

HYBRID IMAGING IN NUCLEAR MEDICINE: CREATING A PATIENT-CENTRIC APPROACH TO SERVICE DELIVERY

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Staffing a modern, hybrid imaging environment requires a skilled and competent workforce, who should have the opportunity to further develop their working practice and clinical service provision.

TECHNOLOGICAL POSITIONING

Health professionals across the world now work within an environment of flux and uncertainty, which inevitably presents new challenges for the workforce, in terms of developing new skills and knowledge¹. This, when coupled with the need to provide high quality care, which enhances the individual patient experience², has resulted in a revolutionary change to the traditional role of the health professional³. The introduction of any new hybrid imaging system may require appropriate staff training, considerations for service redesign and patient workflow dynamics, as part of the change process.

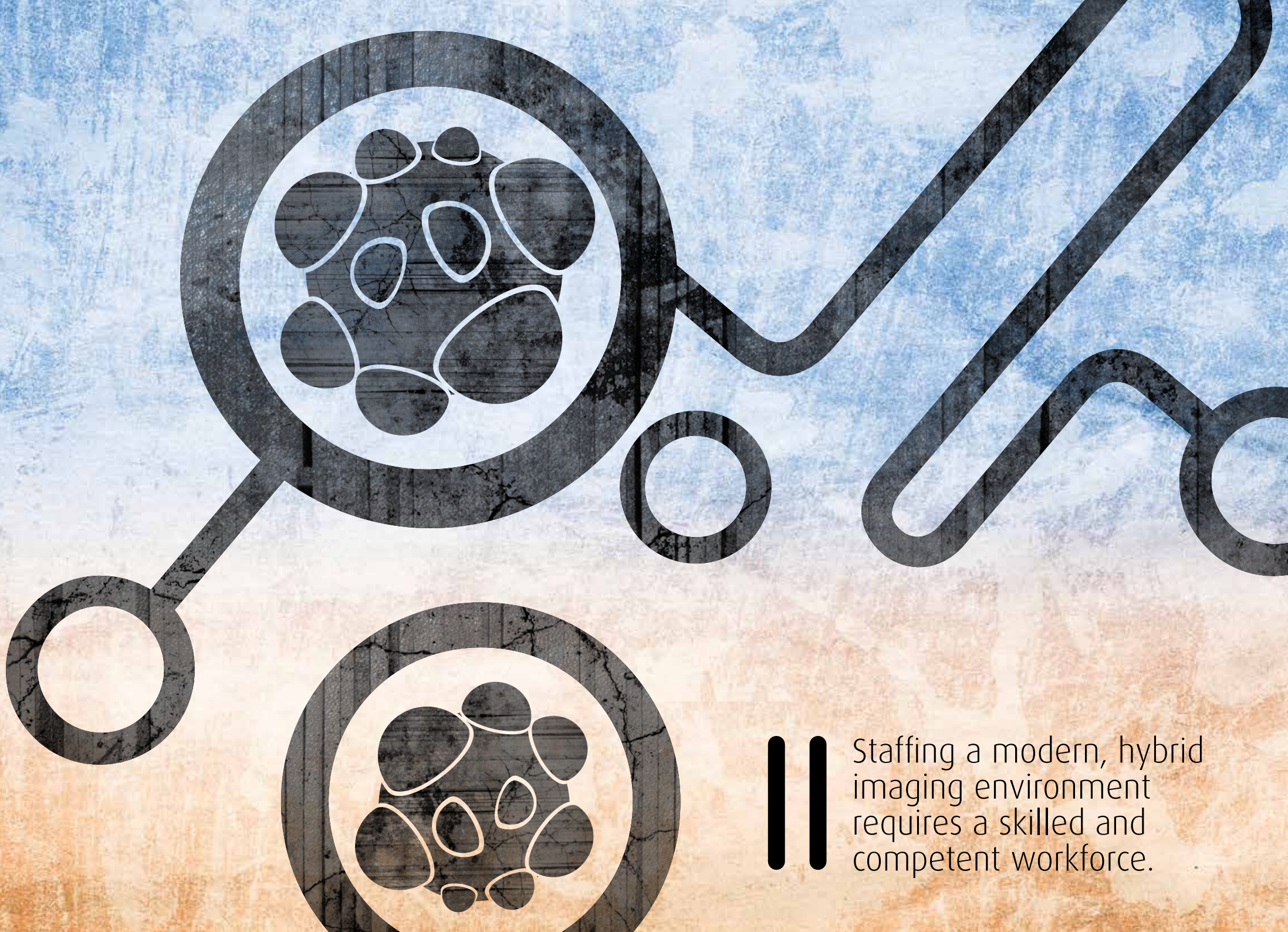
Collectively, the term 'hybrid imaging' relates to the physical fusion of more than one diagnostic imaging tool to provide anatomical and functional information in one environment. The emergence of the hybrid imaging workforce has arisen from the developing specialist area of clinical nuclear medicine over the last decade, mainly due to the introduction of new imaging hardware and developments within current patient treatment pathways^{4,5}. The ability to perform a hybrid imaging examination within a single physical environment provides clinicians with physiological and anatomical information, which may form part of the patient's initial diagnosis or evaluate their on-going response to treatments such as radiotherapy and / or chemotherapy^{6,7,8}. The integration of new technology requires the modern healthcare professional to adopt a greater 'evidence based' ethos, which is innovative, promotes quality patient care, and encourages 'smart' working practices that help deliver productivity savings^{9,10}.

Optimisation of SPECT/CT acquisition parameters is essential to current clinical practice, in order to minimise the patient dose from the CT element of the examination and to ensure that an appropriate level of anatomical information, which is both justified and adds clinical value to the imaging procedure, is acquired. There is a necessity for clear clinical protocols and appropriate use of CT within a hybrid imaging environment, especially where the patient may have recently undergone a diagnostic quality CT examination. Such activities would appear to warrant the development of clear clinical guidelines / protocols, which can help support the healthcare professional as to the appropriate use of CT within the hybrid imaging environment in order to ensure that patient safety can be maintained at all times.

The growing use of CT within the hybrid imaging environment has placed additional pressures on nuclear medicine practitioners, particularly nuclear medicine technologists, who make up a large percentage of the workforce, as previous or recent training and experience with CT may not have been undertaken. Balancing the needs of effective service delivery, workforce development and holistic patient-centric care requires careful planning and collaboration with a range of healthcare professionals. Introducing new hardware and software technology requires appropriate social frameworks, which may include ensuring the role of the practitioner is clearly defined in order that the emerging relationship with the patient is maintained. There is a potential danger of 'patient objectification' during high technology examinations^{11,12}, such as hybrid imaging and the subsequent dehumanisation process that may occur. Creating an environment where workforce flexibility is present, in terms of understanding the position of new technology within the patients' journey and a greater understanding of the need to reshape the delivery of such clinical services, is paramount to the ongoing development of hybrid imaging within the modern healthcare domain.

CHANGES IN WORKING PRACTICE AS A RESULT OF INTRODUCING HYBRID IMAGING TECHNOLOGY

Introducing new hybrid imaging technology may result in an increase in examination



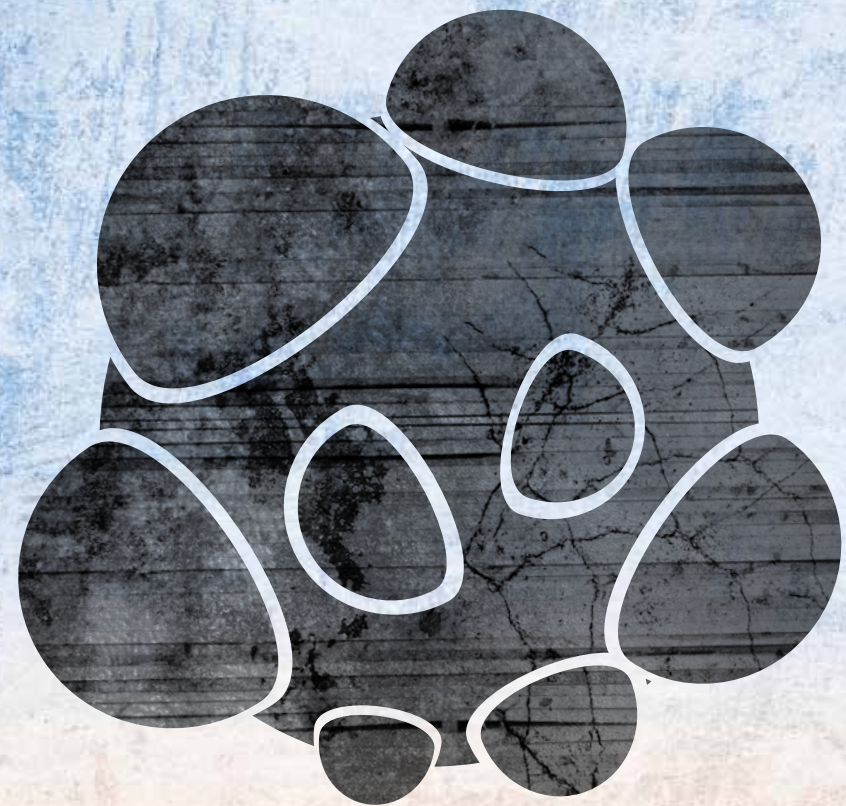
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referrals, requiring revisions to existing clinical protocols and the overall workflow of a nuclear medicine department. Service re-design and innovation are common themes within a modern health system and process mapping of new hybrid imaging techniques will help to establish clinical demand, capacity and overall activity levels. Such an approach is essential to ensure that a robust modelling plan for future workforce requirements is created and that the identification of core areas of service expansion (eg sentinel node imaging), role development and leadership opportunities within this emerging field of imaging are considered. Greater empowerment of Allied Health Professionals (AHPs) to deliver measurable targets is a key driver within the modern health service^{13,10} and as such, AHPs are imperative to the success of such targets. Nuclear medicine, and in particular hybrid imaging, is well positioned to adopt the rapid diffusion of new technology through innovative practice, which integrates clinical, research and educational dimensions¹⁰. There is, however, a need to ensure that the current and future workforce, which is a mix of technologists and radiographers, is appropriately trained in order to utilise the advanced technology effectively.

New working environments require practitioners to possess new knowledge, skills and problem solving abilities, which may not have been inherent to a clinical nuclear medicine department, prior to the introduction of hybrid imaging. Examples of the requirement for new knowledge and skills specifically relating to hybrid imaging practice may include:

- Cross sectional anatomy (following the introduction of CT within Nuclear Medicine);
- Patient counselling and support skills (increase in the amount of oncology patient referrals, especially with patients who are newly diagnosed with cancer);
- Radiation protection and patient dose minimisation techniques (with the introduction of an X-ray source, additional knowledge and understanding is required with reference to the appropriate patient dosimetry and safe working practice);
- Increased decision making capabilities (identification of incidental findings on patients' images and subsequent actions);
- Establishing formal clinical supervision and mentorship within hybrid imaging;
- Service improvement and innovation (provision of a 'one stop service' whereby the patient benefits from having a physiological and anatomical investigation in one hospital visit).

Healthcare professionals are experiencing a transformation in terms of their working environment; the need for improved communication channels¹⁴ for recording patient information and being prepared for attending to patients who are at crucial times in their lives, requires appropriate and possibly extra training. There is also the potential for patients to be overlooked as part of their examination, with the nuclear medicine practitioner instead focusing on the technology, rather than the patient. There is a risk that patients could be secondary to the actual equipment/technology, which is utilised to acquire the relevant images. The traditional approach to nuclear medicine examinations involves practitioners being



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FIGURE 1: Example control console environments of hybrid imaging environments.

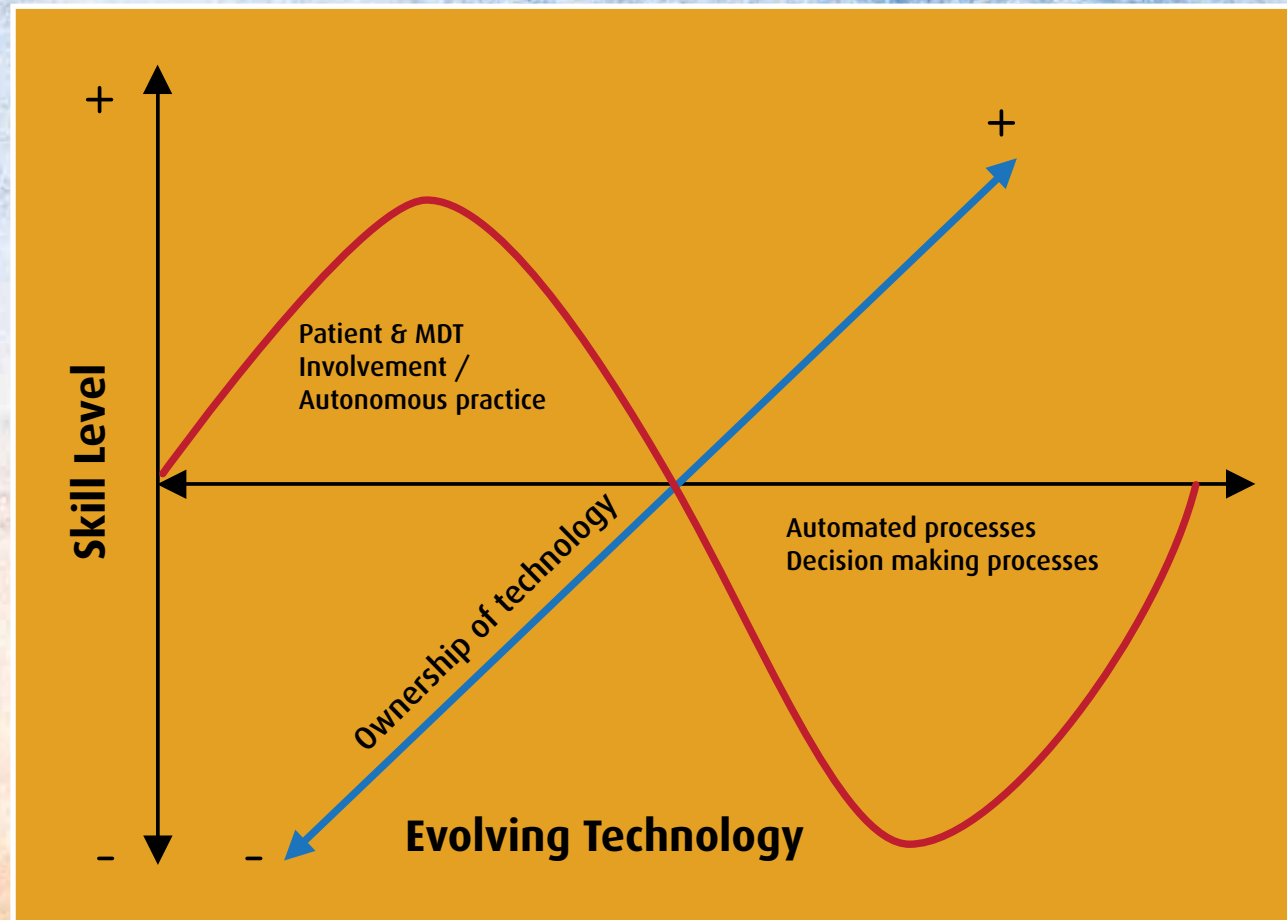


physically present in the same room as the patient, albeit at a distance to minimise individual radioactivity exposure. Introducing a physical barrier in the form of a control console, voice intercom, remote access controls and multiple processing units (figure 1) may reduce contact time with the patient, when compared to traditional nuclear medicine practice.

OPPORTUNITIES FOR GREATER ROLE IDENTITY AND INTER-PROFESSIONAL WORKING

The role of the nuclear medicine practitioner is evolving, with the potential for greater autonomy, decision making capabilities and increased professional recognition. However, the introduction of new technology and imaging techniques has also highlighted questions around who actually 'owns' the domain of hybrid imaging and whether a new hierarchy is emerging from within this imaging modality. A cross-section of professionals may work within a hybrid imaging environment including technologists, clinical scientists, assistant practitioners, radiographers and nurses, as identified in a professional workforce analysis publication¹⁵. However, it is unclear to which professional domain the technology actually belongs. Coupled with this, is the limited range of appropriate professional and educational guidelines for the development of the nuclear medicine, and more specifically, the hybrid imaging workforce in the United Kingdom. This is in contrast to countries such as North America and

FIGURE 2: Professional reorder and ripple as a result of introducing new technology.



Australia, where professional bodies, such as the Society of Nuclear Medicine Technologists Section provide clear career development pathways and clinical protocols within the field of nuclear medicine and specifically hybrid imaging¹⁶.

TECHNO-CENTRIC USE OF TECHNOLOGY


Given the potential increased level of patient throughput within an imaging department, the process of obtaining diagnostic data may be viewed as an extremely quick process, with minimal patient contact¹⁷. This, when coupled with the potential organisational change to the working environment and associated challenges around the adoption of new technology¹⁸, has contributed to the evolution of new roles and the dissolving of traditional, inflexible working practices. There is the potential for organisational barriers and a breakdown of existing social systems within communities where new technology had been introduced, and this has the potential to impact on efficiency, role identity and collaborative working.

Non-contextualisation of the effect of introducing new technologies on practitioners with traditional based social identities may prevent professional development and future social structures from developing. This may also be compounded by the inflexible nature of technology, normally driven by manufacturers as a means of maintaining consistency of patient throughput, but reducing the autonomy of the practitioner. Figure two presents a conceptual model, whereby the nuclear medicine practitioner may be in a state of 'professional ripple' when the ownership of new technology is not necessarily associated with the nuclear medicine community. Greater collaboration should be encouraged within the healthcare arena, which includes a number of professionals taking joint ownership of the new technology, in order to provide a patient-centric service. Care also needs to be taken in terms of how the new technology determines the practitioner's skill level, in terms of managing the tensions associated with automated and autonomous practice.

The challenges associated with defining a clear role for nuclear medicine practitioners working within hybrid imaging are to be expected, given the occurring technological and environmental changes. Hybrid imaging environments present a number of challenges for nuclear medicine staff who are unfamiliar with new working procedures and the need for streamlining patient workflow dynamics. This may lead to confusion and concerns around the use of new technology for a percentage of the workforce, as the shape of the professional identity within nuclear medicine begins to change. Having a clear framework for ongoing training and development of the hybrid imaging workforce is essential for future service provision. Understanding the emerging hybrid techniques and the impact on the patient's diagnosis and subsequent treatment will define the future identity of the hybrid imaging practitioner and influence pre- and post-registration education.

CREATING A PATIENT-CENTRIC APPROACH TO THE USE OF HYBRID IMAGING AND REDUCING THE POTENTIAL FOR TECHNO-CENTRIC SERVICE DELIVERY

There is opportunity for greater skill mix within hybrid imaging practice, along with the



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requirement to further develop new skills or enhance existing skills. The need to ensure a clear evidence-based practice trajectory has been suggested by Hogg¹⁹ as a means of providing greater understanding for nuclear medicine practitioners. Gulliver et al²⁰ also support the notion of a need to redefine the role of the nuclear medicine practitioner, especially given the fact that a number of new duties, such as image reporting, referring patients for additional examinations and requesting CT examinations, were once reserved only for the medical practitioner.

The flow of patients through the nuclear medicine department has changed as a result of introducing new technology³. It is not clear as to the level of independent practice and decision making that might be appropriate within this area of clinical practice, and further research is required. Collegiate working with other healthcare professionals is vital to the future success of hybrid imaging practice and being equipped with state of the art technology is not enough to survive as a specialist modality. The frequency of use of new technology will shape and form the new environment with members of the sub-communities engaging with each other and other professions to ensure successful integration. This fits with Barley's^{21, 22} concept of reorganisation following the introduction of new technology and the need for greater appreciation of the impact that this might have on the respective workforce. Early adopters and service champions should be nurtured and promoted at every opportunity, working across a number of disciplines and creating a greater sense of collective ownership in terms of how the new hybrid imaging technology is utilised. This will require remapping existing workflows and identifying existing roles and responsibilities, to ensure learning and development is available for everyone.

The evolution of new technology within nuclear medicine has created a dilemma in balancing the training needs of the practitioner, humanising the use of the hardware and ensuring the provision of a caring role. This dilemma resonates with other professional groups, such as nursing, where a direct conflict has occurred in creating the appropriate synergy between delivering patient care and optimising the use of new technology^{23,24}. Heavy workloads and multiple demands on practitioners' time are linked with work-related stress²⁵,

leading to reduced efficiency, anxiety and lack of time for direct patient contact²⁶. There is a danger with hybrid imaging that care is now being provided in the absence of the actual patient, which is different to the traditional nuclear medicine environment. For example, the introduction of a separate control room has created a physical barrier between the health professional and patient and the use of an intercom and CCTV has further distanced the level of direct care. Unlike nursing, where all of the instrumental care²⁷ is typically always performed with the patient being present, nuclear medicine practitioners are conducting some of their tasks without the patient being present. This undoubtedly will create some tension within the hybrid environments and may be due in part, to the conflict of having to use the vast amounts of hardware and software, sometimes remotely in contrast to traditional nuclear medicine techniques.

Post Francis review²⁸ there is a greater need for a values and behaviours-based approach to the delivery of patient care and a requirement to ensure transparent levels of accountability and clear leadership within the healthcare system. There is a need for greater focus around mentorship and promotion of early adopters, to facilitate the learning of others within the hybrid imaging environment. The creation of a flexible and adaptive workforce fits with the NHS Education Outcomes Framework²⁹ and fosters a positive promotion of the role of the nuclear medicine practitioner. This is particularly important with regards to creating strong multiprofessional links and flat collaboration opportunities.

Encouraging the involvement of other health disciplines will further raise the profile of nuclear medicine practitioners and encourage multiprofessional working and patient-centric provision of clinical services. This model aligns with the Department of Health's¹⁰ training approach for Allied Health Professionals, nurses, medics and scientific officers, in terms of developing the healthcare workforce, and begins to create a clear trajectory for future hybrid training and education needs within Health Education England and equivalent organisations in Scotland, Wales and Northern Ireland. Figure three (page 36) outlines the potential influences and cultural changes that have been created as a result of introducing new hybrid imaging technology within the workplace. A re-conceptualisation of professional roles will remove pre-conceived barriers to innovative ways of delivering patient services and act as a catalyst to role development³⁰. This will also support future workforce requirements mapping, with a values and behaviours approach to healthcare delivery³¹.

A cause and effect relationship has been created as a result of introducing new hybrid imaging technology within nuclear medicine. The introduction of new technology may act as an independent force and as a result develop a new agency and social structure³². The secondary effects include professional ripple and re-order, occupational shift in terms of domain ownership and potential new roles. It is imperative that the nuclear medicine workforce is able to effectively map the new knowledge and skills required to work effectively within a hybrid imaging environment, in accordance with the government's requirement for healthcare professionals to adopt new technology and further diffuse its use¹⁰.

Collegiate working with other healthcare professionals is vital to the future success of hybrid imaging.

SUMMARY

Given the advent of new hybrid imaging technology, there is the potential for a loss of professional identity and erosion of skills and knowledge pertaining to traditional nuclear medicine practice. This in part is due to the automation of processes and systems and also the risk of technological determinism, which attempts to remove the practitioner from traditional modes of patient interaction.

There is a clear need to understand the new environment, reach out to other healthcare professionals, demystify some of the semantics between various disciplines and create an identity for hybrid imaging that will allow others to further embrace and utilise this emerging technology. This approach would not only create further access by other healthcare professions, but would also create the opportunity for expansion and acceptance of hybrid imaging in other domains that are not visible in the current pathway.

By removing traditional ways of working, nuclear medicine practitioners should themselves use the introduction of new technology as their opportunity to reframe and restructure working practice. Creating a balance between a patient-centric service delivery and being at the forefront of technological developments and advancements is challenging. A collaborative approach involving professional bodies, educators and clinical practice, facilitating the creation of competency and evidence-based practice, is a focal point to begin mapping the future role of the nuclear medicine practitioner within hybrid imaging.

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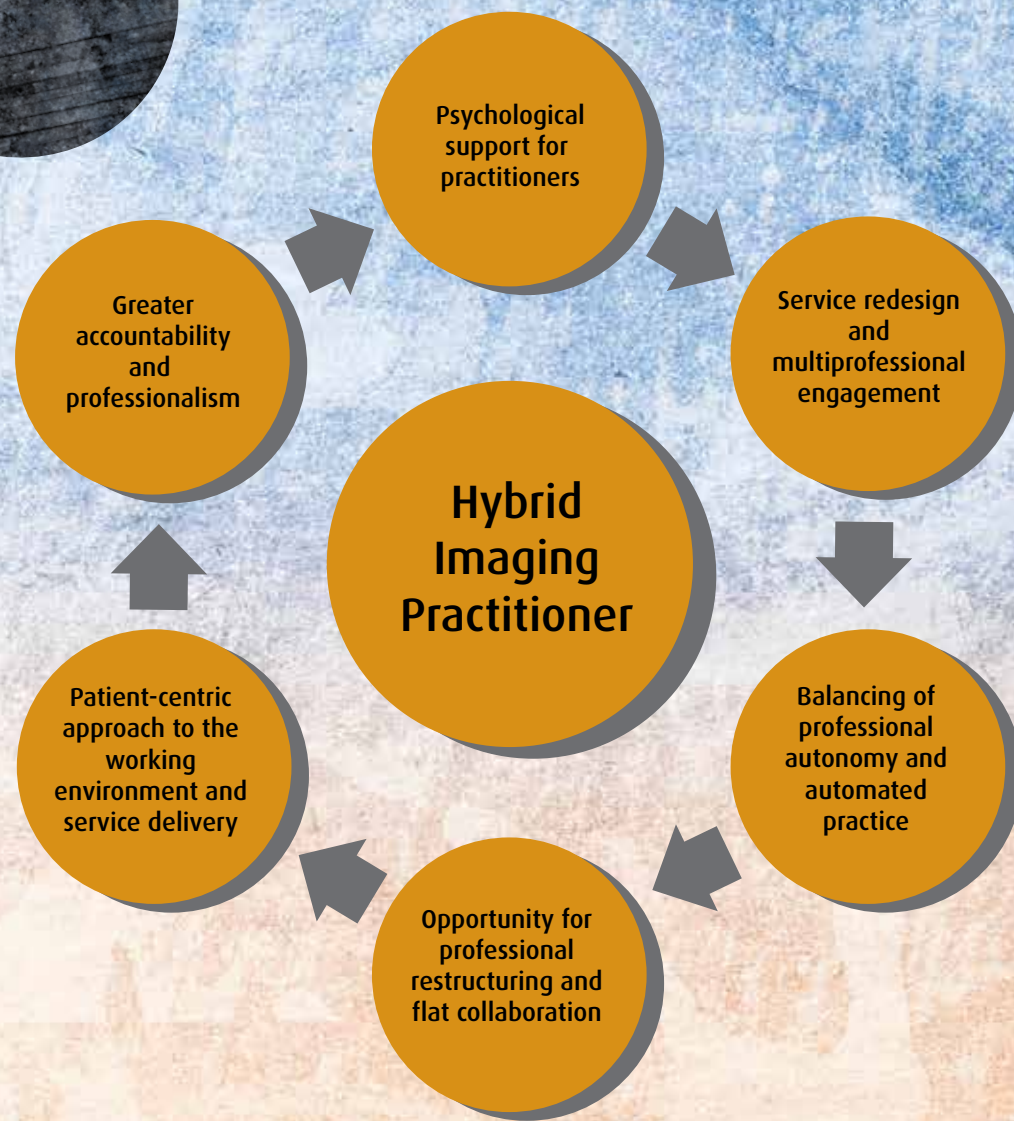


FIGURE 3: Creating a new identity within healthcare – the role of the hybrid imaging practitioner.



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