Opinion Paper

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Teaching the pony new tricks: competences for specialists in laboratory medicine to meet the challenges of disruptive innovation

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Abstract: The 20th century digital revolution has already seen the introduction of faster, more diverse, easier to use technologies with extended capacity and capability that has enhanced productivity in Laboratory Medicine and allowed more effective use of human resource. With increasing demands for better health and best care the challenge to future healthcare systems is to deploy technology, facilities and human resources more effectively. For the 21st century the digital age heralds opportunities for information-led technology providers to become healthcare providers when algorithm driven care can support patients' needs at the point of care close to or in their homes. For Specialists in Laboratory Medicine the opportunity arises for working beyond the laboratory in partnership with the emerging providers. The challenge to specialists is to extend their skill and competence to leadership roles that (a) determine clinical need and strategic direction for local environments, (b) ensure technology solutions are cost-effective, safe and reliable, (c) assume the business acumen to market, negotiate and manage change in services, (d) expect understanding of the clinical bioinformatics that underpin genomics, health information science (data mining and health economics) and physical sciences (e) expect knowledge and skills in the provision of direct clinical care in the face of staffing shortfalls experienced by many healthcare systems and (f) enhance their communication and interactive skills. In growing their leadership contribution a partnership approach in education and training across healthcare divides, in conjunction with the diagnostics and/or information technology industries, through integrated professional organisation approaches, joint approaches with

academia and policy related healthcare organisations is recommended.

Keywords: algorithm driven care; artificial intelligence; competencies; digital age; information technology; leadership; specialist in laboratory medicine.

Setting the scene

As revolutions become new ages, the longevity and intervals between them decrease. The 20th century digital revolution that followed the 19th century industrial revolution was arguably heralded in during the 1970s by the shift from analogue to digital processing of data in the personal computer. It ushered in a new age in which many manufacturing-based economies worldwide have been transformed to economies led on services driven by information technology. The speed of this latest revolution can perhaps be underlined by the global shift in company market capitalisations which by the end of 2017 saw (in order) Apple, Alphabet Inc. (Google), Microsoft, Amazon and Facebook replace historically familiar names as the five largest companies worldwide [1]. For those still watching the revolution from the sidelines the opportunity to influence it may already be limited. For those leading it comes the opportunity to sustain and grow their contribution by adopting and adapting service models in areas where there is predictably increasing demand and in which algorithm driven protocols are more widely applicable.

The new way of working relies less on human resource (both in numbers and skill sets) and more on the use of artificial intelligence and algorithm driven information technology. From businesses that relied on tiers of people in hierarchical management structures a rapid migration has been seen to smaller numbers of less skilled individuals relying on guidance from an even smaller number of leaders with the knowledge, skills and competence to deliver services. The shifting dynamic is perhaps

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underlined by new age providers such as Facebook with 25,000 employees and a market capitalisation of \$516 billion at end 2017 in comparison to Proctor and Gamble who at the end of 2017 stood with a market capitalisation of \$186 billion but with 112,000 employees [2].

For Laboratory Medicine the digital age has seen productivity enhanced in the last 30 years through advances in rapid, diverse technologies with greater capacity and capability. More effective use of human resource has been enabled, but often with less significant changes in workforce numbers. In the UK, for example, the numbers of technically expert biomedical scientists decreased from 29,400 in 2004 to 23,400 in 2018 [3]. The number of specialist practitioners in clinical biochemistry decreased from 980 to 870 in the same period, a small increase in consultant clinical scientists being offset by a larger decrease in consultant medical staff. Arguably the balancing act in meeting new workload demands and demands for 24-hour services dictates minimum staffing numbers with the knowledge, skills and competencies to provide them. Arguably, also, the diagnostics industry's technology advances have contributed to containing and mitigating against those demands. Examples of new technology catalysing new ways of working in Laboratory Medicine include:

- Digital pathology enabling more ready exchange of expertise, allowing people to choose when and where to work, opening remote access to diagnostic interpretation on a 24 hour basis.
- “MALDI_TOF” technology allowing microbial identifications in minutes so obviating labour-intensive culture and sensitivity techniques.
- High throughput reflex testing biochemistry and haematology analytical platforms deploying a diversity of analytical techniques in algorithm driven analytics that reduce the reliance on human intervention and expertise.
- The latest advances in genomics/bioinformatics technology ensuring more accurate differential diagnosis of, for example, cancers, diabetes, heart disease.
- Point of care testing technology taking care out of hospital closer to patients' own management of their condition(s).
- Electronic patient records as harbours of “big data” increasingly integrated with laboratory information management systems, empowering specialists in laboratory medicine as arbiters of artificial intelligence.

With increasing demands for better health and best care from ageing populations living with multiple long-term

conditions the challenge to future healthcare systems is to deploy resources more effectively. Many systems, however, have been slow to adopt new technologies and/or their implementation track records have been poor [4]. The challenge also comes at a time when many systems are subject to staffing shortfalls. In the UK there is an estimated 5.9% shortfall between the number of staff needed in National Health Service organisations and the number actually in post [5]. Given the limited resource and costs constraints that face many publicly funded healthcare systems, opportunities for investment may emerge in partnership with information technology based providers with the resource reserves to invest for the longer term. Some of these [6, 7] already identify much of healthcare provision as algorithm driven services for which there are sustained, growing demands and which can be offered outside the complex local, regional and national infrastructures that are a frequent feature of healthcare provision which may sometimes bedevil opportunities to deliver change [8]. In 2017 the digital health industry was already worth \$25 billion globally but with the potential to cut healthcare costs by an estimated \$7 billion dollars per year in the US [9].

Whilst clinical labour remains in the early stages of moving to new models, clinical interactions may transition more quickly. Depending on condition complexity, access to clinical and diagnostic testing services may increasingly be provided at remote centres (“Access Hubs”) deploying integrated health records; videoconferencing, online tools linked to evidenced based care pathways may obviate the need for direct medical intervention - specialists can be called upon to treat a condition irrespective of geography; the wider application of point of care testing may help empower clinical consultations led by non-medical staff such as pharmacists and laboratory medicine practitioners; mobile technologies ensure redundancy in physical location, allowing virtual appointments that in turn can encourage greater self-management.

The pace of advance in near patient testing technology is such that a market worth \$23.5 billion in 2017 will rise to \$40.2 billion by 2022 [10]. The recognition that such technology could drive innovation in global health [11] dictates a need to draw a balancing act between the value of the central laboratory and the testing that can be done at or near to people's homes. The likely extended use of point of care testing and self-testing technologies providing quantitative information to support clinical decision-making places Laboratory Medicine in a unique position to influence future service delivery.

The digital age challenge to the specialist in laboratory medicine

Arguably, the specialist's knowledge and skill set gained through current education and training infrastructures [12] provides an initial bedrock for meeting the new challenges of providing technology enabled care closer to home:

- Selection and deployment of analytical and IM&T technologies
- Pathway design – diabetes, heart disease, anticoagulation, antibiotic stewardship
- Technology innovation
- Research, development, audit
- Quality assurance, health and safety
- Laboratory leadership

But the new age increasingly dictates competencies and skill sets that ensure successful partnership working with a diversity of stakeholders beyond the hospital laboratory environment that include patients/people, commissioners, technology providers, local community/national healthcare leaders. The new competencies extend to:

- Determining clinical need and strategic direction for local environments. Local expertise is uniquely placed to determine local need, a need in one environment not necessarily being relevant to another environment. Depending on local issues such as disease prevalence/incidence, geography, resource availability (capital/revenue, facilities, staffing capacity/capability), people/patients and commissioner expectations, the required evidence base for a new service may not necessarily meet conventional evidence-based medicine criteria.
- Leading on the development and adoption of safe, reliable, evidence-based technology solutions linked to care pathways. Arguably the unique contribution to partnerships with any or all stakeholders, perhaps the new competence being able to value a technology solution against local need and circumstances that may take the specialist beyond the comfort zone of his/her laboratory protocols and standards.
- Business leadership – communication and negotiation skills, sales and marketing, change management, service contracting. The likely increasing numbers of players on the healthcare pitch places the onus on specialists to complement their established knowledge, skills and competences with those of their future partners if the direction of service provision is

to be effectively determined on behalf of tax, and any other, payers.

- Information governance, regulatory frameworks and ethics governing the use of resources and health information in line with international legislation. The requirement comes at a time of testing of national versus international legislature in resource deployment, most recently with questions arising over the ethics of deployment of information technology running ahead of regulation.
- Clinical bioinformatics (genomics, health information science [health economics, knowledge management, data mining, predictive analytics]) and physical sciences (application of medical imaging, clinical engineering, advanced networking and computerised medical services). Access to such resources may increasingly become the significant determinant of a new diagnostic service when its portfolio stretches beyond laboratory medicine at the point of care.
- Provision of direct clinical care in primary care and community environments (for mental health settings, care homes, patients' homes). The challenge of decreasing workforce numbers with appropriate clinical skills opens the opportunity for new practitioners to lead in the provision of preventive healthcare and clinical and management services.
- Enhanced communication and interactive skills in helping people access and understand evidence, and make decisions about their health and healthcare; adapting technologies to people rather than people to technologies [13].

Who's teaching the pony?

Are our healthcare professionals ready for the digital age? Whilst the new age represents a unique opportunity for "digital leaders" to emerge, the training to support this cohort is currently a little confused in many countries. In the UK, for example, whilst acknowledging that patients' needs are changing fast the discussion on the role of technology advances occupied but two paragraphs in a 57 page *Shape of Training Review* for the medical workforce in 2013 [14]. Some medical and other courses are beginning to adapt their curriculums [15, 16]. For the first time in April 2018 the National Health Service's Digital Academy, a virtual organisation, launched its 1-year programme for training and supporting the next generation of digital leaders but aimed at a peer group largely from

chief information officers and Information Management and Technology leads [17]. The UK's Modernising Scientific Careers programme launched in 2008 for the life sciences, physiological sciences and medical physics/clinical engineering took the initiative in 2012 to add a fourth arm – Clinical Bioinformatics [18]. Across the European Community increasing recognition of the need to fill a 'gap in the market' has seen university courses emerging in digital health in many member states [19]. The US is perhaps leading the late charge with the American Medical Association's launch of a \$1 million "Accelerating Change in Medical Education" initiative to encourage medical schools to change their curriculums to include teaching in the use of electronic health records, management of patient panels to improve health outcomes, and interpretation of big data on healthcare costs and utilisation [20].

The challenge for Laboratory Medicine is to grow its own education and training – acknowledging and filling the gaps whilst reflecting its unique position. In this regard the changing role of teacher and student dictates a partnership approach to support the current and next generation of leaders to capitalise on opportunities. Ready access to information disrupts the historical role of the teacher as the students' source of didactically provided knowledge. With the freedom to access arrays of information away from the classroom comes the freedom for the individual to choose when and where to learn. Increasingly, the teacher's role becomes that of an educator, coaching or mentoring the learner's access to knowledge and its management [21]. The blurring of lines between educator and learner is further brought home when the latter's familiarity with digital learning technology exceeds that of the former. As such the employer-employee relationship is changing. New talent is increasingly in the driving seat.

How should the profession respond to the digital challenge? Those trained to deliver a service rich in staff but technologically poor must work to ensure that they and their colleagues can lead their contribution in the digital age. Whether being more ready happens through partnerships across healthcare/diagnostics services divides, in conjunction with the diagnostics and/or information technology industries, through integrated professional organisation approaches, joint approaches with academia and policy related healthcare organisations remains to be seen. But the leadership in setting the priorities and agendas is needed today rather than tomorrow.

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