



SUSTAINING UNIVERSAL HEALTHCARE IN THE UK:

MAKING BETTER USE OF INFORMATION



A Report by Volterra Partners for EMC
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WITH SUPPORT FROM **EMC²**

FOREWORD

We welcome this thoughtful and incisive report that offers an achievable solution to the crisis in healthcare delivery in the UK. The need for change, the vision and the urgency are clear. The NHS is facing the triple challenge of changing population demographics, rising prevalence of chronic diseases and increasing costs of evermore sophisticated treatment and diagnostics. The solution is to reduce demand, and increase efficiency by harnessing effectively the power of information technology. The grand challenge will be to implement the necessary cultural and technological changes in a health service that historically requires radical organisational upheavals to effect change in the way services are delivered.

This report describes a subtle window of opportunity – the potential for care records, the cornerstone of administrative, demographic and clinical information processes, to yield more analysable data that can be used to sustain health; prevent ill-health; improve patient outcomes; and deliver healthcare more efficiently.

Many have recently observed that the data held in patient records is not presently fit for such widening purposes. Sir Robert Francis was scathing about it in his report on the Mid-Staffordshire Inquiry, and in its latest report on data quality, the Health And Social Care Information Centre has noted the persistent impact of a widespread lack of clinical engagement on the quality of the data in central returns. Improvement in information quality will require leadership at all levels, clinical and managerial engagement, and education, focused primarily on improving the source data recorded in patient records.

The task is of course complex. Clinical meaning is highly dependent on context. A clinical term in the record will have different relevance if it is a current diagnosis, a diagnosis in the past, or the diagnosis of a close relative, and the record structure, or headings necessary to ensure uniformity of meaning have never been standardised in the NHS. This is essential if the vision set out in this report is to be achieved. The window of opportunity arises because the necessary standards are now available, at a time when NHS organisations are modernising their information and IT infrastructure at grass roots level.

The professional standards needed to ensure semantic interoperability of patient records have been published by the Academy of Medical Royal Colleges. They have received wide support from professional and statutory bodies, including the Professional Record Standards Body (PRSB), which represents patients, and all health and social care professions. Both organisations are giving central leadership for improvements in record keeping. This leadership is complemented at a local level by the appointment of senior clinicians as Chief Clinical Information Officers (CCIO's) in delivery organisations. To support them, educational leaders must stress the importance and value of accurate data to promote wellness, deliver preventative patient education and integrate care when illness supervenes. The academic and commercial communities are also hungry for clinical data, but it will only be of value if it is accurate.

This report gives a timely insight into the reasons why change is so important. The opportunity is now. We hope the NHS will deliver.

Professor John Williams

Professor Iain Carpenter

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of Physicians**



**JAMES PETTER: SENIOR VICE PRESIDENT
& MANAGING DIRECTOR, EMC
UK & IRELAND**

EMC FOREWORD

Every medical professional in the UK, to one degree or another, today faces the challenge of managing a growing patient population with a diminishing set of resources.

By the end of this decade it is predicted that the NHS will face a funding gap of £34 billion, only £5 billion less than we spend on defence as a whole today. At EMC we feel passionately that a 'Wellness Model' as advocated by many of the NHS' leaders today, is key to tackling this challenge. We wanted to investigate how a more joined up approach to using information insights could deliver this model, and its efficiency benefits, to the NHS.

This report will add to the body of evidence that shows that the current patchwork efforts to maintain the NHS are unsustainable. It illustrates that more fundamental reforms are required to preserve the spirit of the NHS: universal healthcare for all, free at point of delivery, based on clinical need and not the ability to pay. With talks of a fresh 'NHS tax' after the General Election in 2015, discussions around paid for GP visits and more, the NHS' founding principles are under serious threat today.

We have a window of opportunity to act on the recommendations in this report and build a new infrastructure for the 21st Century NHS; maintaining its founding principles but transforming the way it delivers patient care through innovation in the use of data. Significantly this isn't just about saving money, but done correctly, the impact of this report will make for a healthier UK too. I hope you find the report and its findings as insightful and provoking as we did.

James Petter

**Senior Vice President & Managing Director
EMC UK & Ireland**

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NAME: MR. PATIENT
AGE: 27 YEARS
DIAGNOSIS: BROKEN ARM
REASON OF ADMISSION: ACCIDENT
CARDIO: REGULAR BEATS, NO MURMURS
PULMONARY: CLEAR, NO RALES
ABDOMINAL: SOFT, NO ORGANOMEGALY
NEUROLOGICAL: NOTHING ABNORMAL DETECTED



LAB FINDINGS:
WBC: 7.5g/L HB: 16.7g/L
MCV 92 PRT: 201 g/L CRP
NA: 136MMOL/L K: 4.0MMOL/L
GLYCEMIA RANDOM: 1.6g/L
CPK 300 U/L, TROPONIN 0.0
CREATININE: 1.02 UMOL/L

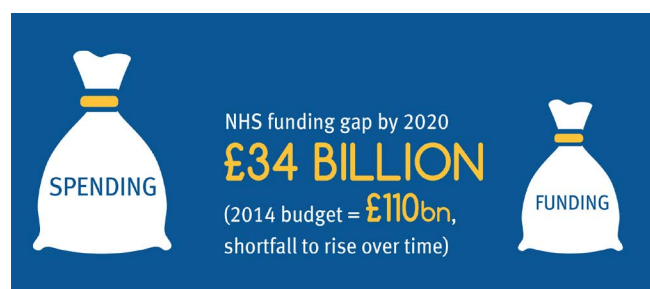
1. EXECUTIVE SUMMARY



THE CURRENT SITUATION IN HEALTHCARE

The NHS is facing unprecedented financial pressure. As a result of the recession and the resulting cuts to public spending, NHS budgets are squeezed across all areas and in real terms expenditure on healthcare is falling. Simultaneously, the population is increasing and ageing, therefore spending per head is falling even more dramatically. Additionally, the number of people with multiple long term chronic conditions, where the majority of the NHS funds are spent, is expected to rise.

This build-up of financial pressure is only likely to continue and worsen over the next decade and it is already beginning to affect patients' quality of treatment, as waiting times increase, and research funding is restricted. Patient information and data analytics could have substantial beneficial impacts but it is not being used effectively to counteract these funding restrictions in order to maintain and improve the quality of patient care.



"Knowledge and data are fundamental to the patient revolution that is so urgently required by our national health service"

Tim Kelsey

DIRECTOR OF PATIENTS AND INFORMATION AT NHS ENGLAND

HOW TO USE INFORMATION AND ANALYTICS TO DELIVER THE WELLNESS MODEL

The Wellness Agenda is a new approach to healthcare which requires a proactive, personalised approach, rather than a reactive 'illness driven' health industry. It is a holistic approach aimed at empowering individuals to have more control over their own lifestyles and care as well as making the healthcare sector more efficient and effective. This can only be achieved through collaboration and sharing of information.

The Department of Health is on the right track in its promotion of the use of information but it needs to go a lot further: it focuses on the use of data for performance management rather than a move to a more proactive system which allows for prevention and personalised care.

We focus on three main areas where information and analytics should be more widely adopted in healthcare:



INTEROPERABILITY OF PATIENT RECORDS:

The ability to access and update records at any point in the healthcare system. There is a lack of interoperability between NHS institutions, leaving the system fragmented and crisis driven.



DATA ANALYTICS

Using large quantities of information to better predict and personalise medicine. The use of data analytics is currently very limited in healthcare in the UK despite having huge potential to improve the quality of care delivered to patients. Significant benefits will only be achieved when insights from analytics are translated into working practice:

RISK STRATIFICATION AND PREVENTION: Data analytics can identify the combination of factors that put the patient at high risk of developing a chronic condition, allowing for intervention to prevent them from getting ill.

IMPROVED TREATMENT OUTCOMES: Personalised medicine can improve early diagnosis and improve quality of care: treatments and outcomes can be analysed in conjunction with patient details in order to maximise the benefit of any treatment.



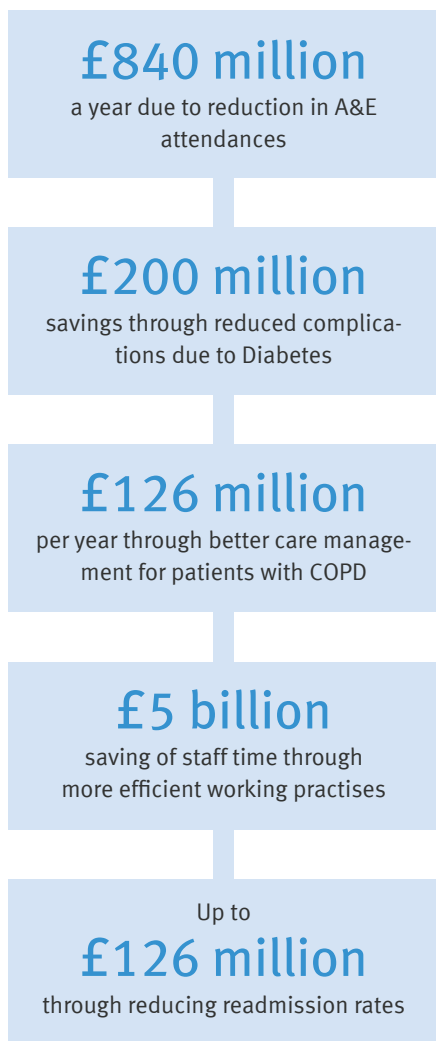
MOBILE TECHNOLOGY

Is growing in prevalence. Apps can be used by medical practitioners to provide up-to-date practical advice and by individuals to manage their health. Tracking devices are becoming more popular and could be used to maintain personalised healthy lifestyles.

THE EFFICIENCIES THAT DATA ANALYTICS CAN DELIVER IN HEALTHCARE

The NHS is currently considerably behind other industries in terms of its use of data analytics. Applying experience from other industries to healthcare, we estimate that using data analytics to successfully deliver the Wellness Model, would improve the efficiency of the healthcare sector by between 15% and 60% resulting in total savings to the NHS of between £16.5 billion and £66 billion per year. This efficiency saving would not result in actual lower costs of the service in absolute terms, but would free up equivalent capacity of staff and resources to ensure that the quality of service provided by the NHS continues to improve, despite funding constraints.

There are pockets of excellence across the UK where data analytics has been effectively employed to deliver better quality of care for patients. If these examples were implemented nationally this would result in savings per year of:



These examples quantify the benefits of expanding current use of data analytics in pockets of the healthcare system, not the total potential benefit of data analytics to the specific patient group considered or to the health system as a whole.

RECOMMENDATIONS

The NHS has long been amongst the global leaders in healthcare but we are falling behind. We must be more ambitious, which requires local and national level action. Government needs to provide guidelines and remove barriers, and local institutions need to collaborate and embrace data analytics.

1. There must be investment in appropriate skills in the health workforce, such as data handling and coding. Data analytics will change the nature of research and it is important that there are enough people with the appropriate skills to maximise the benefits.

2. The data revolution must begin with collaboration at a local level. The crisis in the NHS cannot be solved by any individual institution.

3. The NHS must speed up the accessibility of data. It is important that the benefits of Care.data are effectively communicated to patients and GPs, and that concerns are appropriately addressed before a launch date can be confirmed.

4. While data analytics must begin from local collaborations, there must be a fundamental change in the culture of the Department of Health. There is currently a focus on how data can improve performance management rather than a real shift to the Wellness Model. The NHS must aim higher than simply integrated health records and move towards harnessing the true benefits of data analytics.

CAL



2. THE CURRENT SITUATION IN HEALTHCARE

Health
Doctor
Hospital
Pharm
Nurse
Dentist
First Aid
Surgeon
Emergency



This section sets out the current situation in healthcare with regards to the funding crisis the sector is facing, the quality of the existing service that patients are receiving and the outcomes that are being delivered. We describe specific funding issues that certain bodies are facing, and describe the areas and conditions within the healthcare system which utilise most resources.

KEY POINTS:

CRISIS OF THE NHS

- The NHS is under unprecedented financial pressure: public sector spending constraints mean that real spending on healthcare is falling.
- The population is increasing and ageing, therefore spending per head is falling. Diseases that were once a death sentence are becoming chronic diseases that can be managed, which is expensive.
- This build-up of financial pressure is beginning to affect funds for both research development and patients' access to current services.

QUALITY OF SERVICE AND PATIENT OUTCOMES

- Lack of electronic patient records means that doctors spend a significant proportion of their time looking for records that are often incomplete or non-existent.
- Lack of predictive analytics means that there is a disproportionate burden on Accident and Emergency departments as they have to deal with readmitted patients, whose admission could have been avoided.
- Patient treatment outcomes are not effectively monitored. This has negative impact on patient care and also means that funds are not allocated and used in the most efficient manner.
- There is currently a generic 'one size fits all' policy in healthcare. A lack of information and analysis of data means that the scope for personalised healthcare is currently limited, and patients are given the same generic treatments.

INSIGHT FROM WITHIN THE INDUSTRY

- The NHS Confederation Conference Survey illustrated the significant challenges that the NHS faces and the potential impact of failure to meet these challenges. But it also provided evidence that local health authorities have made progress in setting up collaborations and improving the service delivered by their organisations.
- The Department of Health is on the right track, but it needs to go a lot further: it focuses on the use of data for performance management rather than a move to a more proactive system of healthcare.



2.1 CRISIS OF THE NHS

The NHS Confederation conducted a national survey of healthcare leaders. The following were identified as the main challenges facing the NHS:



1. The effect of an ageing population



2. The effect of an increase in long term conditions



3. Potential future budget cuts



4. Insufficient budget to meet current service requirements



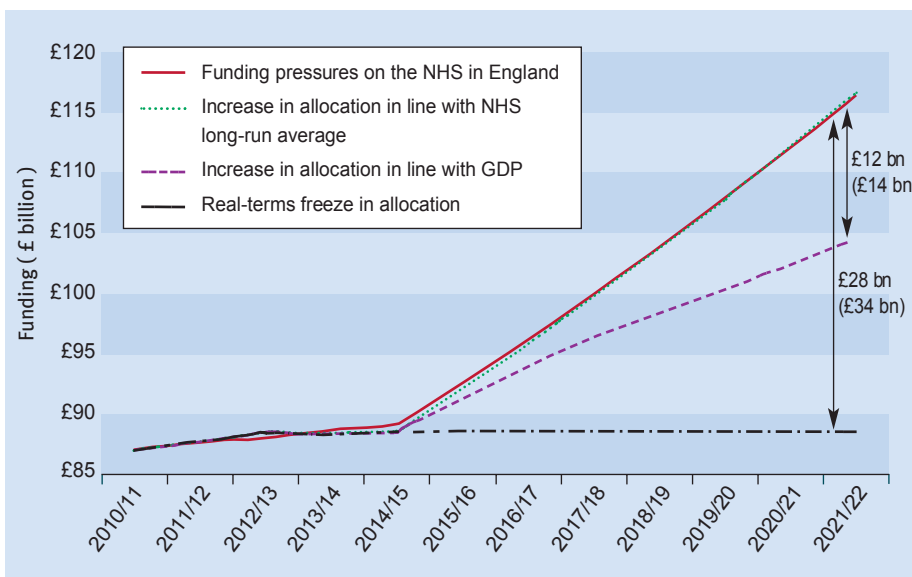
5. Outdated or inappropriate service or workforce models

2.1.1 NHS FUNDING OVERVIEW

The NHS is facing an ‘unprecedented financial dilemma’ as demand for healthcare rises while funding is increasingly restricted. Simon Stevens, CEO of NHS England, described the current funding situation at the NHS Confederation Conference in June as ‘the most sustained budget crunch since the Second World War’ as the NHS is ‘now in year five of essentially flat health funding’.

Figure 2.1 is taken from The Nuffield Trust Paper: ‘A decade of austerity? The funding pressures facing the NHS from 2010/11 to 2021/22’.

Figure 2.1: The funding gap under three scenarios



Source: The Nuffield Trust: A decade of austerity? The funding pressures facing the NHS from 2010/11 to 2021/22

2.1.2 PRESSURES FACING SPECIFIC GROUPS

This build-up of financial pressure is beginning to affect funds for both research development and patients’ access to current services: 51% of respondents to the NHS Confederation

It presents three options for NHS funding for the decade up to 2022:

1. Increase the allocation in line with NHS long run average (green line)
2. Increase the allocation to the NHS in line with GDP (purple line)
3. Real term freeze in allocation to NHS (black line)

Option 3 describes the current situation. Therefore, the NHS will face a funding gap of £34 billion by the year 2021/22, including a £28 billion funding gap for NHS England.

The total NHS budget for the financial year 2013/14 was

£110 billion

This covers total spending on healthcare, including administration and research. The NHS Commissioning Board, NHS England, has a revenue budget of

£95.8 billion

£66 billion of this revenue is allocated to the Clinical Commissioning Groups (CCG), of which the majority (£63 billion) is to cover the provision of local services.

Academic Health Science Networks (AHSNs) were established 'to deliver a step change in the way the NHS identifies, develops and adopts new technologies'. Their role is to promote effective collaboration between organisations across

the whole healthcare sector – NHS, academia, social care, private sector – and drive them to innovate in the way the provide healthcare, speeding up the adoption of innovations and technologies resulting in better outcomes and patient care.

However in the current funding environment, all budgets are constrained. NHS England has reduced the fund for AHSNs for 2014/15 by 20% from £50 million to £40 million. Given that the core objectives is to promote research and development in healthcare and encourage the rapid take up of new innovations and findings into the health service, this shows how much pressure there is on budgets and how blatant the need is to deliver better patient outcomes for less money, using the limited resources of staff and treatments more effectively.

Funding constraints are affecting patients' access to current services: the waiting times for diagnostics, including urgent appointments, are increasing over time. There are differences in waiting times in different regions and treatment types due to varying funding constraints. For example, there can be up to a 50 week waiting list for audiology appointments in the South East.

The government has announced some short term funding of £250 million to reduce lengthening waiting lists for elective treatment but the pressure remains for the next financial year. The general picture is that Trusts and commissioners have to stretch limited funding across increasing numbers of patients, and this is only likely to continue and become more acute.



The Department of Health estimates that **30%** of the population costs **70%** of the total amount spent on health and social care by NHS England. This is the Pareto group which healthcare improvements via data analytics need to be targeted at if they are to make a real difference.

2.1.3 LONG TERM CHRONIC CONDITIONS

The Department of Health estimates that 30% of the population costs 70% of the total amount spent on health and social care by NHS England. This 30% of the population is made up of people who suffer from one or more long term chronic conditions - the Pareto group - which healthcare improvements via data analytics should be targeted at to deliver the most efficiency savings and improvements.

Improvements to healthcare mean that patients with chronic conditions are living longer; conditions that were once regarded as death sentences can now be effectively managed. This success of the healthcare system is expensive and hence there is a paradox of the current healthcare system under the illness model: the more effective the system is at treating patients the more expensive it becomes. If there was a shift to the Wellness Model and the healthcare system became more effective at preventing, diagnosing and treating chronic conditions, the overall cost of treating chronic conditions could begin to fall.

In the year 2010/11, there were 2.46 million diabetes patients in England, 899,000 patients with COPD, 3.27 million asthma patients and 876,000 cancer patients. Since 2006/07, the number of diabetes patients has increased by 25% and the number of cancer patients has increased by 79%. This is partly as a result of people with these conditions living longer.

The total number of people with long term chronic conditions is projected to stay relatively stable over the next decade. However, the number of people with multiple long term conditions is expected to rise . This means the expected cost to the NHS of sufferers with long term chronic conditions is expected to rise by approximately by 8% - £5 billion.

2.2 QUALITY OF SERVICE AND PATIENT OUTCOMES

The NHS is struggling to maintain the quality of healthcare: the poor information system makes it difficult to deliver safe care and to take early advantage of changing techniques.

A recurring complaint from doctors is that they spend a significant proportion of their time looking for patient records that are either incomplete or inconsistent. This is hugely inefficient as doctors have less time to spend treating patients and less information on which to base their treatments.

A lack of monitoring and risk stratification of patients also causes a disproportionate burden on A&E departments. This is as a result of a lack of risk profiling of patients who are likely to be readmitted as emergency cases. If there was more effective tracking of patients, early intervention to reduce the risk of hospital admittance would reduce the burden on A&E. A risk profiling exercise in Wigan reduced A&E attendances by 40% - see section 5.1 for more detail. Early intervention could also reduce the number of people with long-term conditions, and the number of emergency admissions of people with long term conditions.

An audit into asthma care in the UK found that 90% of asthma deaths in the UK were preventable. There was evidence of misdiagnosis, errors in drug prescription, lack of risk profiling and a lack of patient monitoring.

This lack of monitoring of patients treatment outcomes clearly has negative impacts on the quality of care that patients receive. This is true in terms of the outcome of the individual patient as well as the overall impact of the healthcare system. For example, £1.2 billion a year is spent on chemotherapy to treat cancer but the treatment outcomes are not adequately recorded and so it is unclear whether this is an efficient allocation of funding.



There is currently a generic 'one size fits all' policy in healthcare. A lack of data analytics means that the scope for personalised, or stratified, healthcare is currently limited, and patients are given the same generic treatments.

This 'blockbuster' approach to drug creation not only limits the efficacy of treatments, but can have negative impacts on a significant minority of patients: 6% of hospital admissions are as a result of adverse reactions to drugs. The use of biomedical informatics and data analytics offers the real possibility of transforming healthcare from an Acute model to a Wellness model, improving patient outcomes. This personalised approach is referred to as a Long Tail Business model and has been used extremely effectively in other industries.

This generic policy also applies to which patients receive treatment. For example, there is evidence that age discrimination within cancer care means that the provision of chemotherapy falls significantly when patients reach 60.

Personalised medical care would be able to assess each patient on their likely response to treatment based on a significant number of factors, rather than simply discriminating on age. This could mean that some patients over 60 are given treatment, live longer and have better outcomes, and some younger patients for whom better data analytics enables us to identify that they are unlikely to benefit would be placed on alternative treatment pathways. This would allow the current budgets to be more effectively targeted, improving patient outcomes and reducing adverse side effects and unnecessary A&E admissions and complications.

Improvements in data analytics would ensure quality control across hospitals, departments and practitioners. Currently, many A&E departments don't record patients or treatments electronically and so central auditing is very difficult. Through recording the treatment outcomes, the pressure to maintain high quality services increases as performance can be accurately measured and monitored. Therefore, the quality of treatment can be maximised.

FOCUS ON ASTHMA: AN EXAMPLE OF POOR PATIENT OUTCOMES IN THE CURRENT SITUATION

Asthma is a common long term condition that can cause a cough, wheezing and breathlessness. The severity of symptoms varies dramatically from person to person and asthma can be very well controlled in most people for most of their lifetime. The cause of asthma is not well understood, although it is known to run in families, suggesting that more detailed genetic analysis could assist in better predicting those at risk.

The Royal College of Physicians has recently published an audit of asthma deaths in the UK. It stated that 'it is not clear why the number of deaths per year from asthma in the UK have not reduced significantly from around 1,200 for many years even though it is widely accepted that there are preventable factors in 90% of deaths. The aim of the project was to understand why people of all ages die from asthma so that recommendation could be made to prevent deaths from asthma in the future.'

The findings show a failure to identify high risk patients and to communicate with them. There was evidence that patients had been misdiagnosed: only 41% were diagnosed with severe asthma, 50% were treated for moderate asthma and 9% were being treated for mild asthma and yet they all died of asthma. The wrong medication was being prescribed with excessive prescriptions of reliever medications: 39% of patients who died had been prescribed more than 12 relieving prescriptions in the preceding year. This should have triggered warning signs that the patient was likely to have badly controlled asthma and prompted an alternative approach to care. There was evidence of under prescribing preventer medication: 80% were provided with less than 12 preventer prescriptions, this is fewer than is needed to comply with recommendations. There was a clear lack of risk stratification and intervention: 47% of patients had a history of previous hospital admission and 10% died within 28 days of discharge from hospital for treatment of asthma yet only 23% had a Personal Action Plan to improve asthma care.

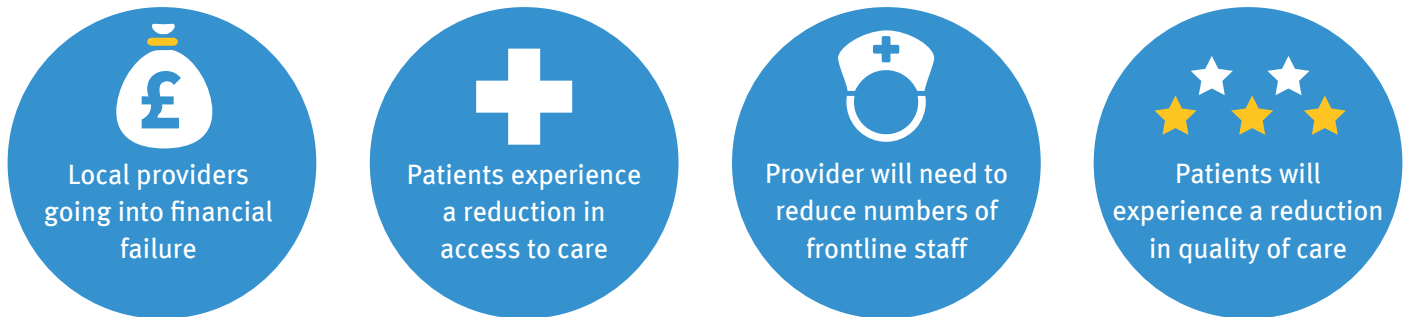


Key recommendations from the audit included a standard asthma template 'to improve the documentation of reviews in medical records and form the basis of local audit in asthma care', and 'electronic surveillance of prescribing in primary care'. An ongoing national audit of asthma should be established, which would help clinicians, commissioners and patient organisations to work together to improve asthma care.

The development of an integrated local data base which can be accessed by local health teams is essential for improving care. This would allow for risk stratification to identify high risk patients and allow for intervention before the patient experiences an exacerbation. Data analytics would improve diagnosis of early stage asthma and highlight potential risk factors.

2.3 INSIGHT FROM WITHIN THE INDUSTRY

A recent survey at the NHS Confederation Conference found that the consequences of failing to achieve change were:



While healthcare leaders recognised the need for change, 70% were not confident in their local health economy's ability to achieve it. However, there was also evidence that changes had already begun to occur: 97% of respondents stated that plans are being made for service change within their organisations and 91% of respondents stated that joint plans are being made in collaboration with other local health and/or social care organisations.

Senior figures within NHS England have recognised the need for a shift in the way in which the health system operates. Simon Stevens CEO of NHS England, identified **personalised medicine**, **the use of data** and the **role of patients in healthcare** as the three most significant changes to come in healthcare:

Tim Kelsey, Director of Patients and Information at NHS England, opened his speech at the conference by saying that **'knowledge and data are fundamental to the patient revolution that is so urgently required by our national health service'**. He argued strongly in favour of data analytics and data sharing between and within healthcare institutions. His aim is for a **'data rich NHS'** and an **'NHS that can remember the people it is treating'**.

The Department for Health is on the right track with its support for data and informatics, but the emphasis is too heavily focused on performance management rather than moving to a new proactive Wellness Model of healthcare. This was clear in a speech by Jeremy Hunt MP, Secretary of State for Health, where he emphasised the need for transparency of data for **'openness and learning'**, noting that there were 12,500 avoidable deaths in the NHS last year and that **'peer pressure is a far better way to improve standards'**.

The Wellness Agenda is a new approach to healthcare which requires a proactive, personalised method rather than a reactive 'illness driven' health industry. In order for a revolution in healthcare to be possible, the need for investment in data analytic capabilities to deliver the Wellness Model must be taken on-board by the whole NHS and not just pockets of it. The emphasis on local level collaboration is important, since this is where the change must start, but there must be real policy and culture changes at a national level in order for these local level changes to have the support they need to occur.

"So – a coming revolution in biomedicine, in data for quality and proactive care, and in the role that patients play in controlling their own health and care. The NHS has to grab these opportunities with both hands, rather than just letting them wash over us, or hoping they'll bypass us so we can carry on with business as usual."

Simon Stevens

CEO OF NHS ENGLAND

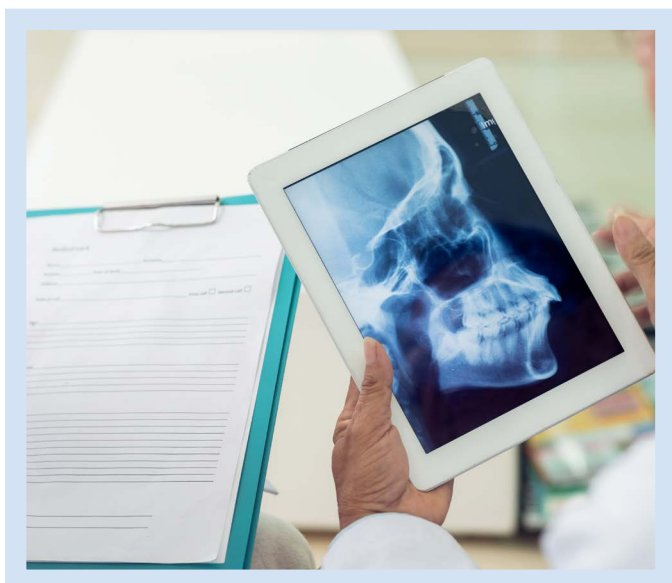
3. USE OF INFORMATION IN HEALTHCARE



This section explains what we mean by information, data, data analytics and informatics within healthcare and how they are currently used within the NHS. While there could be widespread improvements in the use of data analytics, there are already some pockets of excellence. Learning from these and adopting approaches more widely could lead to significant benefits.

KEY POINTS: CURRENT USE OF INFORMATION IN HEALTHCARE

- **THE CURRENT SITUATION** in the use of data in healthcare was described by a Global Development Director as ‘fragmented, rudimentary and not yet fit for purpose’.
- **WHILST THERE IS AN** overarching belief that data and informatics could be used to improve the efficiency of healthcare, there is a lack of understanding as to exactly how, and when, this could be delivered, and the extent to which it could transform the sector.
- **WE FOCUS ON THREE MAIN AREAS** where data and analytics should be more widely adopted in healthcare: **interoperability** (the ability to access and update records at any point in the healthcare system), **data analytics** (using large quantities of information to better predict and personalise medicine) and **mobile technology** (apps, tracking devices) the sector.
- **USE OF ELECTRONIC HEALTH RECORDS** is high in primary care but low in hospital care, resulting in a lack of interoperability between NHS institutions, leaving the system fragmented and crisis driven. There is a national push towards having integrated electronic records across all NHS bodies by 2018 but there is concern that some organisations will not achieve the target date set.
- **ADVANCES IN DATA ANALYTICS** now allow for the analysis of data sets across a variety of different sources and formats, making it easier to identify **hidden patterns and correlations that are ‘too subtle or complex for humans to detect’**. The use of data analytics is currently limited in healthcare in the UK, but has huge potential in improving the quality of care both in terms of disease prevention and more personalised care.
- **MOBILE TECHNOLOGY** is growing in prevalence. Apps can be used by medical practitioners to provide **up-to-date practical advice** on prescribing, dispensing and administering medicines; they can be used by individuals to manage conditions (e.g. diabetes app) and promote healthier lifestyles (tracking alcohol intake, quit smoking apps). Tracking devices are also becoming more popular and could be used to **maintain healthy lifestyles** that are personalised to individuals (monitor exercise, calorie intake, heart rate etc).
- **AWARENESS OF THE IMPORTANCE OF DATA** in healthcare is increasing: Genomics England was launched in 2013 to deliver the **100k genomes project**. The project will sequence 100,000 personal DNA codes, genomes, over the next five years.
- **DATA ANALYTICS WILL LEAD TO BOTH** better treatment effectiveness through risk stratification at an individual level and disease prevention through identification of risk factors.
- **BUSINESS INTELLIGENCE CAPABILITY** has increased significantly across the NHS over recent years, however, the focus has been on retrospective activity monitoring not predictive analysis or decision support. **The real opportunity for innovation comes through big data facilitating both prevention and personalised care.**



3.1 CURRENT SITUATION

The take up of data analytics in the healthcare industry has been slow. This has resulted in a fragmented healthcare system operating a crisis driven 'illness model'. The potential for high quality insights is restricted by the lack of interoperability of patient information within and between health institutions. The current situation in healthcare was described by a Global Development Director as 'fragmented, rudimentary and not yet fit for purpose'.

Whilst there is an overarching belief that data and informatics could be used to improve the efficiency of healthcare, there is a lack of understanding as to exactly how, and when, this could be delivered, and the extent to which it could transform the sector. In the following three sections we focus on the three main areas where data and analytics should be more widely adopted in healthcare **interoperability** (the ability to access and update records at any point in the healthcare system), **data analytics** (using large quantities of information to better predict and personalise medicine) and **mobile technology** (apps and tracking devices).

Each section describes the current situation and the potential improvements that could be made. We also identify pockets of excellence in terms of the current use of information in healthcare. Building on these existing examples of best practice



could deliver modest improvement in healthcare efficiency but it will not address the funding crisis; a more innovative approach which grasps the opportunity of analytics is required to transform the healthcare system.

3.2 SEMANTIC INTEROPERABILITY OF PATIENT RECORDS

Semantic interoperability is the ability of computer systems to exchange data with unambiguous, shared meaning – critical in health care where the meaning of a piece of clinical data is highly dependent on the context in relation to the patient. It requires the adoption of national standards for the clinical structure of the patient record, and the terms used when clinical data is recorded.

Interoperability of patient records occurs when records can be accessed and updated by authorised personnel at any point in the healthcare system. This means, for example, when a patient moves to a new doctors surgery their new GP would be able to access their complete patient record immediately, containing their medical history of previous and current conditions; all GP, hospital and A&E visits; tests, vaccines and past and current prescriptions. Equally, when a patient arrives at A&E it would be possible for doctors to access this information immediately.

The NHS currently operates a fragmented system of patient records resulting in huge costs both financially, in terms of time wasted, and in terms of patient outcomes. The use of electronic health records in the UK is much higher in primary care (over 90%) compared to secondary care (8%). This is as a result of the higher level of difficulty of using Electronic Health Records (EHR) in secondary care compared to primary care: there are a lot more patients who are likely to attend fewer appointments and there is a lack of trust in NHS infrastructure, which is more significant in hospital care as it tends to be higher pressure. A consultant physician described how the NHS IT infrastructure is so weak, taking ten minutes for computers to load and multiple computer crashes, meaning that paper often seems like the most reliable option.

Although the use of electronic patient records in primary care in the UK is high, the lack of integration with the rest of the health service restricts the benefits of this. A Director at NHS England emphasised the need for hospitals to catch up with primary care: there are now paperless GP practices that have to employ someone to scan in documents from the hospitals.



In order for an integrated health system to be efficient, electronic health records need to be updated at every visit to an NHS institution whether that is hospital, GP, nurse or social. The overwhelming message that we were given from the healthcare experts who provided their insight for this report was that this remains the case: 'GPs have got it right' and hospitals need to catch up.

The digitalisation of all medical records would provide a more integrated patient service, improving patient care pathways, and therefore reducing costs. The time taken to transfer records would be reduced, improving the quality of care and reducing costs of wasting doctor's time trying to obtain the records. Data sharing also increases transparency and ensures that falling standards are picked up quickly. This was one of the main benefits outlined by the NHS England in response to concerns over the new care data programme that has now been delayed to the autumn of 2014.

There is a national target for a fully integrated electronic record system across all NHS bodies by 2018. Trusts are at differing stages in their path towards the digital environment and there is concern that some organisations may not achieve this target. This shows that change in the use of data informatics in the NHS is beginning to occur but there is still a long way to go to fundamentally change the practice and culture of NHS institutions.

POCKET OF EXCELLENCE: BADGERNET

BADGERNET is an example of an area which is more advanced than others: it is a data management platform that contains live patient data across maternity, paediatric and neonatal critical care in England. It is an excellent example of successful interoperability of patient data within a specific category of patients. It makes governance and audit much easier as it is easy to transfer patient data. This shows that data technology can be used to provide a high quality, integrated service to specific groups of patients.

Source: Clevermed & Stakeholder comments

POCKET OF EXCELLENCE: EMIS (EGTON MEDICAL INFORMATION SYSTEMS)

EMIS is the big success story of primary care. It is the industry leader in GP systems with over 3,000 GP surgeries using the system: approximately half the GPs in England.

EMIS worked with Manchester CCG to improve quality of patient care: the use of EMIS meant that patients of any of the 34 practices in the area could visit 'host practices' which would have access to their records and had extended opening hours. This increases the time and range of specialist primary care services available to the public.



3.3 DATA ANALYTICS

Data analytics describes the concept of using **large complex datasets** to determine insights that were not previously available. Current data technology has developed to such an extent that previously unusable information, such as handwritten doctor's notes, can now be interrogated by computer algorithms which can pull out important pieces of information from unstructured data. This further enriches the potential sources of data available to the healthcare sector for use in analysis.

The concept of data analytics is not new, however it was previously not possible to incorporate such analysis into the mainstream NHS due to the cost of processing and analysing the data. The cost of analytics technology has fallen and most NHS trusts could now afford to invest in their own capability.

The NHS cannot currently maximise the potential of data analytics in healthcare due to the lack of information available on patients and a lack of data capability within NHS institutions. There is a fundamental lack of centralised data in healthcare. On a local/health economy basis the access to, and analysis of, data is valuable but it could be even more so if national datasets could also be included.

The care.data programme, designed to increase the sharing of patient data across health institutions, has been postponed to the autumn amid privacy concerns among patients and GPs. Tim Kelsey, Director of Patients and Information at NHS England, described the programme as 'a simple ambition to link general practice data with hospital data so we can start to determine what really happens to people between their GP practice and hospital.' These concerns, focused on data protection, ownership and right to opt out, must be addressed and communicated correctly so that the care.data programme can be implemented, allowing for data sharing within NHS institutions.

The use of data within the health sector must improve; the lack of data in the UK significantly restricts the effectiveness of healthcare. Business Intelligence capability has increased significantly across the NHS over recent years, however, the focus has been on retrospective activity monitoring not predictive analysis or support for deciding appropriate treatments.

There is significant investment in treatment without sufficient analysis of treatment outcomes, making the treatments inefficient. For example: £1.2 billion a year is spent on chemotherapy to treat cancer but the treatment outcomes are not clear.

The NHS has long been amongst the global leaders in healthcare and health research. However, as the use of data analytics within healthcare falls behind other countries, the UK is becoming less favourable as a base and the number of clinical trial starts is declining. Between 2007 and 2011, both the number of clinical trials and the number of applications in the UK fell by 22% .

Secondly, the lack of data analytics reduces the future quality of care of patients. Essentially we are currently giving out expensive drugs without recording and monitoring in a centralised and measurable way who actually takes them, and what the impacts of taking them are upon patient outcomes.



POCKET OF EXCELLENCE: GENOMICS ENGLAND

There is an increasing awareness of the importance of data analytics within healthcare in the UK: Genomics England was launched in 2013 to deliver the 100k genomes project. The project will sequence 100,000 personal DNA codes, genomes, over the next five years.

The Chief Executive set up and led the Cancer Research UK stratified medicine programme which delivered gene panel tests for 9,000 cancer patients in the NHS and obtained their consent to use clinical data to make an anonymised research database.

Genomics England has already organised collection of samples of blood from patients with rare inherited diseases. Genomics England plans to take 2,000 samples from more than 600 patients and their mother and father or other immediate family member, for whole genome sequencing. This is seen by leading healthcare professionals as a 'promising start' for the use of data in healthcare and Genomics England has been nominated as one of 2014's 50 smartest companies in MIT Technology's annual list of the world's most innovative technology companies. This is a very important and positive initiative which could bring great benefits to patients in the future.

3.4 MOBILE TECHNOLOGY

! MOBILE APPS

Health related mobile apps are becoming increasingly wide ranging and prevalent. This section explains briefly how apps are currently used by healthcare professionals and patients to improve disease management and make the most efficient use of doctors' time.

The potential impact of mobile technology will be maximised if it can be integrated with patient records and data platforms: apps will become the future of data capture and the interface between patients and doctors. In the future, integration between mobile technology and patient records will mean that the level of detail of patient records will increase significantly. For example, the amount of exercise, calorie intake, mood, drug adherence etc. could be connected to patient records so that doctors have a detailed picture of the patient's lifestyle and the possible reasons for exacerbations. If this data was linked to a data platform, the links between lifestyle, drug adherence etc. and treatment effectiveness could be analysed.

! MOBILE APPS USED BY MEDICAL PRACTITIONERS

Apps can significantly improve efficiency and productivity within healthcare. They improve the quality of care given to the patient by increasing time for personal interaction between doctor and patient and improving the doctor's accessibility to information.

The NICE BNF app is only currently available for NHS staff. It is an offline resource which provides up-to-date practical information on prescribing dispensing and administering medicines. It provides an accessible and easy to use alternative to the paper copy of the BNF (British National Formulary).



! MOBILE APPS USED BY PATIENTS

There are a wide range of apps available that can be used to prevent illness and be used for disease management. Apps that can be used by any individual, to prevent illness and promote healthy lifestyles, will no doubt become more prevalent. These include: exercise apps, calorie counters, alcohol intake, quit smoking apps. Higher use of these could result in reduced childhood obesity, rates of Type 2 Diabetes, and other positive societal health impacts in the future.

Apps can also be used for disease management : diabetes apps, apps to remind people to take medication. The apps can also be used to store data that can then be viewed by a doctor (see Case Study 3).



CASE STUDY 3: DIABETES APP

The diabetes app helps patients to manage their own disease:

- Logs a patient's glucose levels, bloodpressure, food and liquid intake, insulin injections and other medications.
- Tracks weight and BMI changes.
- Logs exercise.

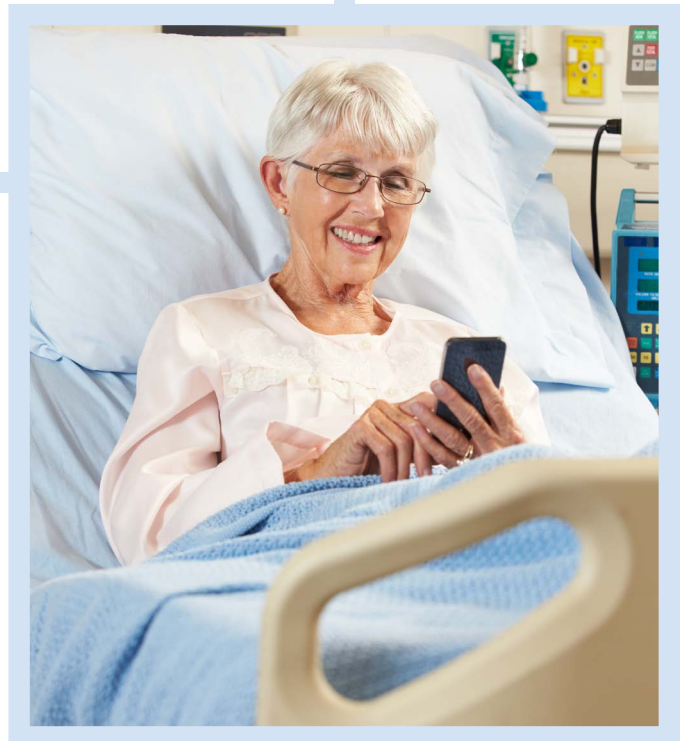
This tracks the factors that influence blood sugar level and allows patients to monitor fluctuations, share data with their doctor and plan ahead.

Source: iTunes

Health related mobile apps have the potential to transform the health sector into one where individuals can proactively manage their own health goals and objectives, where practitioners have easier access to information, and where patients can use apps to improve their quality of care. This is exactly in line with the ethos of the Wellness Model.

! TRACKING DEVICES

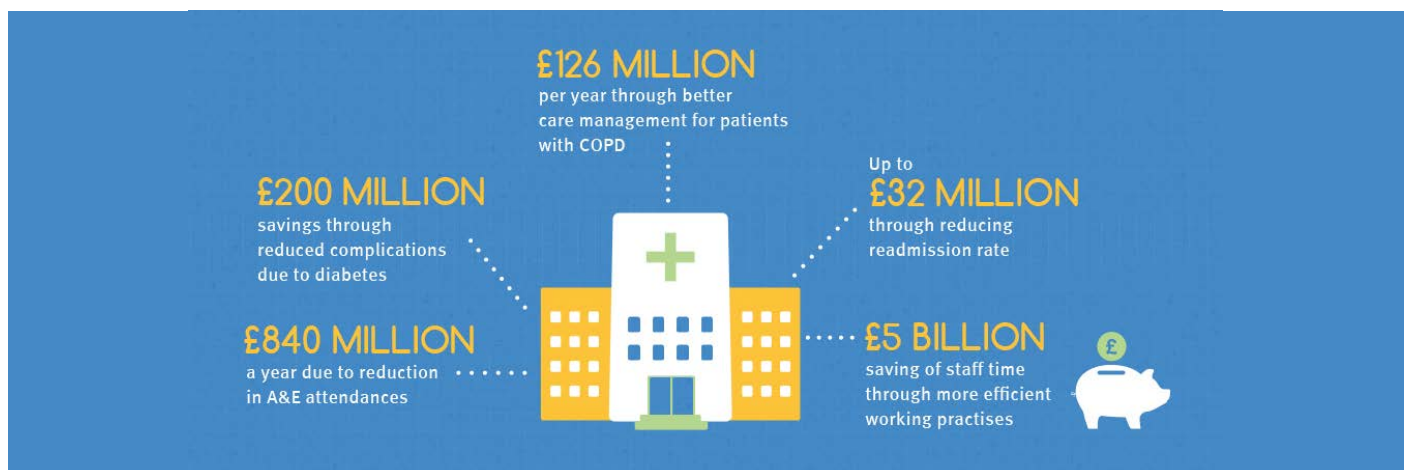
Tracking devices that are worn and can be linked to mobile devices are becoming increasingly popular. These can monitor mood, exercise levels, calorie intake, heart rate and sleep quality. These help to maintain healthier lifestyles and prevent illness. These devices are currently expensive and perhaps not used by those who would benefit from them most. As they become more widely accessible, their effect on healthcare could be significant. Equally, as more lifestyle apps are developed, their impact on healthcare could also be significant.





4. DELIVERING THE WELLNESS AGENDA

This section defines the Wellness Agenda and illustrates how data analytics and collaboration between NHS institutions are vital in order to deliver it.



KEY POINTS: DELIVERING THE WELLNESS AGENDA

DEFINING THE WELLNESS AGENDA

- The Wellness Agenda is a new approach to healthcare which requires a proactive, personalised approach rather than a reactive ‘illness driven’ health industry.
- It is a holistic approach aimed at empowering individuals to have more control over their own lifestyles and care as well as making the healthcare sector more efficient and effective.
- Data analytics is crucial to delivering this both in terms of a data platform to enable collaboration across healthcare professionals and institutions but also through mobile technology enabling individuals to take control of their own conditions and lifestyles.

HOW CAN INFORMATION ACCELERATE THE DELIVERY

- Data analytics can identify the combination of factors that put the patient at high risk of developing a chronic condition – thus preventing them from getting ill. Personalised medicine can improve early diagnosis through **risk stratification** and improving research into the early symptoms of conditions. Different treatments and outcomes can be analysed in conjunction with patient details in order to **maximise the benefit that can be achieved by any treatment**. As patients are living longer and their cases are more complex, better management and identification of risks is crucial. **Monitoring patients** through better data will dramatically improve care management.
- This fundamental step change towards a Wellness Model can only be **achieved through collaboration**. This can only be achieved when insights from data analytics are translated back into clinical working practice.
- **Building a data platform is vital for collaboration**. This is supported by evidence from other industries: nearly all companies are becoming data and software defined enterprises and healthcare must do the same.



4.1 DEFINING THE WELLNESS AGENDA

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PREVENTION

There is now clear evidence that risk reduction and lifestyle change can reduce morbidity. This has been demonstrated in Scandinavia and by smoking cessation programmes. Data analytics can identify the combination of factors that put the patient at high risk of developing a chronic condition. These factors could be as wide ranging as the alcohol consumption to genetic make-up. Mobile apps can enable individuals to manage and control their lifestyle choices and health issues, for example diabetes apps, calorie counters and exercise trackers.



EARLY DIAGNOSIS

Data analytics has huge potential to improve the outcomes of treatments for patients. Different treatments and outcomes can be analysed in conjunction with patient details (health history, genetics, lifestyle etc.) so that the maximised benefit can be achieved through personalised medicine. Improved data recording also enhances quality of care since it is easier to audit and problems with drugs, departments or NHS institutions become evident more quickly.



TREATMENT OUTCOMES

There is a growing recognition that early diagnosis is vital for improving outcomes and the patient quality of life. This is true for cancer, chronic lung diseases and very clearly for HIV related conditions. For HIV, the new therapies are highly effective, but only if the disease is diagnosed early. Personalised medicine through the better use of patient data can improve early diagnosis through risk stratification and improving research into the early symptoms of conditions.



CARE PROGRAMMES AND RISK MANAGEMENT

Improved outcomes for patients which have been achieved from better treatments have created a new challenge for managing individual cases, as patients are living longer and their treatment requires more complex management and planning. Patients need to be monitored efficiently to ensure that their treatment is effective and to reduce the risk of exacerbations and emergency admissions. New data will allow for much better identification of genetic and other risk factors.

There is certainly much more awareness of public health issues since Sir Donald Acheson as Chief Medical Officer changed focus to 'the health of the nation.' However, the overall results have been disappointing.

4.2 HOW CAN DATA ANALYTICS ACCELERATE THE DELIVERY OF THE WELLNESS AGENDA?

The Wellness Agenda is a revolution waiting to happen. There are now promising opportunities for faster progress with collaboration between Trusts, Health and Well-being Boards and CCGs.

The Wellness Agenda cannot be delivered without a significant change in the use of data analytics in healthcare. Without this shift the NHS will cease to exist in the not too distant future.

Data analytics has two major applications to healthcare: improve treatment effectiveness and improve disease management.

Treatment effectiveness:

Can be improved based on analysis of the treatment of conditions and outcomes. This is about risk stratification happening at an individual, not population, level, to increase the effectiveness of treatments. Data analytics with complete personalised information enabled through interoperability of patient records could be used to find correlations between patient characteristics (genetics, health history, previous treatment outcomes) and their likely treatment outcome. Treatments could then be targeted at the individual through personal medicine, rather than the current 'one size fits all' philosophy.

This would significantly improve patient outcomes whilst also reducing costs of treatment due to the inefficient prescription of medications and the adverse effect of drugs: currently 6% of hospital admissions are as a result of adverse reactions to drugs. The research opportunity is significant: improvements of treatment of specific diseases, drug compatibility, treatment of patients with multiple conditions and moving towards personalised treatment plans.

Disease prevention:

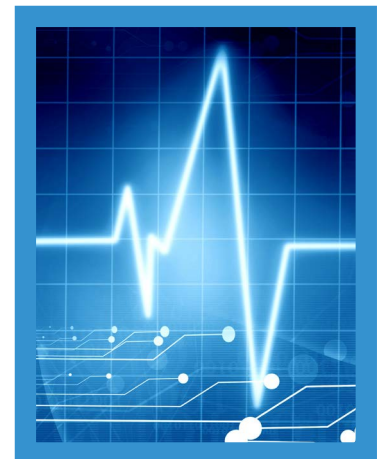
Means getting ahead of the illness demand. This is a combination of prevention and prediction. Analysis of data can help identify those at high risk of diseases so that early intervention can be achieved and the health service can intervene to help adapt their lifestyle and reduce the risk. For example, risk factors for severe asthma could be smoking, exposure to second hand smoke, genetics, non-adherence to medical advice or inactivity. These risk factors are fairly obvious triggers for ill health; data analytics would allow for the detection of more.

If information on triggers was linked to patient records, specific high risk patients could be identified and targeted. For example, rather than simply assuming all smokers are high risk to asthma which could be expensive and ineffective, patients who smoke and have a genetic predisposition towards asthma could be targeted. Linking this technology with mobile devices could allow people to manage their own risk to diseases, with monitoring of health and lifestyle choices, patients could be alerted to their own risk factors.

This fundamental shift to a Wellness Model can only be achieved through collaboration: the crisis in the NHS cannot be solved by one organisation alone. The real change in healthcare will be achieved when the research that results from data analytics is translated back into clinical working practice.

Building a data platform is vital for collaboration. This is supported by evidence from other industries: nearly all companies are becoming data and software defined enterprises and healthcare must do the same.

A collaborative data platform, often referred to as a data lake or a clinical safe haven, needs to have the ability to store large amounts of data, that can be updated and accessed by authorised personnel. In terms of healthcare, a secure data platform allows for the sharing of anonymised data among interested parties. This facilitates easy collaboration and integrated analysis of health data. A data platform must:



1. Enable mobility:



Provide access to data where and when it is needed. This will be a significant improvement on the paper based system and lost patient records that exist in many hospitals today.

2. Increase agility



Being able to rapidly add patient data and analysis to the platform.

3. Enable collaboration



IT systems must be flexible and scalable so that they don't physically limit collaboration.

4. Secure and compliant



Platforms must be secure so that patient data is protected and can only be accessed under the patient's permission.



5. THE EFFICIENCIES THAT INFORMATION CAN DELIVER IN HEALTHCARE

The impact of data analytics on the healthcare industry will be a step change in efficiency. Better use of data has the potential to completely change the healthcare system; therefore quantifying its impact is, by definition, difficult.

In this section, we quantify the impact of data analytics using a bottom-up approach: looking at individual groups of patients and the level of savings data analytics could bring. We then quantify the potential impact on the whole industry with a top-down approach.

KEY POINTS: THE EFFICIENCIES THAT INFORMATION CAN DELIVER IN HEALTHCARE

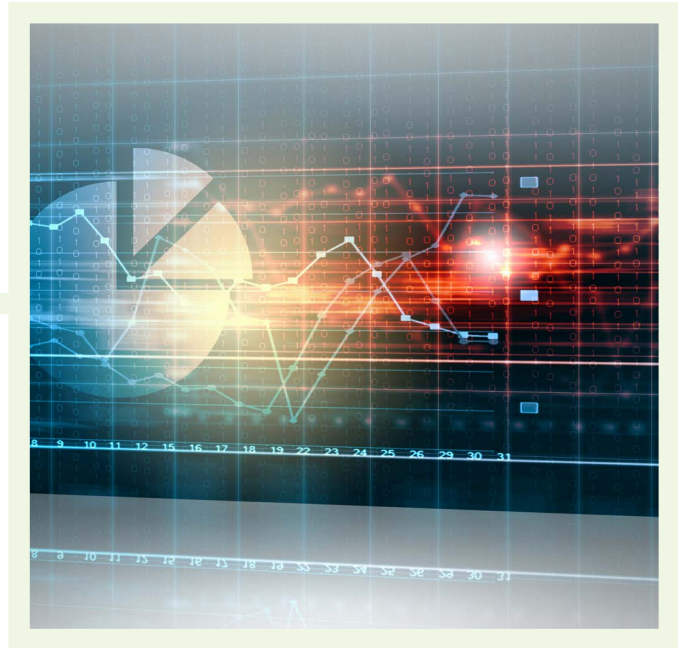
IMPACT ON SPECIFIC GROUPS OF PATIENTS

- **NHS staff efficiency:** Better use of data could raise productivity of NHS staff by at least 10%, since at least 10% of time is currently being wasted by lack of access to information. This would result in £5 billion of staff time that could be saved, allowing staff to provide patients with higher quality care or provide care to more patients.
- **A&E attendance:** A risk-profiling tool, which was used across GP practices in Wigan CCG to identify high risk patients, reduced A&E attendances by 40% and emergency admissions by 20%. If the reductions were rolled out nationally, the NHS would save £840 million a year.
- **Diabetes:** Scotland has used informatics technology to provide an integrated care model for the treatment of diabetes, resulting in a 40.7% fall in major amputations and 30% fall in total amputations. If the same improvements were made in the UK, this would result in a saving to the NHS of £37 million per annum. If the approach was widened to include foot conditions, the savings could rise to £200 million per annum.
- **COPD:** Finland has set the bench mark for effective programmes for treatment of COPD. If the UK achieved the same results over 10 year period, the saving would be £126 million per year.
- **Cancer:** Better informatics would be able to reduce admissions by 30% with a saving of £60 million per annum or £600 million over a decade.
- **Emergency readmission rates:** The Liverpool Big Data study showed that the use of data analytics had the potential to reduce hospital readmission rates by between 8% and 12%. This would save the NHS between £17 million and £32 million per annum after year two.



QUANTIFYING THE OVERALL POTENTIAL IMPACT OF INFORMATION ON HEALTHCARE

- The NHS is currently **considerably behind** other industries in terms of its use of data analytics.
- Applying the scale of **potential impact of data analytics** from other industries to healthcare, we estimate that moving to a Wellness model, for which data analytics is crucial, would **improve the efficiency of the healthcare sector by between 15% and 60%**, resulting in **savings to the NHS of between £16.5 billion and £66 billion per year**.
- This efficiency saving would be unlikely to result in actual lower costs of the service in absolute terms but would free up equivalent capacity of staff to ensure that the quality of service provided by the NHS continues to improve, despite the funding restrictions and the ageing and growing population.



NHS funding gap by 2020
£34 BILLION
(2014 budget = **£110bn**,
shortfall to rise over time)



5.1 IMPACT OF DATA ANALYTICS ON SPECIFIC GROUPS OF PATIENTS

In this section we consider pockets of excellence in the use of data in specific areas and quantify the potential impact if they were rolled out across the whole of the UK.

5.1.1 IMPACT OF DATA AND INFORMATION ON NHS STAFF EFFICIENCY

The NHS faces a critical constraint in experienced staff. Often recommendations for improving care focus on recruiting more staff but typically additional staff will come from agencies or lack the relevant experience. An alternative approach is to raise the capability of experienced staff and of health teams through **providing them with better information**. This means they will waste less time searching for information, leaving more time to spend with patients – increasing the likelihood for better patient outcomes. The current NHS pay bill is £50 billion: 70% of Trust spending.

To use a modified version of an old military classification, staff can be divided into:

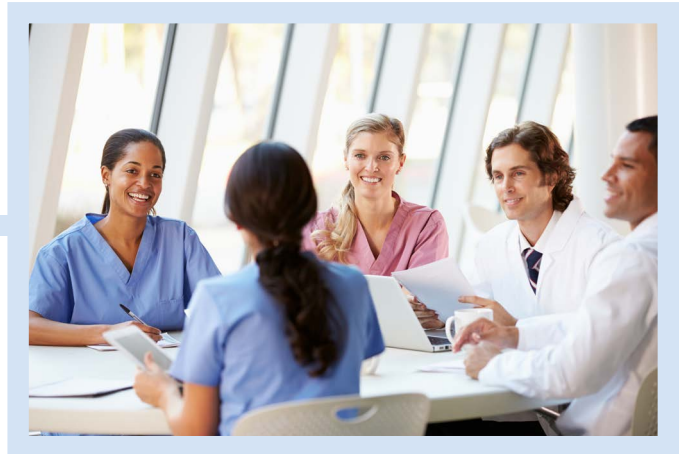
- Informed or ill informed
- Lazy or industrious

At present most NHS staff are industrious but ill informed, hence inefficient.

This is through no fault of their own and more because of the lack of interoperability of patient records. NHS staff spend **too much time looking for patient records** that are often incomplete or non-existent and therefore staff remain uninformed and waste considerable amounts of time that could be better spent treating patients.

Improved use of data will help to raise the capability of experienced staff and of health teams through providing them with better information and better access to that information. This will allow for **more efficient use of staff time** and expertise, meaning **closer control** and increased likelihood of a satisfactory conclusion.

A doctor we spoke to while researching this study gave an example of a patient who came into A&E only knowing their own name. It was impossible to find out any medical history about the patient from the systems available, and the doctor resorted to searching for the man online, finding an article about him which referred to where he came from and then ringing around doctors surgeries and hospitals in that area to find his medical history. Whilst an example of incredible resourcefulness of medical staff, this is a complete waste of their valuable time that better records and interoperability of systems could have avoided.



Improvements in work scheduling and easy access to information could make a significant difference to the sense of security and professional achievement. Such information change could both improve outcomes and lead to time saving. An Associate Director of an NHS Foundation Trust said that **30 to 40 fewer staff would be needed in the medical records department as a result of Electronic Patient Records.**

The benefits would continue along the whole care pathway. Such a **move from ill-informed to informed** will add to staff capability. Instead of staff in a state of anxiety about treatment choices staff will come to work in the morning with the feeling that they are working in an effective team which can do the **best possible job for their patients.** Job satisfaction and positive mental attitudes have a huge impact upon the productivity of staff.

5.1.2 IMPACT OF DATA ANALYTICS ON ACCIDENT AND EMERGENCY (A&E)

A&E departments assess and treat patients with serious injuries or illnesses. There are around **20 million attendances at A&E departments each year.**

A&E is another key area of service where new and timely data is badly needed. After £500 million has been spent on a special fund, it was revealed in information from the Health and Social Care information service, that there had not been a general rise in A&E attendances in many areas, but the increase was actually concentrated on patients with less serious problems in large cities. Therefore, the special fund had been poorly targeted as much of the funding had gone to Trusts which had not had rising attendances.

The quality of data on A&E attendances is low. There is no data on whether patients are new versus repeat, or relating to the severity of problems presented. If there had been a local data base it would have been possible to **identify patients who had recurring problems** and to offer them alternative services. **The lack of data means that the resource use and management response was far less effective than it could have been.**

The **use of data is crucial** to the capability of local teams to bring about continuing improvement. At present local improvement is seen as a desperate battle against the system. If the NHS is to have the feel of a service in which staff can bring about continuing improvement in outcomes in their local care, then better information through the use of data is crucial.

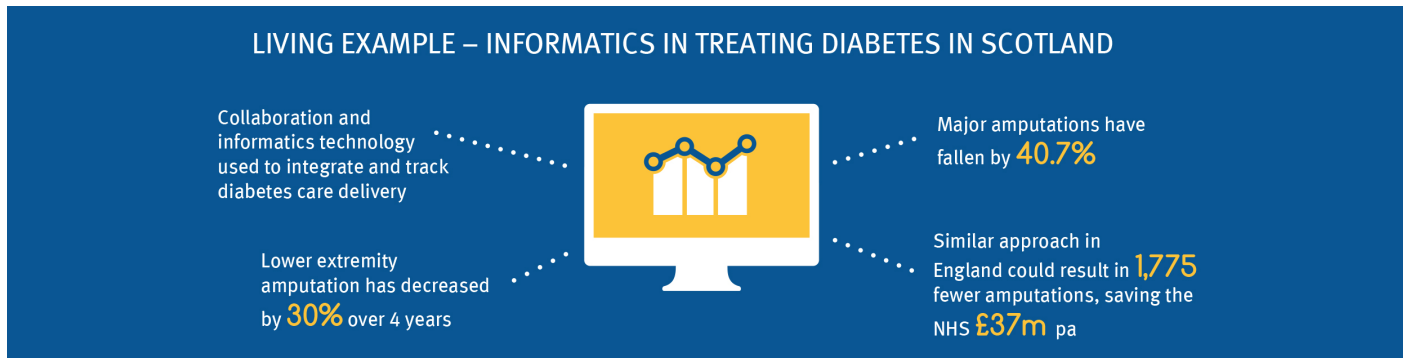
Working in the NHS is too often a frustrating experience where people feel threatened by the difficulty of getting adequate information. We estimate, based on the discussion with practitioners, that **it should be possible to raise productivity of medical staff by at least 10%, since at least 10% of time is currently being wasted by lack of access to information** and lack of use of low cost digital methods of service. For experienced staff, who are most likely to be searching for information, the time loss is likely to be more than 10%. We therefore estimate that **at least £5 billion of staff time could be saved** which would be available for a number of uses both in treating more patients and in spending more time efficiently, especially in key consultations around the diagnosis and care programmes of complex patients.



Wigan CCG has had success with a risk profiling tool which was used across GP practices to identify high risk patients. This has identified 3,000 patients and practices have now organised care plans for them. They found this had reduced A&E attendances by 40% and emergency admission had fallen 20%.

The total cost of A&E was an estimated £2.1 billion in 2012-13, which had risen steadily by 50% from £1.4 billion six years previously. There were 18.3 million total attendances, with an average cost of around £115. If the reductions achieved in Wigan could be rolled out more widely, a 40% reduction in A&E attendances would save £840 million.

5.1.3 IMPACT OF DATA ANALYTICS ON DIABETES CARE



Diabetes is a lifelong condition that causes a person’s blood sugar level to become too high, which the body is unable to regulate through production of insulin. There are two main types of diabetes referred to as type 1 and type 2. Type 1 is often referred to as early onset diabetes because it often develops before the age of 40, whereas type 2 is more common than type 1 and usually affects people aged over 40. **In the UK there are 2.9 million people affected by diabetes and there are also thought to be around 850,000 people with undiagnosed diabetes.** Diabetes cannot be cured but treatment and changes to lifestyle can have dramatic impacts upon controlling symptoms and improving quality of life.

Left untreated diabetes can lead to complications. The most severe complication can lead to amputations, and **diabetes is one of the leading causes of amputation of lower limbs throughout the world (50% of all amputations occur in people with diabetes).** The most frequent reason for hospitalisation of patients with diabetes is problems with the foot. Many of these problems are preventable through simple foot care routines.

In 2010/11 there were 5,917 amputations due to diabetes in England, 2,608 of which were major amputations. If an integrated care system could be achieved in England through the use of data informatics and the same reductions in amputations could be achieved as those delivered in Scotland, we estimate that this would result in 1,775 fewer amputations, at a **saving to the NHS of £37 million per annum.**

Scotland has used informatics technology to provide an integrated care model for the treatment of diabetes. GPs, patients and secondary care professionals have collaborated to treat diabetes over a period of 20 years. **The informatics technology is used to track patients’ treatment and treatment outcomes that are carefully monitored and managed so as to reduce the severity of the condition,** and so reduce the likelihood of foot ulcers or amputations. This has achieved impressive results:

- **The incidence of lower extremity amputation in persons with diabetes in Scotland has decreased by 30% over 4 years.**
- **Major amputations have fallen by 40.7%.**

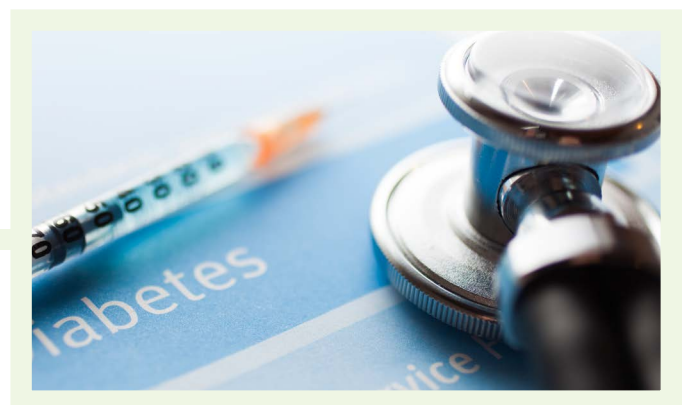


Figure 5.1: Quantifying the impacts in diabetes

	2010/2011			Reduction	2010/2011 – Reductions		
	Admissions	Unit Cost	Expenditure		Admissions	Expenditure	Saving
Amputation	5,917		£42m	30%	4,142	£28m	£14m
Major amputations	2,608	£9,477	£25m	40%	1,565	£15m	£10m
Minor amputations	3,309	£5,244	£17m	22%	2,577	£14m	£4m
Procedure on amputated stumps	315	£4,689	£1m	30%	221	£1m	£0m
Post amputation care			£76m	30%		£53m	£23m
Total:			£120m			£83m	£37m

Source: Volterra Calculations 2014; Foot care for people with Diabetes: The economic case for change Kerr, M. NHS Diabetes March 2012

Costs of diabetes are not limited to amputations. If we widen the expenditure category to include all expenditure on foot ulcers and amputations, then a 30% saving would be equivalent to £190 million - £200 million per year.

5.1.4 IMPACT OF DATA ANALYTICS ON COPD

Chronic Obstructive Pulmonary Disease (COPD) is the name for a collection of lung diseases including chronic bronchitis, emphysema and chronic obstructive airways disease. People with COPD have difficulties breathing, and often have persistent coughs and frequent chest infections. **There are an estimated three million people in the UK with COPD, of which only 900,000 have been diagnosed.** The main cause of COPD is smoking. Early diagnosis is important so that treatment can be used to slow down the deterioration of the lungs.

Research has shown that prevention of Chronic Obstructive Pulmonary Disease (COPD) exacerbations through sustained care programmes (better communication with and monitoring of patients) is vital to reduce mortality and irreversible loss of lung function. The TORCH study showed that poor adherence to medication significantly increased the mortality rate of COPD sufferers: 11.3% of patients with good adherence died compared to 26.4% of patients with poor adherence.

Finland has set the international bench-marks for effective care programmes both in COPD and in asthma. The aims of the programme were reduction in prevalence, improvements in COPD diagnosis (especially in primary care), reduction in the number of moderate to severe cases, reduction in hospitalisation, and reduction in treatment cost.



The quality of the information system has been crucial in delivering these improvements. Local primary care centres have been able to monitor patients with lung disease and to keep in regular contact with them. Local data banks have meant that they have been able to assess the risk of patients and to make sure that they intervene if patients are at high risk of exacerbations. Each primary care centre had a doctor and a specialist nurse with particular responsibilities for asthma and COPD.

The Finland experience shows how **IT can be of critical assistance in an effective local programme.** Finland has set lessons and standards for other health systems. The programmes are now being followed up by longer-term research on prevalence and risk factors.

Between 2000 and 2009, Finland had a 40.7% reduction in inpatient discharges whereas the UK experienced a 6% rise. Hospital episodes are used since hospitalisation occurs as a result of exacerbations: higher quality of care of COPD reduces exacerbations and therefore hospitalisation.

5.1.5 IMPACT OF DATA ANALYTICS ON CANCER CARE

There are over 200 different types of cancer, but the most common are breast, prostate, lung, bowel, bladder and womb cancer. In 2009, there were 320,500 new cases of cancer diagnosed in the UK. It is estimated that one in three people will develop cancer of some form during their lifetime.

There are concerns about the rise in spending that has taken place and whether this can be sustained in the future: spending on chemotherapy has increased from £200 million in 2001 to £1.2 billion in 2012. The majority of the additional spending has been for late stage cancer treatment rather than for promoting earlier diagnosis: many widely used drugs for early stage cancer are generic. There is little information concerning the effectiveness of this additional spending on late stage treatment.

In the last four years spending was accelerated by the introduction of a special Cancer Drugs Fund for high cost drugs which have not been approved by NICE. The views of clinicians close to this fund are that information on outcomes has been quite inadequate: '10% of these drugs prescribed are not in fact used and of those used 60% have little benefit or cause serious side effects.'

Cancer centres need data analytics to focus on disease and treatment progression. Such data would record diagnostic and patient data from a variety of sources and would allow access for the health team. It should be an essential for the MDT (multi-disciplinary team) meetings which have been so important to the improvement of cancer services. Conditions for such meetings to be safe and effective have never been clearly defined. They are in fact likely to change over time and must now surely include standards for the availability of information.

In England in 2012/13 there were 207,211 hospital discharges where COPD was the primary cause of admission. This included 751,954 bed days and 1,371 day visits costing approximately £310 million. If the UK achieved the same results as Finland over a 10 year period, the number of visits per year would fall to 122,876 resulting in a saving of £126 million per year.

Cancer services cover diagnostics, surgery, chemotherapy and radiotherapy. Treatment programmes have become much more complex and there is pressure to improve information on risk factors and on outcomes. As cancer care programmes improve, and patients survive for a longer period of time, there is a requirement for information not just on the disease state but on genetic factors.



Five years ago the Department of Health Cancer Strategy set an aim of reducing the number of unnecessary admissions for cancer patients. It was estimated that there were 100,000 unnecessary admissions mainly of late stage cancer patients who were not able to communicate when they had problems. Little progress has been made in reducing admissions over the last five years. Our estimate would be that better informatics would be able to reduce admissions by 30% with a saving of **£60 million per annum or £600 million over a decade**. This could be done with more timely communication with patients, so as to provide more help and reassurance and faster and better targeted help through access to the whole range of information.

NHS England plans to concentrate cancer services on fewer sites along with its policy of increasing concentration on specialist care. Such a move makes improved information even more essential for patient safety. Although the initial treatment is likely to be at a few hubs, the follow up is likely to be at local spokes. Like care integration, care concentration brings urgent new requirements for better information.

EXAMPLE OF HOW DATA ANALYTICS CAN FACILITATE IMPROVEMENTS IN QUALITY OF CANCER CARE:

1. **Safer prescribing:** It is recognised that safe prescribing of powerful medication cannot be done by hand written prescriptions. Yet only 20-40% of prescriptions in cancer services use electronic prescribing. The IT system is not developed to ensure basic patient safety. This is even more important when the range of drugs, their cost and the length of drug courses has increased so much.
2. **Personalised medicine:** A recent joint report by NHS England and the ABPI has shown that few patients over 65 are receiving chemotherapy. Decisions are made on an age basis rather than on evidence of whether that patient can benefit. Such an approach is likely to lead to inadequate treatment of some patients and excessive treatment of some younger patients who will experience severe side effects without benefit.
3. **Access to genetic information:** Cancer is one area in which research on the human genome holds out great promise for improved outcomes. In breast cancer there are already advances taking place in assessing risk from genetic factors such as the Oncotype DX Breast cancer Assay. However these results require an IT service which will allow rapid access to a huge range of data. Risk management cannot be done responsibly just through hand-written notes.
4. **More effective radiotherapy with fewer side effects:** The NHS is now committed to a strategy for improving radiotherapy by ensuring that patients can benefit from new methods such as IMRT (Intensity Modulated Radiotherapy). Such methods are currently strongly recommended for patients with prostate cancer but the expertise required is scarce as the new methods require more time from specialist staff such as physicists and radiographers. As the strategy reports:

‘Technology such as cloud based systems now support virtual planning so that it can be undertaken from any location.’

There is a special section indeed in the strategy report on the importance of data collection in improving services. There would be risk in expanding activity without adequate information for improving outcomes for patients. Information technology is again the indispensable assist for higher quality, safer healthcare.



5.1.6 IMPACT OF DATA ANALYTICS ON READMISSION RATES

A study by the The Liverpool Big Data Collaboration estimates that the introduction of big data solutions might reduce Trust related 30 day readmission rate by between 8% and 12%. Big data would use predictive analytics to analyse the risk of readmission of each patient while they are in hospital so that early intervention to mitigate risk is possible.

Trusts are effectively fined for Trust related readmissions because they do not receive their Payment by Results (PbR) payment and have to absorb the cost themselves. The Liverpool study found that this reduction in cost and readmission penalties would result in net savings for Liverpool (minus operating cost) of between £171k and £312k per annum. The cost of implementation of the big data solution in the first year would be £225k, so effectively could be recouped within just one year if expected savings are achieved.

In 2011/2012, there were 560,807 28 day readmissions in England. If we assume that 27% of these were the result of the Trust, as in the Liverpool Study, then this is equivalent to 153,000 readmissions. If this big data solution to reduce readmissions was rolled out nationally, assuming costs rise in line with number of current admissions, there are potential net **savings of between £17.4 million and £31.8 million per annum** after year two.



5.2 QUANTIFYING THE TOTAL POTENTIAL IMPACT OF DATA ANALYTICS ON HEALTHCARE

In the new funding environment, health services are faced with a choice: rationing of access to static levels of service or to move to continuous improvements so that staff teams can deliver increasing service to higher quality standards. The option of another huge rise in funding, as took place between 2002 and 2010, is no longer a possibility since neither the funding nor the additional experienced staff are available. **In order to deliver better services, the NHS requires a new nerve system: informatics.** The NHS now needs to seek a rapid catch up with other industries to make better use of their experience and expertise.

Previous sections have quantified specific impacts that improved use of data could have in certain areas, and these are clearly significant. The previous sections are based on extrapolating examples of where data technology has been used in certain areas across the country – i.e. doing what we currently do better and more widely. In this section we consider at a higher level the impact that data analytics could have on healthcare more generally, taking a more holistic view. It is currently hard to comprehend exactly what these improvements could be but examples from other industries clearly illustrate that once technological advancements are adopted, their use spreads rapidly and that this can have huge efficiency benefits and can completely change the way in which industries function.

5.2.1 EVIDENCE FROM OTHER INDUSTRIES

The examples from other industries set out in section 3.1 of this report and further supported by more general examples in the appendix **show realistic tangible examples of where data analytics has delivered between 15% and 60% savings in costs, improvements in revenues, or efficiencies in provision of services.** Based on the impact of data analytics in other industries, we estimate that moving to a Wellness Model via data analytics could significantly improve the efficiency of the healthcare system, equating to savings to the NHS of between £16.5 billion and £66 billion per year.

We do not suggest that this efficiency would actually result in lower costs of the service to this degree, but it would free up the equivalent capacity of staff to ensure that the quality of service provided by the NHS continues to improve, despite the funding restrictions and a growing ‘customer base’ in terms of more people who are living longer and with more prevalent chronic conditions. **The effectiveness saving would lead to better prescription of appropriate medications to those who would benefit most, thus reducing wasted expenditure and freeing up resources to be reallocated.**

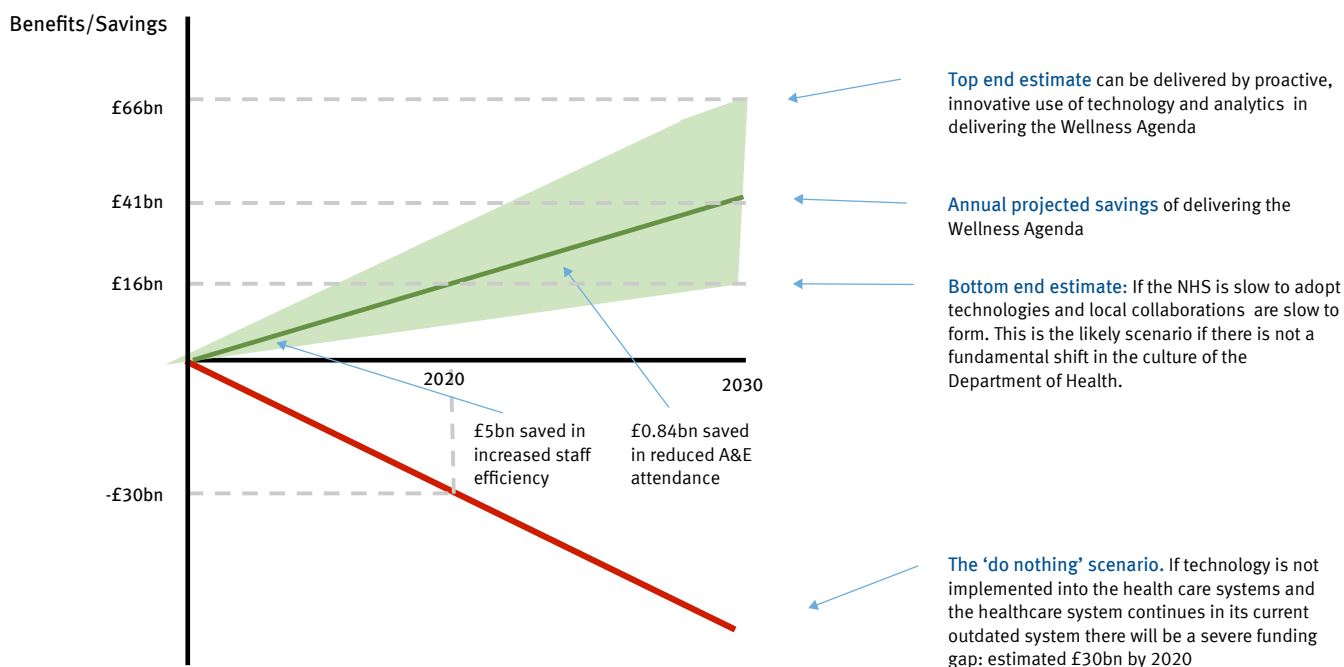


Figure 5.2 shows the build-up of potential savings for the NHS of implementing data analytics. The range of benefits depends on the speed and efficiency with which data capability is implemented. The upper scenario will occur if there is a fundamental shift to the Wellness Agenda. This requires local institutions collaboration to implement innovative data technology into their local healthcare system, as well as a change in the policy and attitude towards data analytics in the Department of Health. The longer it takes for these changes to be implemented the lower the medium term benefits will be, this is shown by the lower estimate. If there is no change to the current use of data analytics in healthcare, it is expected that there will be significant funding gap of £30 billion by 2020.

A man in a white lab coat is focused on his work at a computer workstation in a laboratory. He is leaning forward, looking intently at the monitor. His hands are on a keyboard and mouse. The background shows a wall with a grid of papers, some of which appear to be diagrams or charts. The lighting is bright and clinical.

6. KEY RECOMMENDATIONS

The following section outlines our key recommendations for the implementation of data analytics in the healthcare industry.

- The NHS must **speed up the accessibility of data**. The negative media attention surrounding Care.data should not act as a negative influence on the sharing of patient data between and within NHS institutions. An important debate is now occurring about the use and ownership of data. Care.data has now received royal assent, and the use of the data for anything other than health purposes has been ruled out: there were previously concerns that the data may be sold to insurance companies or used in junk mail. Care.data is due to be launched in autumn 2014, it is important that its benefits are effectively communicated to patients and GPs, and that concerns are appropriately addressed. Linked to this, Government must provide clearer guidelines and an ethical framework around how data should be used.
- There must be **investment in appropriate skills** in the health workforce: data analytics will change the nature of research and it is important that there are enough people with the appropriate skills to maximise the benefits. These skills include being able to code and manipulate data so that clinicians can be given the information they need.
- While data analytics must begin from local collaborations, there must be a fundamental **change in the culture of the Department of Health** if the Wellness Agenda is to be achieved. We must strive for the best improvements possible – in short, we need to be more ambitious. There is currently a focus on how data can improve performance management rather than a real shift in the way the health system operates – the real opportunity for step change will come through data analytics facilitating both prevention and personalised care. The NHS must aim higher than simply integrated health records.
- The data revolution must **begin with collaboration at a local level**. The crisis in the NHS cannot be solved by any individual institution. The Government must support the development of local informatics hubs.

The following five point plan lists the actions that should be followed by local health collaborations.



APPENDIX A: EXAMPLES OF OTHER INDUSTRIES

Data analytics is often seen as a concern in the healthcare sector, and people have doubts that the claimed improvements could actually be achieved. It is difficult to imagine exactly how it could be used and what a fundamental shift in quality of care and patient outcomes it could deliver. In this section we give a few brief examples of other industries where use of data has made huge advances to the quality and effectiveness of service provided. Indeed in some cases, use of data has changed how the industry works all together: for example, AirBnB's impact on the holiday accommodation industry. The following examples also provide good proof points demonstrating improvements that have been made by data that may not have been imaginable ten years ago, prior to their implementation.

The **Union Pacific Railroad** uses predictive analytics to predict derailments days or even weeks before they are likely to occur: using thermometers, acoustic and visual sensors on the underside of each of its rail carriages they can detect and analyse imminent problems with tracks and wheels. These sensors have led to a reduction in bearing-related derailments by 75%: a significant improvement since a major derailment can cost as much as \$40 million.

The **Los Angeles Police Department** used a data analytics model based on historical crime records to predict where and when crime was likely to occur. The predictive model led to a reduction in crime rates in the areas where the model was used: there was a 33% reduction in burglaries, 21% reduction in violent crimes and 12% reduction in property crime.

Macy's is a department store chain in America. They have used data analytics to analyse shop floor data and customer data in order to provide a more personalised service. As a result of improvements from data technology, Macy's sales have increased by 10%.

The **Coca-Cola** Company is far ahead in using data analytics to improve its organisations', products, increase its revenue and reduce its costs. For example, they cut staff overtime costs by 46% just by analysing the data in their employee service centre.

Purdue University developed Course Signals, a system that helps predict academic and behavioural issues and notifies teachers as well as students when action is required. The system has been in use already since 2007 and the results are significant: improved grades for students and higher retention rates. The Course Signals website states: 'As and Bs have increased by as much as 28% in some courses. In most cases, the greatest improvement is seen in students who were initially receiving Cs and Ds in early assignments, and pull up half a letter grade or more to a B or C.'

APPENDIX B: CASE STUDIES

CASE STUDY 1: PERSONALISED MEDICINE AND ANALYTIXAGILITY PLATFORM

The Stratified Medicine Scotland Innovation Centre (SMS-IC) aspires to be a world-class centre of research, innovation and commercialisation in the field of stratified medicine.

Challenge

- To enable precision targeting of population subsets in order to demonstrate the benefit of stratification in clinical trials, with a series of exemplar projects commencing throughout 2014
- SMS-IC aims to be the first collaboration to deliver true capability in the area of stratified medicine, delivering value to both patients, and the pharmaceutical and biotechnology industries in terms of developing new pharmaceutical therapies and diagnostic tests

Solution

- Aridhia's AnalytiXagility platform enables clinical, phenotype and genotype data to be brought together into a single platform where the data can be rapidly and securely analysed by multidisciplinary teams from across Scotland

Aridhia is supporting these efforts by providing:

- Research workspaces within the AnalytiXagility collaborative analytics platform
- Bespoke computing solutions and data modelling

CASE STUDY 2: BIG DATA AND THE NHS: EXAMPLE OF PREDICTIVE ANALYTICS

A 1,500 bed leading teaching hospital found that the Weekend Emergency Admissions deaths were higher than in similar hospitals.

They used predictive analytics to identify and model key influencers for patients likely to become long stay hospital attendances and modelled patients readmission risk and key influencers. This resulted in savings of £17.3 million.

The cost of implementation was £0.5 million so the total saving was £18.2 million.

For more information visit: <http://emc.im/UKHealthcare2014>
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