and primary care [6,83]. Whilst this has been extremely encouraging to see, prompting collaborative working is needed to better the care for patients in community.

Discussion

The [84] report highlights how primary care could look in the future [85]. The report informs how it will be important to integrate between different healthcare sectors and professional groups [85]. The report also informs patients want to be partners in their own care. Patients want the knowledge, skills and confidence to take ownership of their health and feel more in control of outcomes [85]. The UK is seeing a continuing and important shift in the burden of disease, from mortality to morbidity. Much of the burden, be that morbidity or mortality, is preventable. For example, two-thirds of the improvements to date in premature mortality are related to reductions in smoking rates, cholesterol and high blood pressure, and a third due to ‘treatment’, including polypharmacy for patients with multi-morbidities. Perhaps now is the time and role for the Healthcare Scientist in primary care? [41,86].

Conclusion

CKD monitoring in primary care could be delivered involving Healthcare Scientists (at least in an educational and supplementary capacity) who have robust knowledge of CKD laboratory investigations reducing unnecessary test requests and streamlining the CKD pathway where referrals are concerned. This could also support especially where clarity on timing of tests requests and quality assurance of investigations required.

Recommendations

a. Healthcare Scientists with expertise to be provided further training and qualifications if wanting to consult with patients and the public through digital platforms.

b. Professional registration bodies and organisations to prompt guideline and practice for healthcare scientists to gain additional certification to provide ‘soft education’ relating scientific expertise.

c. Wider allied health professional collaborations are also required to prompt online group consultations. This is especially important when focusing on the ‘hard to reach’ populations (i.e. Black and Asian Minority Ethnicities).

Summary

Invoking healthcare scientists in primary care on how to monitor disease trends, providing patient-centred understanding needs contemplating owing to CKD burden and other biochemistry focused diseases. This avenue could open doors to involving scientists more so on the frontline, supporting care more so for patients with LTCs. Therefore, there is a need for a review of the current Healthcare Scientist workforce in the UK and cost-benefit analysis for these health professionals being available for CKD patients in primary care (NICE 2013).

References


