NHS England

National Pathology Programme

Digital First:

Clinical Transformation through Pathology Innovation

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National Pathology Programme

Digital First and the Call to Action

Digital First comes at a key time for the NHS, which treats around one million people every 36 hours. One quarter of the population (just over 15 million people) has a long term condition such as diabetes, depression, dementia or high blood pressure - accounting for fifty per cent of all GP appointments and seventy per cent of days in hospital. The number of older people likely to require care is predicted to rise by over 60 per cent by 2030. Hospital treatment for over 75s has increased by 65 per cent over the past decade and someone over 85 is 25 time more likely to spend a day in hospital than those under 65. This increased demand comes at a time of financial pressure, where modelling shows that continuing with the current model of care will lead to a funding gap of around thirty billion pounds between 2013/14 and 2020/21.[1]

The need for transformation in models of delivery, focussing on producing great value care with the best outcomes for patients, has never been greater. Early diagnosis to prevent premature mortality, care of long term conditions, and acute care are all areas in which pathology has an enormous role to play, not only in supporting clinical teams, helping design pathways, and making results visible and interpretable for patients, but also in innovation to make the pathways faster and better.

Pathology is leading the way in the use of digital technology, with the automated disciplines at the leading edge. In cellular pathology I have seen the way in which my own practice has changed, to include order communications and electronic delivery of reports, bar coding of cases, use of electronic templates, voice recognition for complex narrative upload, electronic requesting of addition special stains, SNOMED CT (Systematized Nomenclature of Medicine–Clinical Terms)

Preface by Professor Jo Martin

coding for both diagnosis and procedure enabling both tariff and research information to be gathered with ease, electronic referral and consultation from all over the globe via email and image transmission, workload analysis, and most recently digital external quality assurance. I refer to electronic resources, such as the Online Mendelian Inheritance in Man database for information on the rarer genetic conditions and I can access this, and the latest literature, all from my desktop, laptop, tablet and smartphone, and can access and complete the majority of my statutory and mandatory training needs in the same way. Data show that over 60% of the UK population and more than 80% of the younger UK population now own a smartphone. As technology and connectivity improves, we are moving to a position where the technology becomes more and more invisibly integrated into laboratory settings and in everyday care.

There is huge potential for improvement in patient care through digital transformation of pathology, and this document highlights some of the opportunities and illustrates some of the many ways in which digital creativity and innovation in pathology can make a real difference.

Prof JE Martin MA PhD FRCPath

National Clinical Director of Pathology NHS England

Professor of Pathology, Queen Mary University of London

1. NHS Call to Action. http://www.england.nhs.uk/wp-content/uploads/2013/07/nhs_belongs.pdf

Digital First Pathology

Quality improvement in pathology in a digital age

The Pathology Modernisation Programme and the Carter Review both recognised the need for a change of scale for pathology services. Although the initial focus was on internal efficiencies within the test production process, the same logic applies to innovative ways of using pathology services. Indeed a focus solely on local test production misses opportunities for pathology services to work in different ways to enhance care pathways, enable patients to take control of their chronic disorders and save resources outside the laboratory and across health economies. Where changes such as patient access to the results of their blood tests have been introduced, the main benefit has been in a reduction in the number of visits required by patients – the use of this innovation by Kaiser Permanante is a widely recognised example.

Foreword by Dr Ian Barnes

Using pathology services differently must be based on improving quality of care as well as increasing efficency. Pathology underpins the majority of clinical interactions and clinical value chains can only be unlocked if pathology services are coordinated in concert with clinical services. The gains from digitisation described in this report accrue when pathways are joined up across care settings and clinical networks. Quality is a major part of the equation in achieving value. Technology innovation such as standardisation of pathology reporting through the use of the National Laboratory Medicine Catalogue, digital techniques in histopathology and genetics will be essential to achieve quality improvement.

We hope that this report will highlight the range of excellent initiatives already underway in NHS Pathology which point to the opportunities for digital innovations to improve care and make better use of resources.

Dr Ian Barnes PhD FRCPath

Chair, Pathology Quality Assurance Review Board, NHS England

Executive summary

Around 95% of clinical pathways rely on patients having access to efficient, timely and cost effective pathology services. Pathology touches all of our lives, from before we are born to, in many cases, after we die.

Through our primary care and other clinicians and healthcare professionals, we rely on pathology to help:

- Diagnose our illnesses
- Screen us for congenital diseases, cancer and other conditions
- Monitor the progress of disease and manage our therapies

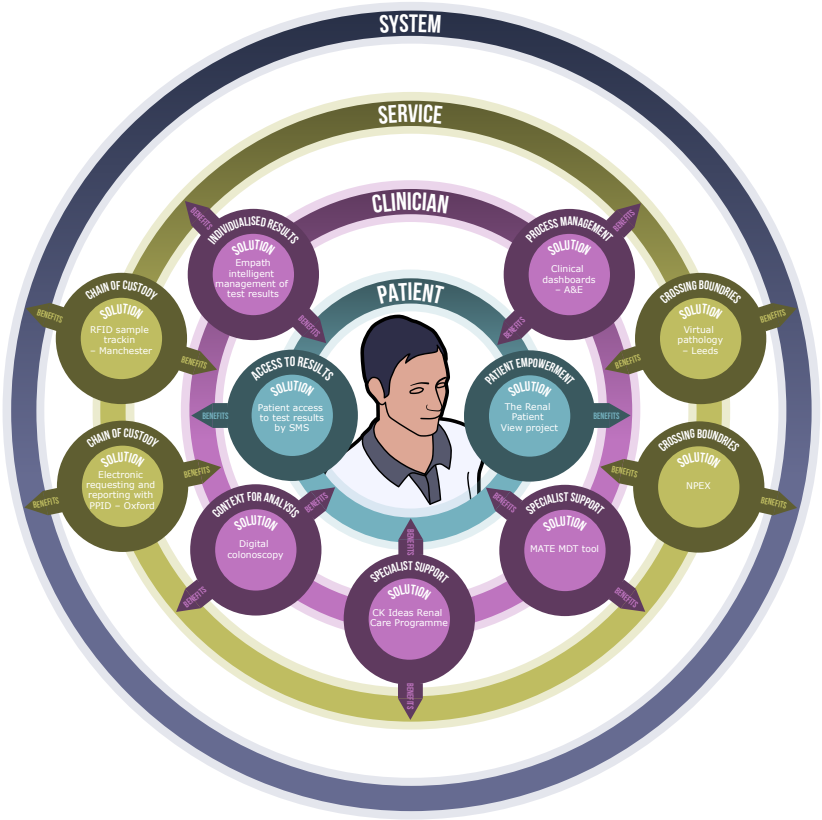
Pathology has embraced digital technology to enable it to deliver these services. Because pathology supports healthcare throughout care pathways, there are many innovative digital enhancements that will have a significant impact across health service delivery, helping clinitians delivery evidence based care and helping patients manage their own conditions.

The ability of digital to enable effective pathology service delivery must start with understanding user needs – patients, clinicians and commissioners. We need to appreciate that digital is only an enabler – the first step is to understand how services can be designed to better serve patients while also delivering safer and more efficient care. Digital, by its nature, can open up new possibilities and can inspire different ways of thinking – it should never be applied for its own sake, but we should be at a stage where digital is not merely as an add-on option.

We have to ensure that services are accessible to all of those who need them, and we are living in a digital world where people now expect to be able to access information and services in a way and at a time that is convenient for them, and the benefits of delivering through digital channels can be huge.

This report contains a number of great examples from across the NHS in England where digital thinking has helped to deliver real service enhancements.

EXAMPLES OF HOW EXISTING DIGITAL IMPROVEMENTS CAN HELP TO TRANSFORM HEALTHCARE SERVICES



Benefits delivered include:

- People feeling more in control of their health through better access to test results
- Multi-disciplinary teams having timely information and specialist advice to enable better treatment planning
- Better workflows between wards and labs to improve turnaround times and improve patient care
- Better identification and management of samples to enhance patient convenience and safety and reduce the cost impact of re-testing

These projects have improved how things work within pathology but, more importantly have delivered benefits at the interface between pathology and the services it supports.

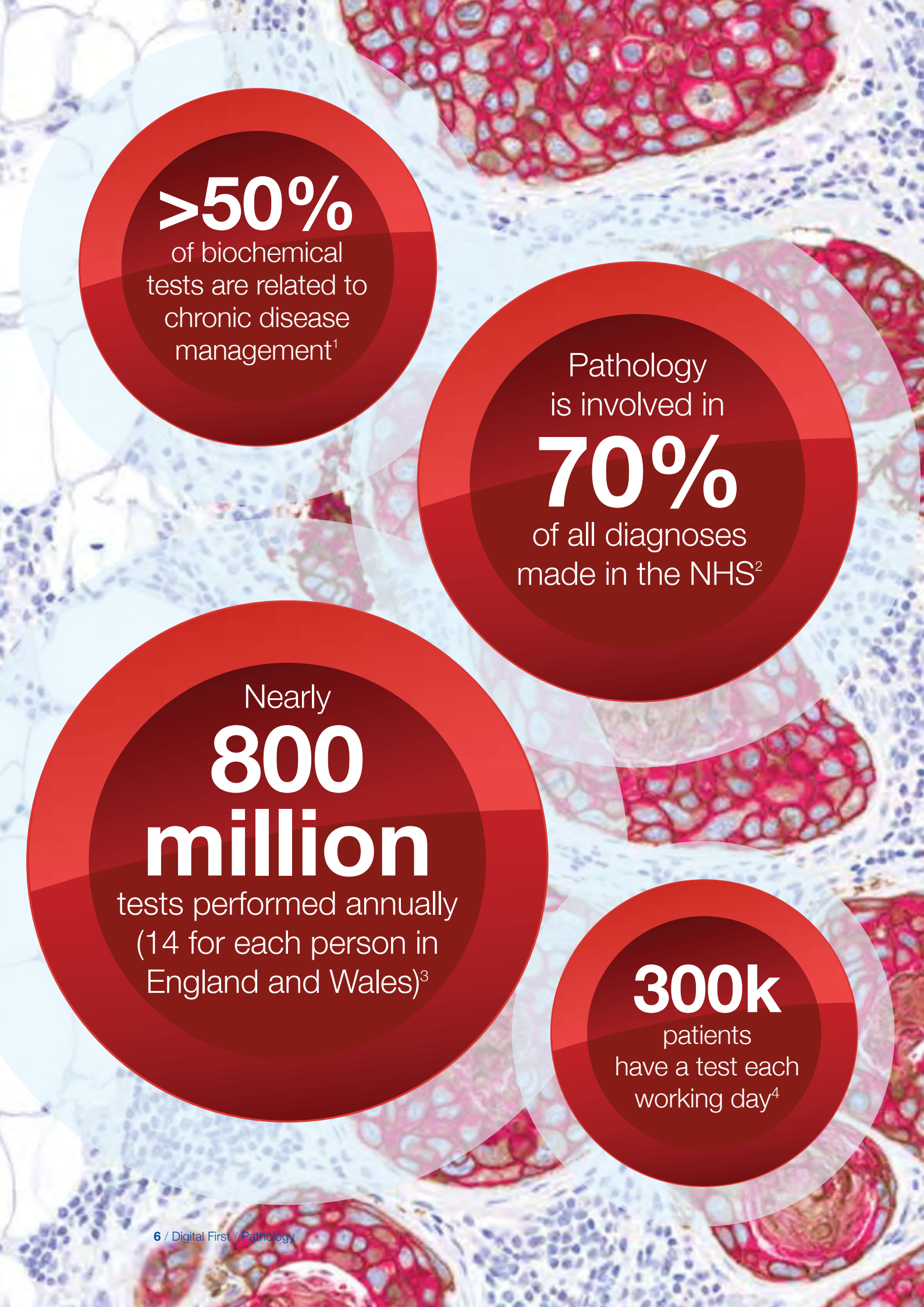
The challenge now is for commissioners and providers to understand how pathology benefits service delivery, and then drive change and enable digital innovation in pathology to help realise wider, longer-term strategic objectives.

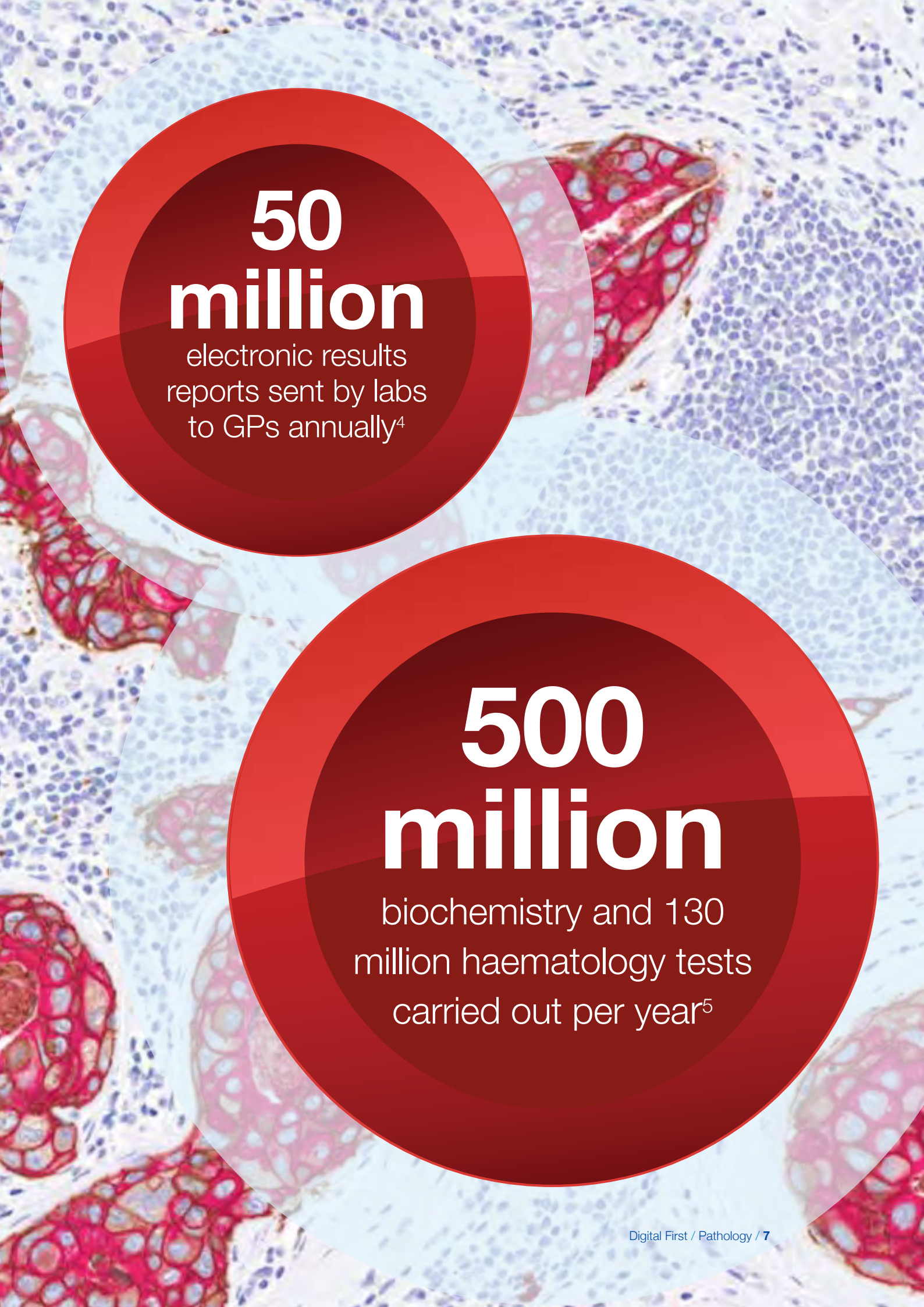
WHAT COMMISSIONERS SHOULD ASK

USING THE TECHNOLOGY
Are our pathology services using digital technologies to deliver the best service they can?

SERVICE INTEGRATION
Are our clinicians working with and supporting the integration of pathology services to enhance patient care?

EFFECTIVE COMMISSIONING
Are our commissioning and procurement models supporting innovation in pathology services?


>50%
of biochemical tests are related to chronic disease management[1]
Pathology is involved in
70%
of all diagnoses made in the NHS[2]
Nearly
800 million
tests performed annually (14 for each person in England and Wales)[3]
300k
patients have a test each working day[4]


50
million
electronic results
reports sent by labs
to GPs annually[4]
500
million
biochemistry and 130
million haematology tests
carried out per year[5]

Context

The NHS is in a period of rapid change – not only are the demands on it growing and changing, but widescale transformation is in progress, making sure we deliver the best outcomes for patients. Review of the quality and value of services helps drive the culture of continuous improvement to serve the needs of the future.

Laboratory medicine is undergoing its own transformation, both as a result of scientific and technological advances, and in response to the need to meet growing demands.

In his review of pathology services in England[2], Lord Carter of Coles spelled out the way in which the level of demand on pathology has been accelerating, including:

- an ageing population with an associated higher rate of chronic disease
- the shift towards personalised medicine
- advances in disciplines such as genomics and metabolomics that will increase demand on pathology for predictive and preventative investigations
- the potential of Summary Care Records to support identification of trends and warning signs in individuals' health events.

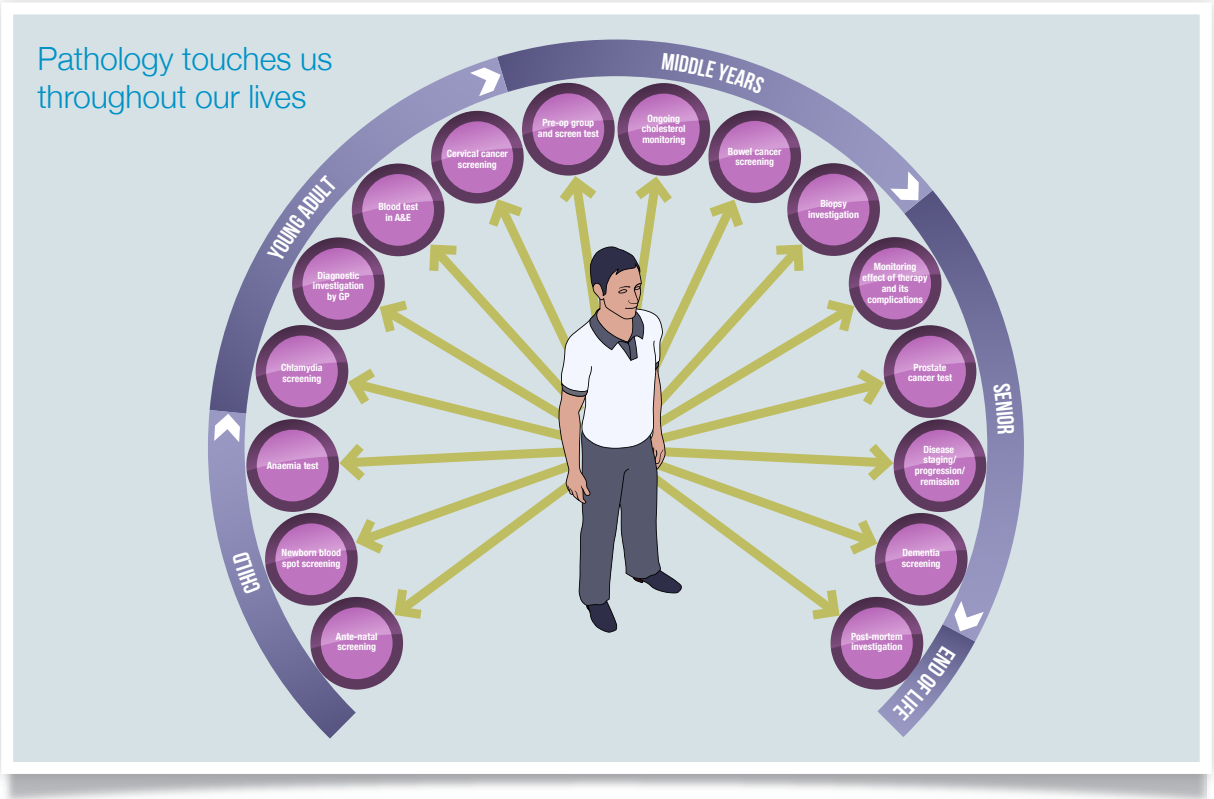
Pathology services are implementing the recommendations of the Carter report, and in particular finding ways to consolidate services to build physical and virtual structures that can respond to these demands.

The role of pathology

Delivering real improvements for patients means that clinicians, service managers and commissioners must identify the opportunities for improvement in care pathways. Key to this is understanding the roles and interplay between different clinical specialties and services, and how to maximise the value of those elements to the whole and remove or redesign parts of the system that do not add value.

Pathology is involved in 70% of all diagnoses made in the NHS[2]. But that figure underplays the role that pathology plays in screening and monitoring, and particularly in management of chronic conditions. And Pathology is not just a back-office function – it provides direct patient care in many specialist situations including clinics, infection control and as part of multi-disciplinary teams (MDTs).

Pathology's relevance to delivering better outcomes is due to its role throughout pathways, and not just at the point of diagnosis – 95% of clinical pathways rely on patients having access to efficient, timely and cost-effective pathology services[6]. Innovations within pathology have a significant impact across health delivery.



Pathology services impact at all stages of care pathways

A key issue in building business cases for change within pathology is that in many cases it is not pathology – as defined as a discrete service – that will see savings or even improved outcomes in itself. Hence investment needs to be seen in the round and not just in silos. Improvements are often at the interface with users or through achieving greater efficiencies and effectiveness in the services of clinical users. In the short term, this could be through more accurate test requesting and reporting, but in the long term this will be by tapping into the enormous potential for streamlined pathways, personalised healthcare and preventive medicine.

In its recent review of blood sciences[6], NHS Innovation cited a number of case studies where simple process improvements around the collection, processing and reporting of blood samples in a hospital setting made a significant impact on other areas, such as patient safety in the operating theatre (by improving the availability of Group and Screen results prior to surgery) and to length of stay. Conversely, in one “before” case the misaligned timing of sample collection and analysis in relation to ward rounds had turned what should have been a 38 hour stay in hospital into an eight-day stay for one patient.

In the case of infectious diseases, and particularly where carrier behavior has a significant impact on their spread, for example STIs, there is evidence that shortening the turnaround time from test to treatment is not only better for the patient but for the population as a whole.

The introduction of liquid-based cytology testing in cervical screening was another example of a great success, where a modest investment in pathology transformed the pathway. It dramatically saved cost and improved sample quality and the service provided to patients.

The challenge for pathology is to find other ways to promote its wider role in care pathways so that investment made in the lab or at the lab interface is linked to benefits manifested elsewhere. The challenge for commissioners is to understand how pathology benefits service delivery, and to drive change and enable digital innovation in pathology to help realise better value healthcare and better outcomes.

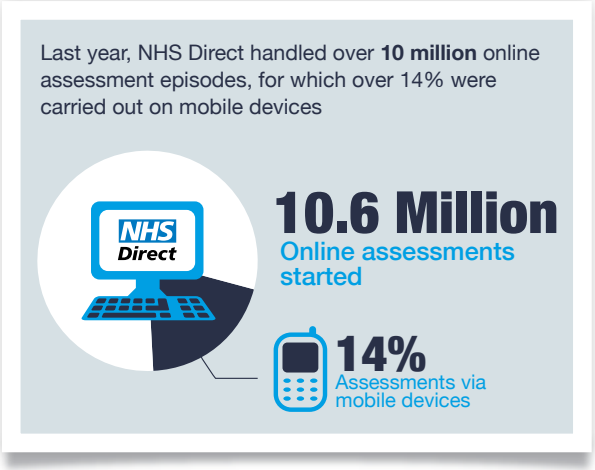
The digital dimension

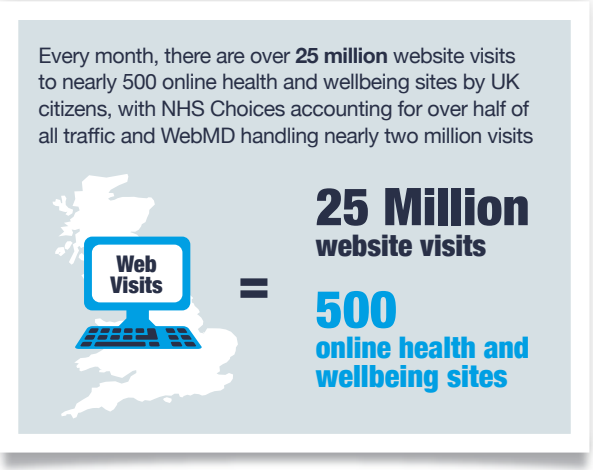
In the context of an evolving NHS, the central role of information, and digital technology as an enabler to sharing information and innovation in care, is receiving serious focus. There are particularly exciting opportunities as the emphasis shifts from the treatment of illness to the maintenance of good health.

The NHS IT strategy[7] focuses on the power of information to deliver the ambition for patient-centred healthcare. Almost 22 million people now have Summary Care Records (Dec 2012) with rollout continuing, and these are already delivering benefits in emergency care settings[8]. The move to patient online access to GP records – including test results – by 2015, and eventually to fully integrated electronic health and social care records, will be transformative in the relationship between health professionals and patients, and between patients and their health and wellbeing.

Online services such as NHS Direct and NHS Choices – which will soon evolve into a single health portal – show there is an appetite; the challenge for health services is to use digital to deliver services in a way that people want and need, that supports the quality and value agenda and results in better patient outcomes.

Digital First is focussed on harnessing the potential of digital channels to enable patients and healthcare professionals to interact in different ways, reducing face-to-face contact where this is not considered by clinician or patient to be necessary, and providing access that is more appropriate and convenient to people's lifestyles and needs. In the context of support services, these principles also apply to contact between healthcare professionals and the ways in which services are managed and delivered.





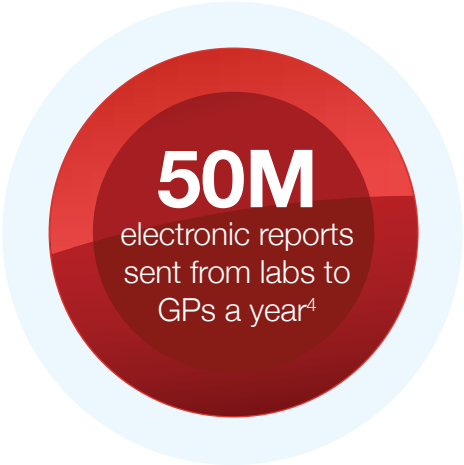
2012 figures

Pathology has a long history of embracing technology

As a scientific clinical service, pathology has a long history of embracing technology to support laboratory operations. It has also been at the forefront of informatics, in particular information standardisation and management, and has a mature informatics infrastructure.

Many areas of pathology are highly automated, and most laboratories manage their samples and workflow with some form of automatic identification and data capture (AIDC) – the majority using barcode systems to label and identify samples within the lab. Digital pathology is also gaining ground in specialist areas such as histopathology, as it allows for transmittable images and voice recognition to capture complex narratives.

Most labs also use some sort of laboratory information management system (LIMS) to manage their data, and order communications systems enabling clinicians in primary and secondary care settings to make electronic requests for tests are now in widespread use. Test result reports are sent electronically to primary care clinicians from all NHS labs via the NHS Spine using Pathology Messaging Implementation Project messaging (PMIP) – totalling 50 million electronic reports a year (2012)[4] . These transmissions enter results into the GP-held patient record automatically.



At a strategic level, the new National Laboratory Medicine Catalogue is leading the way in the NHS by developing information standards that will have a positive impact on patient safety, system interoperability and the value of data to the health system as a whole.

Each of these examples has brought benefits to the practice of pathology itself and, probably more importantly, adds value in terms of efficiency, patient safety and quality of care, which go beyond the boundaries of the laboratory.

There is however, still a huge amount of untapped potential, and while the production side of pathology can be made more efficient and responsive through innovation, the true value of pathology will only be released if it is viewed not as a production unit but as a customer-focussed service[11], where more significant gains can be made through exploitation of the digital opportunities in the clinical value chain. Digital technologies will enable linkages and communication to happen more easily, between pathology professionals and across specialism and geographical boundaries.

Digital quick fixes

Innovation is not just about new technologies, but also about new ways of applying existing technologies. NHS organisations already have access to a range of digital tools and channels that can enable smarter communication with patients, fellow professionals and other stakeholders and the development of faster, safer, better ways for managing processes and information that impact on patient care and experience.


Digital dictation


Voice recognition


Automatic ID and data capture (AIDC)


Digital clinical correspondence


Mobile working


Voice Over Internet Protocol (VOIP)


Secure SMS


Online meeting services

Many of these are available free or at competitive prices, with pay-as-you-go models rather than those requiring up-front capital investment. There are applications that have been developed or adapted specifically for use in healthcare settings and within appropriate data security parameters. They are already delivering proven benefits across the NHS, so provide quick building blocks for service improvement and further innovation.

In addition, application of technologies for remote support and healthcare are becoming more widespread in the NHS, and in many cases impact on and are impacted by, developments in laboratory medicine.

Telecare – remote monitoring of emergencies and lifestyle changes to manage the risks of independent living

Telehealth – remote monitoring of specific health indicators such as INR (Warfarin monitoring), blood pressure, blood oxygen levels or weight. Solutions vary from simple SMS links to more complex technologies

Telemedicine – remote consultation eg. between patients and consultants or between GPs and specialists. Can be real-time or via data (eg images) captured and sent for expert second opinion, such as very high resolution histopathology sample images for cancer diagnosis.

QIPP Digital Technology has produced a useful guide to enabling technologies:

Digital technology essentials guide – go to:
http://www.networks.nhs.uk/nhs-networks/qippdigital-technology-and-vision/documents/QIPP_DT_Technology_Essentials_Guide.pdf

Using SMS to report results

SMS is low cost and widely used, with 92% of people in the UK now owning a mobile phone and 129 billion text messages sent within the UK in 2010. There is growing evidence that users see SMS as a secure direct communication channel and less likely to compromise confidentiality than letters or landline phone calls.

Since 2004 the Isle of White NHS Trust has been using SMS to inform patients of negative results from the Sexual Health Service. In 2006 this was extended to include appointment reminders. The initiative has reduced missed apointments from 22.5% to 14.1%, has reduced clinic appointments by more than 3,000 and avoided 4,000 letters each year. The cost efficiencies add up to more than £350k[12].

Opportunities to exploit innovation

If all laboratories and pathology services implemented those digital services already used by some labs, and all used them to their full potential, it would result in benefits without requiring any further innovation.

For example, laboratory information systems enable data mining and analysis, but to date haven't been widely used for this purpose. The potential of this data lies in pathology's role in the delivery of care along patient pathways, and in identifying trends and links between treatments and outcomes.

Although improving laboratory systems and processes through digital technology is good in itself, it could be much more beneficial if the full potential of digital connectivity was harnessed. Order communications systems for instance have created a paperless, structured transaction between clinicians and labs and are already helping to improve the quality of test requests and reducing errors. Current systems are still fairly rudimentary, and not properly integrated with primary care or hospital systems. Although they can capture some information from the clinical systems, such as the patient's NHS number, the value of fully integrated systems connecting information across an EPR would be immense, for example enabling features like the creation of automatic queries when a test is ordered that is impacted by a patient's medication.

Despite the fact that PMIP messages can feed results directly into GP systems, there is potential for further improvements to make these links more effective and to really use the data that is available to enhance patient test management.

In other cases, better processes outside the lab will have an impact on the quality of service delivery from the lab. A digitally enabled system for managing information within a laboratory relies on the quality of data coming in, so if a sample is wrongly labeled, no amount of bar coding or other asset management systems within the lab is going to fix that error. Given the potential impact of poor sample management in delaying diagnosis and treatment for the patient, and the costs and inconvenience of repeat testing, there is a clear incentive for the clinical services collecting samples to make improvements in their own sample management. You can read later in this report just how using digital technologies at the point of testing are helping to resolve this.

These and other issues occur at the interface between pathology and other parts of the care pathway, and it is these areas that pathology must now seek to address, by supporting the spread of innovation to all users and providers. Keeping up the momentum and, most importantly, connecting across service boundaries, will maximise this potential and ensure that the opportunities provided by technology in general, and digital technology in particular, are not missed.

This is not just down to the professionals working within health. Increasingly, it will be about driving market innovation through commissioning specifications and choices. As industry also takes its agenda on board, the suppliers of GP systems are already starting to look at how order comms can be integrated into their products.

"Pathology is an information business. Pathologists provide useful answers to good questions."[10]

Making procurement quicker and simpler

The NHS IT Strategy[7] signalled a move away from centralised IT procurement towards more local responsibility. This doesn't mean the end of national infrastructure programmes (eg. the Spine), but it does open the way for more locally responsive solutions and innovation.

At the same time, initiatives such as G-Cloud are helping to support a more flexible procurement approach. G-Cloud is a cross-government programme focused making public sector IT procurement easier and encouraging more SME providers to enter the market.

The G-Cloud CloudStore is an online catalogue of products and services, which have been procured under the OJEU process and can therefore be bought 'off the shelf' by individual organisations without having to undergo a lengthy procurement processes.

The procurement model has been developed to encourage a dynamic and responsive marketplace that supports emerging suppliers. Many of the services are offered on a pay-as-you-go basis without big up-front capital costs, which can support a totally different business model for digital innovation.

Although in its infancy (the G-Cloud framework and CloudStore were launched in February 2012) it lists over 3,500 services.

All this is good news for pathology services looking for agile, innovative approaches to service needs that can deliver benefits faster, and cheaper.

More information:

G-Cloud:
http://gcloud.civilservice.gov.uk
CloudStore:
http://gcloud.civilservice.gov.uk/cloudstore

Buyer beware

There are many considerations when commissioning services, but never assume all providers have the same digital credentials. There are examples of tenders for pathology tests that have failed to specify that results should be returned in electronic format, with the result that the commissioning laboratory receiving results from an outsourced service has to input manually all of the paper-based results on to its LIMS, adding cost and delay.

A similar problem arose when radiology services were outsourced some years ago and x-rays were returned in non-standard formats.

Commissioners should ensure that they understand how the inputs into pathology services affect the quality and efficiency, as much as the service itself.

Unlocking the potential of data

The power of information in helping us to understand issues and trends and to improve services, will be unlocked by creating a digital ecosystem. Data will be collected, stored and transmitted in a way that allows interoperability between systems and clear interpretation at the point of use – whether that be in a patient care setting or for public health research.

Transferable data is a pre-requisite of joining up digital information systems and processes, and that means we all have to be speaking the same language. The challenge is not only to physically transfer data, but to ensure that its meaning is clear and its context is preserved.

The NHS has adopted three standards to ensure that IT systems can communicate with each other, to support and enable better end-to-end care of patients and efficient and effective back end processes:

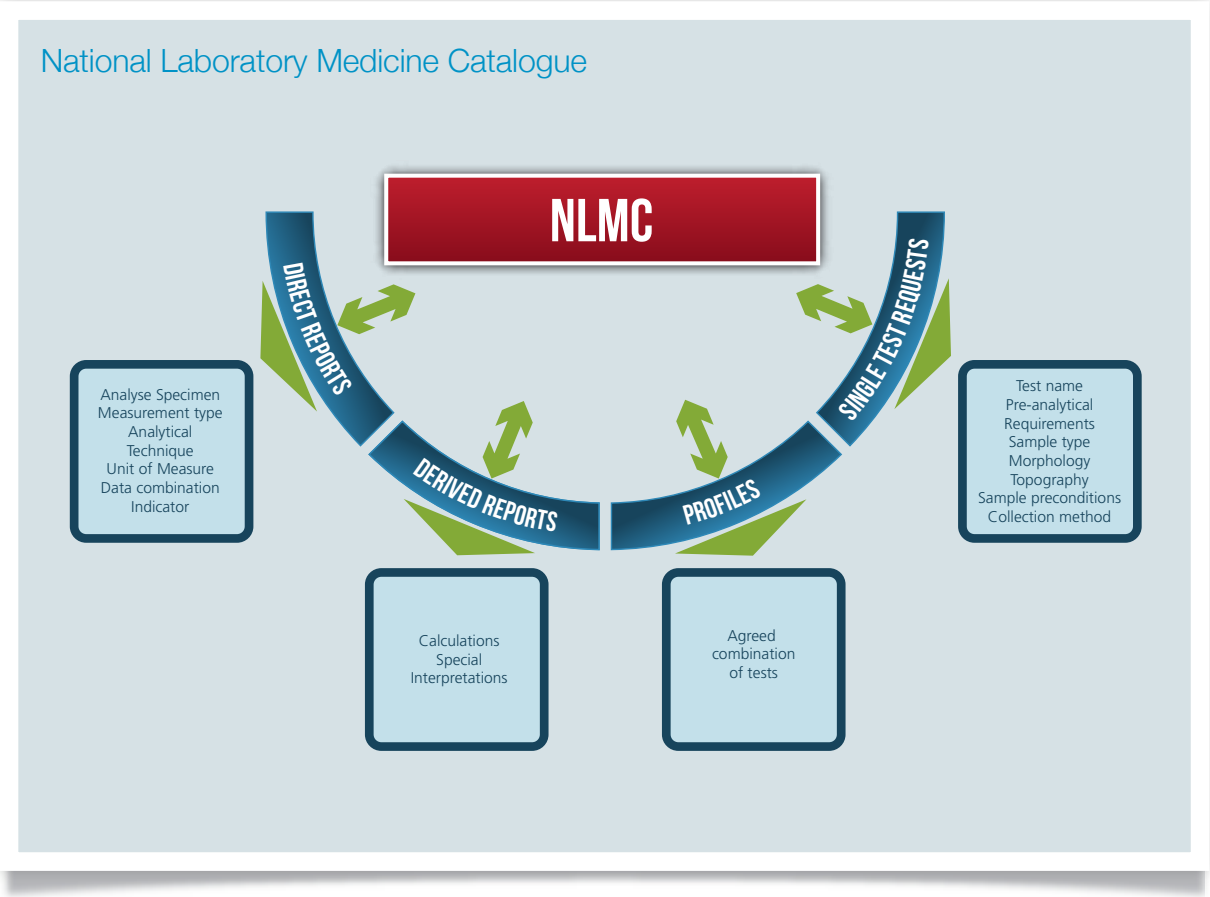
- **SNOMED-CT*** – for the unambiguous identification of clinical concepts such as diseases, findings and procedures. This includes pathology sub-sets
- **HL7** – for the exchange of messages between systems from different manufacturers. This includes a set of pathology-specific messages
- **NHS number** – for the unambiguous identification of patients

Used together, these standards will ensure that all systems and services are able to link and share data clearly and safely.

Pathology has been at the forefront of developing and adopting data standards – SNOMED was created out of over 40 years work by the College of American Pathologists as well as international collaboration. It is the most comprehensive international clinical terminology available, now adopted across all clinical areas, not just pathology.

The creation of the **NHS National Laboratory Medicine Catalogue** (NLMC) is building on these standards. It is the UK's first comprehensive catalogue of test requests, and provides a clinical content information standard using SNOMED-CT coding terminology and additional content on appropriate tests and techniques, quality assured and validated for use across the NHS.

* Systematized Nomenclature of Medicine Clinical Terms



The catalogue embodies the principle of enabling effective and safe communication through the use of unambiguous standard naming conventions and, by providing decision support and improving test evaluation, it will help clinicians find and order the right test and reduce the number of inappropriate test requests. Conceptually equivalent to the British National Formulary (BNF), NLMC has the potential not only to list diagnostic tests, but to be used to support service delivery, regulation, innovation and research.

Although the existing catalogue of pathology reports, the Pathology Bounded Code List (PBCL), enables electronic data transfer between clinical laboratories and other clinical systems via Pathology Messaging Implementation Project (PMIP) messages, its limitations are becoming increasingly apparent as data needs to be shared more widely between multi-disciplinary teams, clinical networks and disease registers. The inception of the combined patient record will focus this need still further.

NLMC is a joint initiative between the Department of Health, NHS England , HSCIC and the Royal College of Pathologists, with clinical input from across the NHS and industry. It is designed to be a living, web-based resource and is being developed using open-source principles with online, real-time editing, moderation, validation and professional sign-off.

Open data standard for pathology

NLMC will provide the standardisation required to make pathology data open to all those who want to use it – not just clinicians and patients, but others including screening programmes, disease registries and service commissioners.

Standardisation will make it easier to use tools like the Atlas of Variation to interpret differences in investigation policies across the country, as it will be clear that like-for-like comparison is being made. It will also make trend analysis more accurate and meaningful.

As experienced in industry and other public sector organisations, opening up access to data through standardisation should also lead to innovation and novel applications – data can be combined and used in new ways to create new information-based services that respond to user needs. Popular examples outside medicine include crime data mapping and real time, location-sensitive transport information about tube or bus services or bike share availability.

The catalogue is being built in phases, and the first version is now available as a 'technology preview' release. As a starting point, this concentrates on basic standardised content relating to pathology single test requests on seven areas:

- Clinical biochemistry
- Haematology
- Blood transfusion
- Immunology
- Histopathology
- Cytology
- Virology

The focus is on implementation into new systems, as it is recognised that many existing systems have limitations that would prevent compliance with NLMC implementation rules. Having an open and ready-made catalogue of pathology tests validated for use in the NHS will lead to significantly shorter implementation times for new electronic order communication systems.

The NLMC team is encouraging services to implement the catalogue on a trial basis, to evaluate its usefulness and safety, and to suggest improvements. This feedback will be incorporated into plans for further developments, and may lead to NLMC eventually replacing PBCL.

The benefits of the NLMC will grow over time, as more tests and disciplines are added to the catalogue, and as more pathology services implement it.

More information:

National Laboratory Medicine Catalogue:
http://www.laboratorymedicine.nhs.uk/

HSCIC – NLMC:
http://www.hscic.gov.uk/

http://systems.hscic.gov.uk/pathology/projects/nlmc/nlmcrelease/keymessages

Examples of digital innovation in pathology

There are many examples around the country of pathology using digital innovations to improve service delivery, patient safety and communication, among other things. The following is just a snapshot of the range of initiatives that are already delivering improvements that help patient care

Transformative infrastructure

The National Pathology Exchange (NPEx)

The full value of digital technology comes in connecting people and services – efficiencies can be limited where manual processes are needed as inputs and outputs of automated systems. The National Pathology Exchange (NPEx) is a national data exchange service that provides the missing link in lab-to-lab communications.

Complexity

Moderate

Background

Though the majority of core laboratory services are highly automated and computerised, the referral of samples to other centres is still paper driven.

It is estimated that around six million pieces of paper are sent between NHS laboratories and manually input into computer systems every year (2001 figures), using an estimated 300 resource years and introducing the risk of errors and delay in patients receiving their results[14].

The volume of lab-to-lab communications will continue to grow with the consolidation of specialist services, the rapid growth in point of care testing and the opening up of the marketplace for laboratory services.

Insights

NPEx provides a solution for these issues in lab-to-lab communications, by establishing a direct interface between laboratory LIMS systems and a national hub, creating a streamlined, paperless process.

The digital service uses a Microsoft BizTalk messaging engine, which converts local codes to HL7 messaging and NLMC SNOMED coding standards, and enables interoperability between LIMS such as iSoft and CliniSys. Messages go via the NPEx exchange hub, which is located in a secure NHS data centre.

NPEx was inspired by a DH think-tank in 2001 and created by X-Lab Systems based at the University of Leeds. It was first installed across the nine labs of the Greater Manchester Pathology Network in 2009. The service is managed by The Health Informatics Service (THIS), hosted by Calderdale and Huddersfield Foundation Trust and is the largest informatics shared service in the UK. Around 30 NHS laboratories are using NPEx to digitise their lab-to-lab communications, and by August 2014, 25% of the NHS labs in England expect to be connected.

An additional benefit of NPEx is that it allows the progress and physical location of tests and results to be tracked. It can also provide pathology managers with a view of tests offered by other labs, how much they charge and turnaround times. Opening up this information about the marketplace should help to drive improved service performance because it will lead to more intelligent pathology commissioning, for example outsourcing tests that can be done more cheaply or faster elsewhere.

As more labs in more regions get linked up to the system, the value of this market transparency will increase. In addition, by providing interoperability between different LIMS, NPEx provides a way of joining up services regardless of whether they are using the same LIMS. These benefits should enable procurement and collaboration across network and geographical boundaries, reshaping pathology services in ways that go beyond the regionalisation recommended in the Carter report[2].

This may be some way in the future, but the success demonstrates the transformative effect that a comparatively straightforward, digitally-enabled business change can have.

Likened to the services provided by a telephone exchange, THIS supplies NPEx using a 'software-as-a-service' model – participating labs pay a quarterly subscription fee, which covers network connection and support. They must also purchase an NPEx interface from their LIMS supplier. Costs for this vary according to supplier, but would not rule NPEx out for most laboratories or networks. A free web-based service has also been developed for low volume users.

Outcomes

- Helps deliver faster service to patients and clinicians
- Estimated cost savings £1-3 per sample – data entry, handling, postal and paper
- At least one day faster service as results received electronically and not by post
- Reduced opportunity for errors introduced during data entry
- Auditable sample trail – bar-coding used from end-to-end
- Reduces ad-hoc enquiries as electronic status checking and monitoring
- View of market intelligence supports better commissioning decisions
- Could help break down the organisational and geographical barriers to collaboration

Next steps

Roll-out so far has tended to be regional – it makes sense that with most lab-to-lab work currently mainly within regions, the greatest benefits will be where those working together get linked up. The target is to get 50% of labs in England on NPEx by 2014, and this is expected to provide a tipping point that will make it more and more beneficial for all labs to get connected.

NPEx interfaces are currently provided by CSC iSOFT, CliniSys and Molis, with Roche SwissLab, STARLIMS and Technidata interfaces in development. X-Lab Systems and THIS are working with other LIMS providers to encourage them to develop interfaces too.

Resources

For more information on NPEx and to register for a free trial, visit: **http://www.this.nhs.uk/our-services/national-pathology-exchange/**

You can view a short introductory video to NPEx here: **http://www.npex.nhs.uk/Home/NpexInAction**

Virtual pathology

Digital pathology promises great improvements in delivering patient care, including faster test results and ease in seeking a second opinion. With the use of virtual microscopes this is now becoming possible.

Complexity

High

Background

Digital pathology (the complete digitisation of pathology slides) allows for a number of benefits in the delivery of patient care – slides are easier to access, the risk of slides getting mixed up is radically reduced and patients can receive specialist review more quickly.

Despite these benefits, digital pathology is rarely used outside of research and teaching facilities in the NHS. There are several reasons for the slow uptake of digital pathology, including lack of regulatory approval, lack of an established cost benefit and pathologists' reluctance to use the technology. For many of these reasons, an underlying cause may be that the currently available digital pathology software is inefficient and rejected by users.

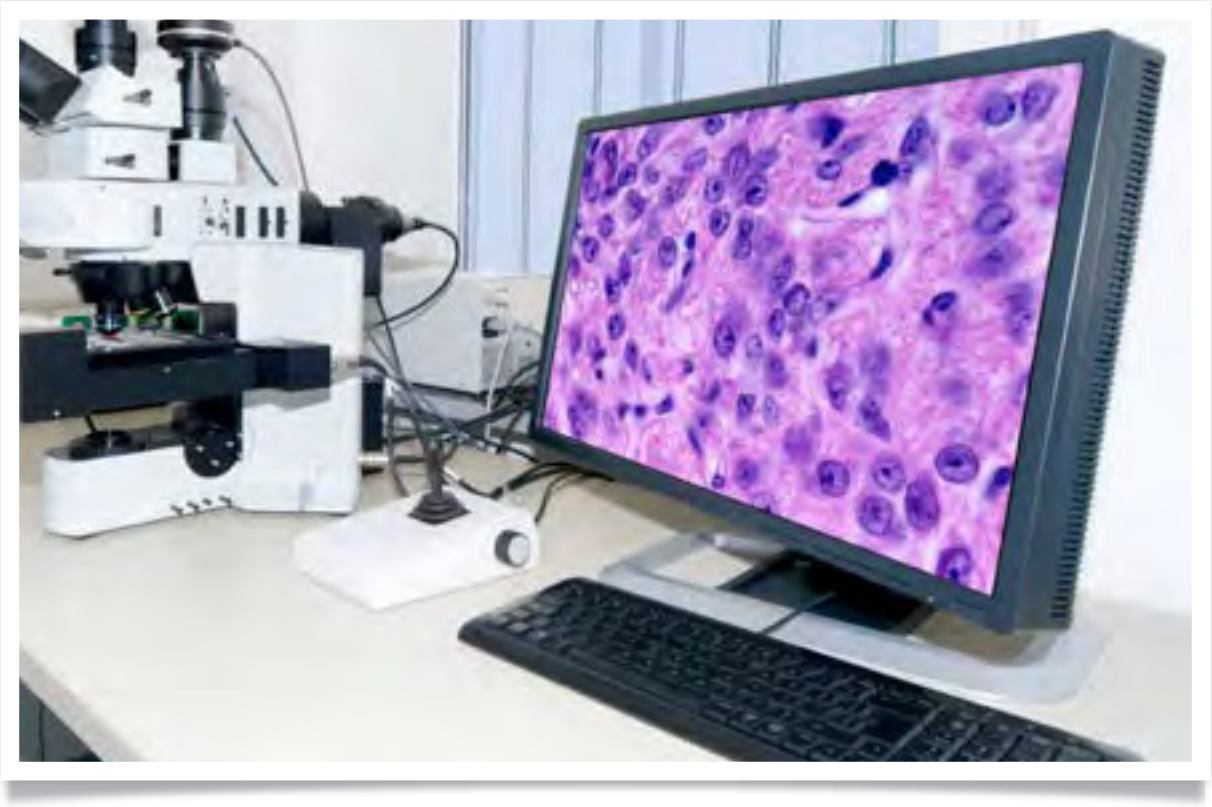
Funded by the Pathological Society of Great Britain and Ireland, and the National Institute of Health Research (NIHR) New and Emerging Applications of Technology (NEAT), a group of researchers at the University of Leeds (Pathology and Computing) and Leeds Teaching Hospitals Trust have spent the past four years developing a virtual microscope to make these benefits more widely available.

Preparatory work found that it can take 60% longer to make a diagnosis using digital slides due to the level of detail they contain and the size of the images – if they were printed on paper they would be the size of a squash court, yet most manufacturers only provide slow standard PC-based desktop software with small screens.

Insights

The goal of the project has been to create a Virtual Reality microscope that allows for faster diagnoses with the same accuracy as a conventional microscope, and that histopathologists will feel comfortable using in their day-to-day practice.

The key innovation of the project is to combine expertise in multiple disciplines (pathology, computer graphics, ethnography, psychology and medical imaging) to design a digital pathology system which is truly fit for purpose for both individual pathologists and the health service. The system was developed with significant input from pathologists at Leeds Teaching Hospitals Trust at both the design and evaluation stages.



The Leeds virtual microscope uses a combination of Virtual Reality software techniques and medical grade monitors to make the viewing of digital slides dramatically easier and quicker.

The team has developed both a single-user workstation for clinical use, as well as a multi-user “Powerwall” consisting of 12 high-resolution monitors that can be used for teaching and multidisciplinary team meetings.

Using the single-user workstation, virtual slide images are presented to the user on a very high-resolution display using two medical grade monitors (giving a total of nine megapixels, similar to the image seen with a microscope). The software is much faster than commercially available software, allowing the pathologist to move around the image freely as they would with a microscope. A thumbnail image and case overview on the right-hand screen shows where they are on the sample so they can stay orientated at all times.

Initial evaluation shows that the Leeds virtual microscope can be used with minimal training to make a diagnosis as fast as a microscope.

Outcomes

- Faster transmission of cases between centres (eg. for review at multidisciplinary team meetings)
- Facilitates remote working (eg. providing specialist services at remote sites, such as neuropathology, transplant pathology or frozen section diagnosis)
- Improved safety and efficiency
- Accuracy equal to conventional microscopes
- Easier access to specialist review
- Potential improvements to laboratory efficiency including administrative and medical time

Next steps

Follow-on work is planned to further improve the software so it is faster than the microscope, and to prove the cost-benefit of such a system to a health system (for example, by reducing the overall time to make a diagnosis). Commercialisation discussions are also underway.

Resources

Further information including videos is available at:
www.virtualpathology.leeds.ac.uk

Integrated management of test results

For large pathology departments spread out over multiple locations, finding an integrated laboratory system is crucial to improving efficiency, adapting to growing needs for services and enhancing multidisciplinary working.

Complexity

Moderate to high

Background

In 2002, Leicestershire Pathology Service (LPS) was operating labs at four separate locations and using five different laboratory systems covering haematology, biochemistry, immunology, blood transfusion, histology, cytology and microbiology.

The LPS realised they needed to consolidate to a single system that could work across multiple sites in order to work more efficiently. The system they choose for the task was iLaboratory, made and supported by iSoft.

Insights

By 2010 up to 80% of routine work in some areas were automatically authorised using 'rules and gauges' checks, and with regular upgrades from iSoft, the LPS was able to adapt to the increased demand for their services, which was growing at a rate of 10% a year.

The integrated system allowed for test result reports to be sorted and dispatched more quickly. Multidisciplinary reports allowed for patients to be seen for numerous tests before their outpatient appointment – a 'one-stop shop' for blood tests, ECGs and chest X-rays, for example.

The LPS continued to expand and in 2012, the University Hospitals of Leicester NHS Trusts and Nottingham University Hospitals joined together to create *empath*. The partnership now delivers more than 25 million pathology tests and serves over three million patients every year, providing services to around 600 GPs across the East Midlands.

Outcomes

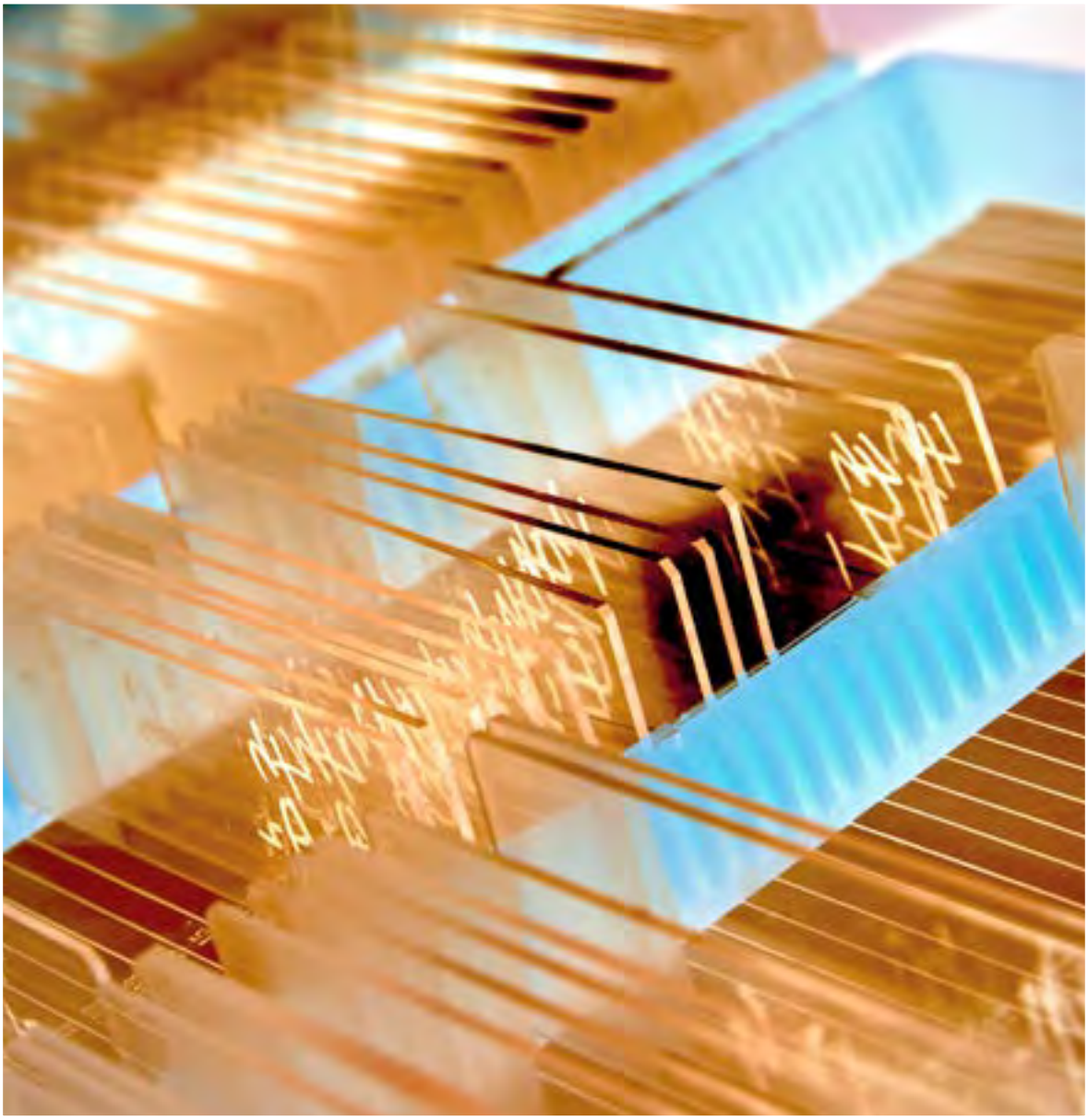
- Improved efficiency/turn-around times
- Online reporting of results
- Real-time tracking of all samples
- Ability to handle growing demand for service
- Multidisciplinary working supported
- Significant cost reductions to GPs and for hospital services

Next steps

empath was formed following Lord Carter's review and recommendations that pathology services should consolidate on a regional basis[2]. While many labs will not be in a position to join up with others at this point, they can take advantage of existing integrated systems such as iLaboratory to make this transition easier in the future and to improve efficiency in the interim.

Resources

empath website: **www.empath.nhs.uk**
iSoft website: **www.isofthealth.com**



Sharing information to improve patient care

Electronic referrals and sharing of electronic health records

Using an e-consultation advisory service to make electronic referrals and share electronic health records between primary care and specialists could result in a significant reduction in unnecessary referrals and improved care for thousands of patients with chronic diseases.

Complexity

Low

Background

Patients with chronic kidney disease (CKD) are generally referred to a renal specialist by letter. This often leads to lengthy delays and unnecessary hospital visits. In addition to sub-optimal patient care, there is a negative impact on the workload of renal specialists and GPs are not adequately supported to manage CKD in the community.

To address these problems, Bradford and Airedale Primary Care Trust and the Bradford Renal Unit developed an electronic consultation service based on sharing of the primary care electronic patient record between GP and specialist, using the functionality of a centralised IT system (SystmOne®).

Insights

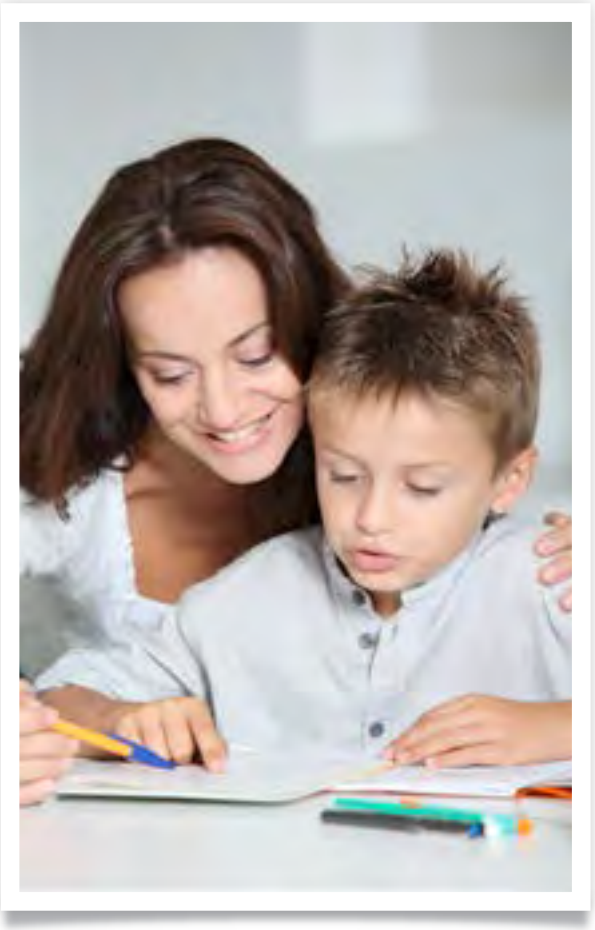
Using this secure system, GPs are able to send electronic referrals to renal specialists and share the patient's electronic health records, including important clinical details such as medication history, communication from other specialists, reports of previous imaging and numerical pathology data.

The GP chooses either to 'request advice' or 'question the need for hospital clinic review', using agreed referral criteria. Based on the clinical details provided in the electronic patient record, the specialist decides whether the patient should be referred to clinic, undergo preliminary tests or interventions, or continue to be monitored and treated by the primary care team. Responses are saved in the electronic patient record and also sent as tasks to the primary care team.

Since the initial pilot of e-consultation involving 17 GP practices, the programme has been expanded to all practices in Bradford and Airedale Primary Care Trust. The hospital IT infrastructure has been developed to support wider use of primary care electronic patient records, including the management of other chronic diseases including cardiology, endocrinology, rheumatology and diabetes.

The concept of sharing primary care electronic records within the Bradford Renal Unit has now been extended to patients with more advanced disease (including dialysis and transplant patients). Clinical benefits include medicines reconciliation and streamlining of shared care pathways such as anaemia management, hepatitis B vaccination and coordination of palliative care services.

The project was awarded first prize at the 2011 British Journal of Renal Medicine Innovation Awards. It has been published in NHS Evidence and is referenced in various DH and NHS Kidney Care publications. The benefits of e-consultation have been presented at numerous events, including a Quality and Safety in Healthcare international conference, Royal Society of Medicine meetings, a DH Tackling Long Term Conditions: Health and Wellbeing event and NHS Expo, to promote its adoption at a national level.



Outcomes

- Dramatic reduction in average response time – from 52 days with paper referrals to five days with electronic consultations
- Significant reduction in unnecessary referrals
- More time for patients who need it most
- Easy to implement, works with existing electronic patient records
- GPs report system as convenient and easy to use
- GPs feel more confident to manage uncomplicated CKD in the community
- Potential environmental benefits recognised by the Greener Healthcare Campaign

Next steps

As evidenced, the system can be used across a number of specialties, in particular those that provide care for patients with chronic diseases such as CKD.

All patients in the UK have a detailed primary care electronic health record. There are opportunities to exploit these health records to redesign pathways at the interface with secondary care and so provide seamless and cost-efficient care closer to the patient's home. Clinical Commissioning Groups can work in collaboration with colleagues in secondary care to develop these pathways. There is potential for record sharing to be implemented widely throughout the NHS.

Resources

SystmOne: **www.tpp-uk.com/working-with-the-nhs**

Supporting patient self-management

Renal PatientView project

Digital is a natural fit for helping patients with long-term conditions to self-manage their disease, leading to a greater sense of control and potentially better outcomes.

Complexity

Low to moderate

Background

Engaging patients in their care is widely recognised as key to improving the patient experience and outcomes for those with long-term chronic conditions.

In 2003, the Renal Information Exchange Group (RIXG) began exploring ways to use digital tools and services to improve access to information and care for kidney patients in the UK. The group, which includes representatives from the entire renal community, identified the development of electronic care plans as the most effective way to do this.

The service they developed, Renal PatientView (RPV), is an online patient portal that allows kidney patients to access their test results along with information and advice on their condition.

Insights

After piloting the service in four units, the RPV service was made more widely available and is now used by 80% of renal units in the UK. RPV has over 17,000 registrations and 1,000 logins on an average weekday.

The system continues to evolve and now interfaces with almost all renal electronic patient record systems, as well as with several non-renal or bespoke systems. The RPV was mentioned as an example of good practice in the 2012 NHS Information Strategy[7].

Total development funding for the system was £120,000 and used an agile approach to software development. On-going maintenance costs are covered by the participating units, which pay an average of £2,000 a year, except in Scotland where the government pays for the service.

Both staff and patient feedback has been very positive. Patients feel better informed and more in control of their condition. Staff report patients are less anxious, resulting in fewer phone ,calls and better quality consultations since more time can be spent on future plans, rather than reviewing test results. They also feel the more engaged and informed patients are, the more likely they are to strive to improve their outcomes.

Outcomes

- Improved patient engagement, knowledge and satisfaction
- Better quality consultations
- Increased feeling of partnership between doctors and patient
- Potentially improved outcomes

Next steps

The system is currently being piloted for another chronic condition and the RIXG have altered the architecture to make it easier to adapt to any disease.

Soon they plan to test another pilot that allows the patient to flip their view from one topic to another, such as from a blood condition to kidney disease, or to liver and so on.

Engaging patients in their care by providing online access to test results and information about their condition is a cost-effective way to improve both patient satisfaction and outcomes.

Resources

Renal Association website: **www.renal.org/rpv**

Renal PatientView portal, includes demo logins: **www.renalpatientview.org**

Updates and news on Renal PatientView: **www.renalpatientview.blogspot.co.uk**

Business intelligence in pathology

Using information to improve services and outcomes

The running of pathology services can be enhanced and improved by using business intelligence tools such as geographical mapping, visual displays and clinical dashboards.

Complexity

Moderate

Background

Business intelligence tools and technologies help businesses to gain insight and understanding of their operations. With them a business can mine its data to better manage what's going on and to predict what's likely to happen. Some of these tools include SQL mapping, data warehousing and mining, reporting applications, dashboards and alerts.

Pathology services can benefit greatly from these tools. They can help labs handle continually increasing workloads and data as well as the rising complexity of tests, IT systems, networks, rules and regulations. A team at Sandwell and West Birmingham Hospitals NHS Trust decided to use these tools to do just that.

Insights

The team first recognised the need to get information to its users is just as important as the information itself. In order to do this they used a combination of information delivery methods including 42" screens in the labs to present dashboards and messaging, web pages to present dashboards and email to send alerts. They are also currently developing the use of texts and bespoke forms to inform patients of some of their test results.

Using health outcome monitoring the team set out to reduce blood culture contamination rates. They started by doing a base-line assessment of the scale of the problem then identified target areas (and individuals) of concern. The results included a noticeable reduction in blood culture contamination rates, reduced costs associated with unnecessary clinical and laboratory work as well as the reduced risk and cost of inappropriate treatment.

Using a clinical dashboard the team was also able to reduce test turnaround time in A&E. Since the introduction of a TV screen showing turnaround times from receipt to authorisation average times dropped from:

- 61 minutes to 48 for liver check plus
- 57 to 45 for urea and electrolytes
- 79 to 37 for ferritin
- 73 to 45 for prothrombin time

Thanks to the improved turnaround times clinicians are able to make diagnoses more quickly, resulting in patients being able to begin treatment or be discharged in less time.

In addition, the team also improved the lab's 14-day cytology targets through using online target monitoring and data mining. Since implementing the change, all cytology tests now meet the NHS 14-day standard.

Outcomes

- Improved data quality
- Improved efficiency and productivity
- Positive impact on budgets
- Early reaction to change thanks to real-time information
- Cost effective – uses available tools and technology

Next steps

Most laboratory information management systems (LIMS) have a wealth of data that can be unlocked using business intelligence tools. In order to use these tools to their maximum advantage, pathology IT teams need a good understanding of pathology, the systems and new technologies.

Using existing LIMS, pathology departments can improve quality, efficiency, costs and patient outcomes often with only small investments such as additional TV screens or inexpensive software.

Resources

iSoft website:
www.isofthealth.com

Safer sample management

Managing samples from end-to-end with automatic identification

Laboratory processes and systems to manage samples are well developed and, these days, are almost always automated. But it's a different story with the collection and transportation of samples to the laboratory from surgeries and clinical or hospital settings. Poor labelling and lost samples are an everyday occurrence across health services, impacting on patient safety and convenience and service costs. But now digital technology is being used to tackle this issue.

Complexity

High

Background

Oxford University Hospitals NHS Trust is using positive patient identification (PPID) to improve the management of pre-transfusion blood samples between the bedside and the lab across its three acute hospitals. It has set up an electronic requesting and reporting service that uses barcoding to create a permanent identification link between patients and their specimens.

The system integrates with, and has been introduced as part of the implementation of, the Cerner Millennium electronic patient record across the Trust. Wireless connectivity was also already in place across the sites.

Insights

The Oxford University Hospitals laboratory medicine service is highly automated and uses barcoding to ensure that samples are properly managed within its laboratories. This meant that focus could be given to improving the interface between pathology and the clinical services it supports, and the introduction of a new electronic patient record and management infrastructure offered the opportunity to redesign test request and reporting, improving efficiency and patient safety at the same time.

Using a system based on Cerner Bridge Specimen Collections but adapted to suit local requirements, the process is operated from a portable terminal that can be taken to the patient. A barcode on the patient's wristband is swiped by a reader, which is then combined with the test information to create a label that is printed and added to the sample at the bedside. Additional information provided on the label and electronic record is that of the person taking the sample (who also has a barcode ID) as well as the time, to give a full picture of the sample's provenance.

As well as providing security of identification, the terminal provides step-by-step collection and handling instructions, which help to improve the quality and viability of samples. Not only that, but use of the portable printer improves the quality of the information and legibility of the label compared to handwritten labels.

Once the information is captured by the system, it interfaces directly with the LIMS back in the lab, which enables more effective sample collection and processing management by sending real-time specimen collection requests with all relevant data attached. Collections can then be planned to ensure samples are dealt with promptly and feed effectively into the laboratory workflow.

The project has started with the blood transfusion service, as these samples are expensive and mistakes can be dangerous. This was tied in to establishing a wider electronic transfusion management system, and involved significant change management and training, as well as the introduction of technology to deliver improvements.

Outcomes

Implementation has reduced errors, improved the management of samples and speeded up the reporting of results.

- In the first year (2006-7), the rejection rate of samples due to poor labelling fell from 4.8% to 2.5% - rejected samples were predominantly among the small number not collected using the electronic process
- Reduced time was spent by lab staff chasing up incomplete order information
- By January 2012, a monthly total of more than 35,000 test requests were sent using the system

Next steps

The system has been implemented throughout the Nuffield Orthopaedic Centre, A&E and the maternity department.

The Trust is also considering how the system can be applied to other areas, for example medicines management, where accurate identification of patients and their medication is also a high risk, high value operation.

Resources

Cerner:
http://www.cerner.com/solutions/Hospitals_and_Health_Systems/

Case study:
Murphy, M. et al. Approaching a major change program. Transfusion Vol 49, May 2009

Oxford University Hospitals NHS Trust news article:
http://www.ouh.nhs.uk/news/article.aspx?id=73

RFID supports HTA compliance

Complexity

Moderate

Background

Radio Frequency Identification (RFID), widely used for stock control in supermarkets, in smart ID cards and for high value equipment tracking, is now being applied to pathology sample management. Central Manchester University Hospitals Trust's toxicology service is applying this technology to help them improve efficiency and fulfil their responsibilities under the Human Tissue Act[15].

Insights

RFID uses tags that contain a microchip and antenna, allowing them to transmit stored information using radio-frequency electromagnetic fields, either when activated by a reader close by (passive), or as a constant transmission that can be picked up over a much longer distance (active).

RFID tags are considered more resilient than barcodes – they can be individually read and identified in the presence of other objects (for example within a fridge or freezer), at oblique angles or when they are dirty or covered in ice.

RFIDs can store far more data and therefore more complex identifiers than barcodes, which are typically limited to less than 20 characters. This is significant as it means that the permutations of numbers available for barcodes are limited, which could be a real issue where samples received at a lab come from multiple sources – it's possible that two samples from different hospitals could have the same barcode.

TrakPath is a fully automated sample asset tracking and location system, which uses passive RFID tags embedded in sample containers and associated readers and software to enable sample management from collection to analysis to disposal. The system has been developed through a partnership between Central Manchester University Hospitals Trust, software development company MDSAS and RFID and sample collection and asset tracking specialists, Agriyork400 Ltd.

Toxicologists at the Trust were looking for a better way to manage Coroner's post-mortem samples, which have specific challenges. Samples are irreplaceable and ensuring the chain of custody is a vital element in the process. Complex investigations may involve multiple pathologists, numerous tests and samples being sent off to a number of specialist labs, which all require careful and auditable tracking. As well as storage and disposal being governed by the Human Tissue Act, there may be additional requirements to return samples to family members.

The service worked with MDSAS to develop a database and business process to request, log and track samples. This is now being automated with the help of AgriYork and the introduction of RFID tagged containers, which will cut out the paper-based aspects of the process and enable samples to be monitored more effectively.

Samples will be tagged with a unique identifier at the mortuary, which can then track that the correct set of samples has been sent to and received by the toxicology lab. Similarly, the receiving lab can manage outsourced tests, and will have certainty about the actual location of all of the samples. Personal details associated with the sample are kept on the secure database and not the RFID tag, meaning that sensitive information can be kept secure but linked to the sample and accessed by authorised users of the system.

In large labs, many samples may be retained, and TrakPath will enable staff to locate and audit samples easily without having to cross-check paperwork and unpack freezers. In addition, the perpetual identification and features such as consent form tracking and automatic alerts when samples are due for disposal, will help labs to comply with the requirements of the Human Tissue Act.

Outcomes

The system is still in development and is due to be implemented in Manchester in the next few months, but predicted outcomes include:

- More assured sample management between mortuary, labs and back to families if required
- More easily auditable chain of custody, which will be visible in real time
- Significant productivity gains in reduced paperwork and locating samples
- Better management of samples due for disposal

A post-implementation review will be undertaken to measure the value of these improvements as well as to identify any other benefits.

Next steps

As well as full implementation of TrakPath for toxicology samples, the team has also developed a system for the management of controlled drugs, which are used under licence within the toxicology lab, and which are subject to stringent record-keeping which is currently paper-based.

Resources

Central Manchester University Hospitals Directorate of Laboratory Medicine: Contact Neil Howarth on **0161 276 5411**

AgriYork: **http://www.agriyork.co.uk/** or contact Duncan Carmichael directly on **0175 930 6580**.

Pathology future state - A vision for proactive health management

As the pace of change in the NHS accelerates, pathology services are well placed to create and facilitate a new vision for patient-centred healthcare. A vision for the future might include:

- People will manage their own health, and will have access to their records and test results through their own health portal accessed online or on personal digital devices. They will commission their own health services, and will seek support and advice from the most appropriate specialist.
- Pathology will be at the centre of this, working directly with patients and alongside other health professionals to support them through screening, diagnosis and monitoring of health and disease.
- Digital technology will increasingly enable cheap and easy point of care testing, in health environments or by patients themselves. Results will be automatically directed to the appropriate specialist and uploaded into peoples' health and care record – an EPR 'plus' which will cover every aspect of their health and wellbeing and will form the core of their personal health portal.
- Scientific advances coupled with efficient and effective testing processes will mean that personalised medicine can become mainstream – people will only be given drugs that they will benefit from. Pathology and genomics will play a central role in improving outcomes for people and reducing costs for the NHS.
- With decision support clinicians will have a clear understanding of which tests to order and a joined-up, automated process for requesting and receiving results from the most appropriate provider.
- Extracting and analysis from the system, using the power of standardised information brought by the NLMC, will provide the opportunity to identify a clear link between tests, treatments and outcomes.
- Shared electronic care records will provide an end-to-end view of patients health and care – standardised pathology terminology will enable patterns and warning signs to be detected by pathology analysts.
- Pathology services will have been reconfigured to provide the most appropriate structure to deal with commoditised and more specialist testing, including prevention and diagnostics. Digital connectivity will have enabled this move, and removed the limitations of size and geography from providing the most appropriate services to clinicians in primary and secondary care, and to patients.
- Digitally-enabled services that now seem innovative will become commonplace, and will provide the platform for further innovation at an increasing rate.

The case studies above show rapid progress towards this vision in some areas. These examples need to be picked up and championed across the NHS.

The following examples show how this progress could be built upon.

Patient-centred pathways

Once data is available digitally, it opens up huge opportunities to redesign process-driven services to create patient-centric care systems. Digitally enabled laboratory medicine services have the potential to bring pathologists closer to patients and so to speed up and improve the patient experience.

By taking a more active role in managing patient interactions, coupled with an acknowledgment that patients should have direct access to their test results, pathology services can reduce clinician time and make services more convenient for patients, by:

- Monitoring chronic disease
- Monitoring therapeutic interventions
- Linking results to patient pathways or treatment
- Providing information to minimise testing

Here are two examples of how this could work in practice, both of which embody the principle of empowering patients to take charge of their own healthcare.

Firstly, in future, appropriate test results reports could be issued to patients at the same time as being sent to their GPs. Consideration would have to be given to the type of test being reported, and to making the commentary more understandable for non-experts – however this would also serve to help people reviewing their electronic patient record, where this information will eventually reside.

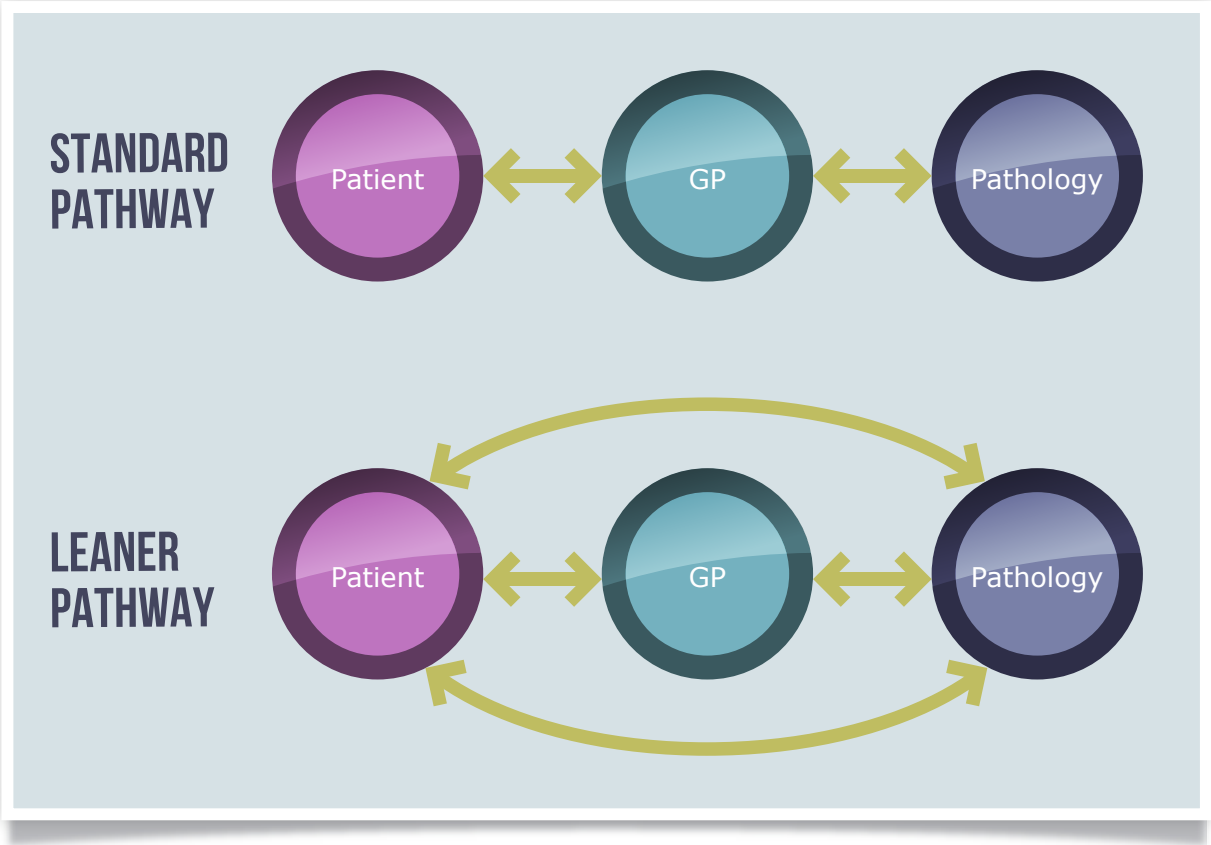
The impact of this would be to cut out an unnecessary loop in the patient's care pathway, which is also the potential bottleneck of a busy GP. Knowing that they were to receive their own results, with advice on whether they need to see their doctor again, should also cut down on calls to the GP surgery to check whether the results are in. For most patients, the results would be delivered electronically (by email or text), so it would be easy to provide a link to more information on the web. For example, Lab Tests Online already provides useful information for patients in lay terms.

Taking this a step further, the test report process could trigger further action within a pathway, where a diagnostic rule could show that this was appropriate, without the GP having to initiate it. For example:

- positive cervical smear generating a colposcopy appointment
- positive BNP result generating an ECHO cardiogram appointment
- positive calprotectin result generating a colonoscopy appointment
- positive Chlamydia or pre-op MRSA test triggering a prescription for an appropriate antibiotic

Communication with GPs would be triggered at the same time, whether they need to be involved with the next step in diagnosis or treatment, but it would cut down on delays and costs in the pathway caused by the need for every action to go back through the GP before further action could be taken.

There will have to be safeguards in terms of how information was presented to the patient. Sometimes this would be in parallel but, in the case of a positive screening for serious conditions such as cancer, for example, the patient should still be informed by the GP, but with an appointment for further investigation already offered.



This will be particularly appropriate and beneficial where frequent tests are required for monitoring the progress of chronic disease or therapy, especially as patients become experts in their own condition so may not need routine face-to-face contact for test result monitoring alone, and the frequency of testing would mean convenience would have a significant impact. In addition, having tests initiated before seeing a clinician, and having the results available for that consultation, not only cuts down on the number of appointments, but has been shown to make patients feel more in control of their condition[16].

There are already examples of where this is being done successfully – information on the Renal PatientView project is included in this report – but other suitable cases could be:

- Annual diabetes checks
- Pre-chemotherapy checks
- Annual checks for patients on stabilised doses of eg. lithium, digoxin, thyroxine replacement or anti-epileptic drugs

This sort of dis-intermediation of services, enabled by digital data management and interfaces with patients (for example EPR), has been shown to improve services and deliver efficiencies but we are a long way from moving to this as the default approach.

Pathology goes mobile

Increasing the availability of point of care testing (POCT) was one of the clear ambitions of the Carter report[2], and new compact diagnosis instruments are making it easier for patients to be tested and treated in one visit to their GP or clinic. As well as reducing the need for repeat GP and hospital visits, on the spot diagnosis and treatment should also improve treatment compliance and reduce the risk of transmission, which is particularly pertinent in cases such as STIs and hospital-acquired infections like MRSA.

For example, Atlas Genetics' ultra-rapid point of care platform[17] allows infectious diseases to be diagnosed by a non-specialist in 30 minutes, using a unit that is a fraction of the size and cost of laboratory analysers. The system uses disposable sample cartridges and is fully automated and easy to use, with the ability to test for multiple diseases from a single sample. It is designed to meet Clinical Laboratory Improvement Amendments (CLIA) waiver standards, and can provide nucleic acid, immunoassay and small molecule chemistry testing.

Beyond POCT, self-diagnosis and condition management is already a reality – go into any pharmacy and you can buy self-test kits for conditions ranging from high cholesterol to bowel cancer. And while the NHS has warned people to be cautious about their use[18], the demand for simple and quick answers to worrying health concerns is real and happening now.

In the more controlled context of managing chronic diseases, clinician-directed self-testing is commonplace, for example patients with diabetes carry out regular tests at home that enable them to manage their condition.

Innovative new ways of linking POCT and self-testing to the digital world are emerging all the time. Mobile technology is being embraced to deliver user-centred, flexible ways for people to monitor their own health. This can be active monitoring, where patients report information about themselves and their state of health and increasingly, with the growing sophistication and reducing cost of Smartphone-embedded sensors (location, movement, pressure etc), passive monitoring using the phone itself or wearable devices linked to the phone.

Other devices, such as miniaturised analysers, are also on the rise, and taking full advantage of the potential of connecting to mobile applications to collate and present data, link to multi-media health content and provide meaningful communication between patients and their healthcare professionals.

Recent developments linked to pathology include:

- The iBGStar® Blood Glucose Meter[19] from Sanofi Diabetes connects seamlessly to the Apple iPhone or iPod Touch to enable diabetics to manage their condition in a way that doesn't limit their lifestyles. The glucose meter is about the size of a usb stick, and can be used on its own to give a glucose reading, or plugged in to the iPhone/iPod via its dock port to utilise the system's Diabetes Manager app. This allows users to monitor trends in their glucose levels and keep track of carbohydrate intake and insulin dose, as well as to share information with their clinician.

- The £13 UCheck app launched at TED 2013 by Biosense[20] enables a smartphone camera to be used to analyse a urine sample depending on its colour. Urine can be tested for the presence of ten elements, including glucose, proteins and nitrates. The app will be piloted in a Mumbai hospital to check its accuracy against standard laboratory analysers.

- The Scanadu Scout[21] device links to a smartphone app to show vital signs such pulse rate and variability, temperature and blood oxygenation. Now the personalised health electronics firm has developed low-cost disposable cartridges that will integrate with the system and enable smartphones to be used for urine analysis – for early detection of pregnancy complications, kidney failure and urinary tract infections – and saliva analysis to assess cold-like symptoms.

These developments will have an impact on delivery of diagnostic services, and present both challenges and opportunities. In many cases pathologists are involved in their development, and they should also be at the forefront of determining how these and similar innovations can revolutionise the way in which diagnostics impact on health and patient care. As well as a strategic role, service interventions for pathologists could range from providing quality checks on results and maintenance for self-testing equipment, to remote support for patients monitoring their own conditions.

Future health delivery will need to take account of the clinician led and personally-driven testing and monitoring, and to provide a context in which people can make sense of the implications, limitations and opportunities that it brings. Taking a lead in these developments should provide a springboard for pathology to place itself at the centre of self-managed healthcare.

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