FT SPECIAL REPORT

The Connected Business

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A suitable case for treatment

Technology will play a growing role in care delivery but obstacles need to be tackled, writes Sarah Murray

t Stanford University in the US, electrical engineer Ada Poon has developed a means of wirelessly transferring power into the body to run tiny electronic medical devices such as pacemakers and nerve stimulators. Meanwhile, Google and Novartis, the Swiss drugs group, last week announced a deal to develop "smart" contact lenses that will help diabetics track their blood sugar levels by measuring glucose in eye fluid.

But if technology is accelerating medical advances, IT will also play a critical role in reshaping health systems as the industry struggles to meet rapidly rising demand for care.

With populations around the globe growing older, millions of individuals are living longer but with one or more chronic conditions. As this puts increasing pressure on healthcare systems, the whole emphasis of healthcare needs to shift, experts say.

What was once a reactive system, mending broken bones and curing disease, now needs to prevent people from becoming ill, manage their conditions and do so at lower cost and increased quality.

None of this will be possible without information technology. "IT is the only hope we have of making sure we do a better job of that," says Stephanie Reel, chief information officer for the US-based Johns Hopkins University and Health System.



First, IT can help shift care from the hospital to the home, cutting costs sharply and giving individuals a better quality of life. Home-based svstems can, for example, monitor bloodsugar levels in diabetics and transmit that information wirelessly to the clinic. Sensors in shoes can detect changes in gait and alert caregivers if a patient or relative has fallen.

Apps and wearable health monitors encourage individuals to become more involved in their own care, helping them make dietary improvements or exercise more frequently.

"We're evolving to systems and sensors that will be able to manage,

monitor and motivate people into wellbeing," says Joseph Coughlin, founder and director of the Massachusetts Institute of Technology's Age-Lab, which conducts research into technologies, business strategies and policies relating to longevity.

Some see a "consumerisation" of healthcare as IT enables greater choice and price comparisons. "We're used to shopping and booking flights and hotels online," says Anurag Gupta, a research director at Gartner specialising in healthcare. "There's a big push to have some level of this in healthcare.

But while remote monitoring and

apps increase quality and choice in developed countries, in poorer parts of the world they provide something more fundamental - access.

Mobile phones allow community health workers in rural areas to conduct diagnoses remotely by sending texts and images to the nearest healthcare centre. And in the absence of local medical services, the ability to talk to a doctor or nurse in an emergency represents a big step forward.

Another technology tool that is proving critical in advancing healthcare is the electronic medical record. Once used merely to collect information about individual patients, the

EMR is becoming a data source providing the insights necessary to design preventive strategies and more customised interventions.

Correlated with other information, health data can be used to improve population health. Researchers could, for example, compare the incidence of diabetes in a particular area with census and demographic data and information on the number of local parks or shops selling fresh vegetables.

Armed with this knowledge, policy makers, health professionals and others can respond more effectively. In

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Cheap DNA sequencing will

transform medical research

Genome technology

A process that once cost \$1bn is likely to fall to tens of dollars within a few years, writes Clive Cookson

DNA sequencing has experienced a spectacular fall in its price to performance ratio, exceeding that in every other important field of technology.

The cost of reading the three billion chemical "letters" in a human genome crashed from \$1bn in the 1990s to \$10m in 2007 and is likely to dip under \$1,000 within the next two years. A small bacterial or viral genome can be decoded for tens of dollars.

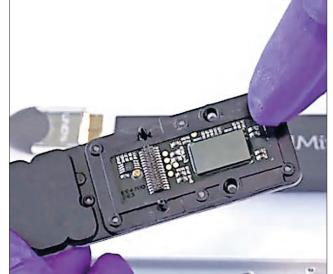
medicine and the biosciences of quick and affordable DNA sequencing will be profound. In healthcare, an era of personalised medicine is dawning, in which treatments can be matched to an individual patient's genetic make-up.

In research, genomics is transforming fields from palaeontology – decoding DNA extracted from the fossils of extinct species - to agriculture, where it is giving plant breeders new insights into crop improvement.

This is happening some years later than suggested by a few of the overenthusiastic predictions made as the original Human Genome Project was coming to a close 15 years ago, but that delay was not due to any failure by the technology to make the expected progress; rather, the biology turned out to be much harder to decipher than expected, with the control and functioning of genes showing levels of complexity that scientists are only just beginning to understand.

But there is unevenness in how the revolutionary impact of genomics is affecting research.

An analysis released last month by Marks & Clerk, light to sequence DNA on a the field is UK-based the London-based intellec- cell phone camera chip."



Oxford Nanopore's Minlon: the smallest DNA sequencer

But the technology being

promoted most actively by

NIH is "nanopore" sequenc-

ing, which involves thread-

ing single DNA strands

through tiny protein pores

in a membrane. Individual

bases, the chemical letters

of DNA, are read one by

one as they pass through

the nanopores; each of the

four bases in DNA has its

own distinctive effect on an

electric current passing

shows great promise but it

is still a new area of sci-

ence," says Jeffrey Schloss,

driving advances in

director of the NIH pro-

gramme. "We have much to

learn about how nanopores

ogy, which is why five of

programme's eight

Several companies are

'Public research

research into

technologies'

technology

through the pore.

"Nanopore

tual property company, shows that "public research The consequences for organisations are driving advances in research into genome-related technologies and their use in medicine and industry, with the private sector lagging behind". Most of the innovation is taking place in the US, with the National Institutes of Health (NIH) particularly active.

"The markedly strong performance of US public bodies reflects badly on Europe, with European universities and research bodies surprisunder-represented ingly among the large filers of patent applications," says Gareth Williams, Marks & Clark partner.

The biggest single source organisations are of innovation is the NIH Advanced DNA Sequencing Technology Program, which has been providing about \$20m a year in grants since genome-related 2004. The last round of eight grants was announced in September 2013 – two to companies and six to universities – and the next announcement is expected

this autumn. Perhaps the most eyecan work effectively as a catching grant went to a DNA sequencing technolsmall Californian company, Biomedical, which Eve the intends to develop a system grants are exploring this "that can sequence an approach. entire human genome for under \$100. The overall system will be based on using

technology. A leader in Oxford Nanopore, a private

company that has raised £145m from investors since its foundation in 2005. Its MinIon device, the world's smallest DNA sequencer, is not yet on sale but is beginning to give results for academic researchers who have been given early access to the technology.

In principle, nanopore technology has advantages of speed and simplicity over current sequencing methods. These require DNA to be chemically labelled and copied; it has to be broken into short segments up which are sequenced many times.

The world of DNA sequencing machines used to be dominated by Applied Biosystems of the US, which was acquired in 2008 by Invitrogen and subsumed into a merged com-pany renamed Life Technologies. Last year, Life Technologies was bought by Thermo Fisher Scientific for \$13.6bn.

Illumina, still an independent US company after seeing off a \$6.7bn bid by Roche of Switzerland, is leader of the DNA sequencing market, although Roche remains the largest player in Europe. Last month, Roche, which predicts a big role for gene sequencing in its large diagnostics business, bought Genia, a privately owned Californian sequencing company, in a deal worth up to \$350m.

The patent analysis by Marks & Clerk shows Illumina and Life Technologies are far ahead of the corporate pack in the number of patents filed in DNA sequencing technology over the past 10 years, with 80 and 70 respectively.

The leading Asian company in the field is BGI Shenzhen (formerly Beijing Genomics Institute). "We are seeing interest from emerging markets like China, where life sciences companies have for many years lagged behind their electronic counterparts in terms of patent filings around the world," says Mr Williams. "The importance commercialising nanopore of BGI Shenzhen's appearance in the list of top filers should not be underestimated.

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The Connected Business

Can patients be left to own devices?

Connectivity

Remote monitoring has big potential but users need to stick to their routines, writes Jessica Twentyman

are, anywhere: that is the promise made for a new generation of personal medical devices that enable doctors to remotely monitor patients with chronic conditions such as high blood pressure, heart disease and diabetes.

Demand for this kind of care is high. In developed countries, chronic illnesses – long-lasting conditions that can be controlled, but not cured already place a far greater burden on healthcare systems than acute illnesses requiring hospital stays.

In ageing populations, the problems associated with keeping a close eye on older patients, who are more prone to chronic illness, are only set to get worse as the numbers increase.

It stands to reason that medical devices making it simpler for doctors to collect vast amounts of data on the progression of such illnesses and the effectiveness of their treatment could drive down costs for healthcare providers, while improving quality of care for patients.

In fact, by the end of 2013, about 3m patients worldwide were already being monitored through the use of connected personal medical devices, a figure that is set to rise to 19.1m by 2018, according to a study by Swedish research firm Berg Insight.

Today, the main application for such technology is monitoring patients with implantable cardiac rhythm management (CRM) devices. typically pacemakers and defibrillators. These accounted for nearly twothirds of all remote monitoring in 2013, says Lars Kurkinen, a Berg Insight analyst.

But by 2018, he adds, the CRM category will account for just over onefifth of all connections, as physicians increasingly receive data from patients equipped with devices to measure their glucose levels, blood pressure, blood oxygen levels, sleep patterns and coagulation rates, for example.

"Connectivity is finding its way into a whole range of medical devices and that's enabling whole new ways of care," says Mr Kurkinen. "Aside from this strong general trend, we were surprised in our research to find how



Heart of the matter: remote monitoring is mainly used for pacemakers and defibrillators, but its use will spread

Patching it up The 'sticking plaster' that monitors a patient's condition via the cloud

Healthcare technology innovators often fall victim to "pilotitis", says Frazer Bennett. It is a distressing condition in which product ideas never make it past the pilot stage.

drug is very susceptible to adherence, meaning that it loses effectiveness if it is not taken strictly as prescribed. For the physician, it is important to know

that has a radio in it," says Mr Bennett. "Mobile phone production is 1bn a year but there are different flavours, varieties and manufacturers.

PA has now proved that such a

price is possible and is looking at

monitoring lung conditions, where

a similar patch could save elderly

patients from arduous trips for a

check-up and free up consultants

to see more patients. Each type of

patch would vary, says Mr Bennett

- for example, some

would need to last

longer in use than

the two days'

other applications that include

could also be opportunities in the exploding market for wellness or fitness monitoring. That could have a big impact on manufacturing costs, says Mr Bennett.

Apps have wide role in disease management

Smartphones

Mobile health could save money and support the shift to prevention, reports Paul Solman

A look at Android and iOS online stores reveals the range of smartphone apps aimed at helping users to live a healthy lifestyle. Bestsellers on GooglePlay and iTunes cover fitness, running and weight loss, as well as healthy eating and care in pregnancy, while devices such as the Fitbit can connect wirelessly to the smartphone to monitor the body and feed information back to the app.

Yet while many popular apps are aimed at general wellbeing, mobile phones have the potential to make a wider impact on healthcare and disease management

The power of the mobile phone in healthcare has already been seen in parts of Africa, where doctors and medical organisations have harnessed the technology to send text reminders of appointments to people in isolated communities, store patient immunisation records and even provide a way for patients to check the provenance of medicines to combat the spread of counterfeit drugs.

In the world's wealthier nations, too, mobile phone texting has been used to help administer appointments, while smartphone apps can provide information on just about every imaginable disease or condition - from allergies, diabetes and epilepsy to insomnia, health problems and sexual health.

ditions.

But doctors say mobile phone technology could be used more widely to help patients manage their con-

other procedures are possible'

be used as a

Evidence is growing that health apps work. A study published last month in the British Journal of General Practice reported that a simple smartphone app significantly increased physical activity over eight weeks in a primary care population. Smartphones also have a great deal of potential in managing long-term conditions such as asthma, diabetes and inflammatory bowel disease, says Hilary Thomas, chief medical adviser to KPMG in the UK. "There is already a wide variety of apps in use and, as younger generations that have grown up with apps get older, I think apps will be increasingly seen as a normal way to engage with health," says Prof Thomas. "Apps are ideal for allowing patients to monitor the changes in their condition from day to day, so they can be alerted when they need to go to hospital. Apps can give patients more of a sense of control over their using remote monitoring, he says, and condition.' 35 per cent less likely to die than Some believe mobile patients with low remote monitoring. phones also have a broader "I can't tell you how exciting that it part to play in helping is to me. For years, we've talked healthcare providers and about remote monitoring as somegovernments streamline thing that can improve patient quality services and cut costs. A of life, improve healthcare delivery report produced for the EU and potentially reduce costs. These has forecast that encouragthings are the focus of most studies," ing "m-health" initiatives could save €99bn in the EU he says. "But for the first time, we're showing clear evidence that remote in 2017, and add €93bn to monitoring saves lives - it's associ-EU gross domestic product. Indeed, the global market "That's incredibly profound. It's a

according to a report by GSMA, the telecoms industry group, and PwC, the consultancy. An EU green paper published this year suggested that, as healthcare systems face challenges such as the ageing of the population

provide healthcare services

- will reach \$23bn in 2017,

and budgetary pressure, "m-health could be one of the tools to tackle these challenges by contributing to a more patient-focused healthcare, and supporting the shift towards prevention while at the same time improving the efficiency of the system". The paper called for more

investment in research and innovation to support the development of more advanced and innovative m-health solutions

Smartphone apps and online services are already widely used and have a lot of potential, but their use needs to be recommended by GPs, says Ray Jones, professor of health informatics at Plymouth University. "Use of mobiles by over-65s is still low, so the

uptake of ehealth is on the rise but there is a long way to go.' More also needs to be

done to encourage app developers to work on health, he says. Plymouth University's Health App Challenge, for example, aims to encourage new apps for patients with diabetes and those who have undergone pre- and post-weight

loss surgery. Meanwhile, apps for use by medical staff are likely to be increasingly important. In the US, Epocrates, which provides information

'A smartphone can

stethoscope, and

quickly devices for glucose monitoring and medication adherence monitoring were starting to take off, from pilots to clinical trials to commercial rollouts.

The area of medical adherence monitoring is particularly exciting: many patients, after all, forget to take medicines at the right times or in the right doses. Some will view any improvement in their condition - or no improvement at all – as a valid reason to neglect their treatment or abandon it altogether. The World Health Organisation estimates that non-adherence, as it is known by the medical profession, may account for one in 10 hospital admissions worldwide.

With that in mind, pharmaceuticals company Merck Serono recently launched an updated version of its Easypod automated injection device for patients with growth hormone deficiencies, an area of medicine where two-thirds of physicians cite non-adherence as the main reason for treatment failure, according to the company.

The new Easypod system comprises an injector, a transmitter and a webbased software platform, Easypod Connect. Patients are reminded by text message or email to inject their drugs and, when they do, the information is forwarded by the transmitter, enabling doctors to track their patients online.

But adherence may prove to be one of remote monitoring's own biggest challenges. According to a 2012 survey of patients conducted by the Economist Intelligence Unit and management consultancy PwC, 61 per cent of evidence patients discontinued their use of mobile health (m-health) services designed to promote better communication with healthcare professionals within the first six months, while 70 SAVES IVES per cent stopped using the devices

"Two of the major causes are: one, not enough understanding of the economic value chain, and, two, not really understanding and identifying the patient need at the outset," says the technology expert at PA Consulting Group.

Mr Bennett has been careful to avoid catching the disease over the past year, during which PA has developed a low-cost health patch the size of a UK 10p piece that can be used for remote monitoring in real time.

The health patch, claimed to be the world's smallest and just 1mm thick, has a huge range of potential uses, says Mr Bennett. But a generic solution will not work in the "hairy" economics of healthcare, he says, because the rationale will vary from case to case. Instead, specific diseases, drugs or care pathways need to be targeted, so the patch can be kept as simple as possible.

PA's initial customer has been a big pharmaceutical company with a blockbuster drug of which 200m doses are sold each year. The

the patient has not forgotten to take the pill but the drug company needs to know this, too, as the drug's performance and its reputation will suffer if the pill is not taken regularly.

That could be particularly important in the future, notes Mr Bennett, as drug companies are increasingly likely to have to wait for payments by results rather than be reimbursed upfront after the prescription is handed in at the pharmacist.

The patch, activated when taken from the packet and attached to the skin, has a sensor for the monitoring and a tiny transmitter whose signal is picked up by a watch or pendant with a cellular connection. From there the signal can be forwarded to the cloud, picked up by a service provider and passed on to the physician. The big issue was to achieve a target price of 30p a patch, or 50

US cents, on a production run of 200m units a year. "There is no single product on earth today of which 200m are made each year

'For the first time, we're showing clear that remote monitoring

that automatically send data to health providers. That said, the results for patients who do stick to remote monitoring devices and procedures are extremely encouraging, according to Mark Carlson, vice-president of global clinical affairs and chief medical officer at medical device company, St Jude Medical.

In research presented for the first time at the Heart Rhythm 2014 conference, held in San Francisco in May, executives from St Jude Medical were able to demonstrate a clear reduction in mortality among patients equipped with its pacemakers or defibrillators

Part of the reason is that

There are multiple levels

savs Mr Van Kuiken.

and monitored by its Merlin Remote Monitoring System.

Of the 260,000 patients observed in the study, those who stuck with home monitoring had more than twice the probability of survival than that of patients without home monitoring.

"And the closer they stuck to home monitoring routines, the better they

Ultimately, the patch could be produced cheaply enough, maybe five cents apiece, to be put into sticking plasters, and used to monitor a patient from roadside injury to full recovery, he says. Meanwhile, once the product for

the drug company gets on to the market, after clinical trials that typically take two to three

> years, 200m extra devices will be on the internet every year, says Mr Bennett, and that is just for one drug treating a single condition. "This is the 'internet of things' emerging by stealth almost, if you like," he says. Never mind washing machines talking to fridges. **Andrew Baxter**

about drugs and dosages, is the most popular app among physicians.

"The direction of travel is for care to be very much closer to the patient, and use of miniaturised and mobile technology is part of the trend," says Maureen Baker, who chairs the UK's Royal College of General Practitioners.

"The potential [of apps and online services accessed via mobile phones] is almost limitless – for example, electronic records where clinicians can enter information on a smartphone or tablet. A smartphone can be used as a stethoscope, and there are other diagnostic procedures possible. This is happening now but not yet at scale."

Nevertheless, the growth also brings safety challenges

In the UK, the NHS Choices website has created a Health Apps Library, which lists apps that have been checked by a team of doctors, nurses and safety specialists. In the US, the Food and Drug Administration last year issued guidance on how it regulates medical apps.

"At the moment, anyone can write an app in their bedroom, call it a diabetes app and sell it," says Dr Baker. "So as use of apps grows, an important issue is the regulation of health for m-health - mobile apps and ensuring patient devices and projects that safety.'

A suitable case for treatment – but hurdles must still be overcome

Continued from Page 1

the case of diabetes, this might mean opening more parks, fitness centres and shops selling healthy food.

Information generated by EMRs also enables the development of standardised "care episodes" - the range of treatments needed over a set time to address a condition, whether it be a hip replacement or congestive heart failure.

While customisation may still be needed, reducing variations in the way care is delivered can cut "You need good healthcare

to make that work," says Steven Van Kuiken, head of go. "Healthcare has been McKinsey's work on healthnotoriously one of the

care IT. Co-ordinating care by using teams that range Gupta. from physicians to social workers can bring similar healthcare is a complex ecobenefits. Payment is made system made up of everyfor packages of care rather thing from small practices than the expensive fee-forand specialists to large hosservice model, where health pital systems and insurers. providers are reimbursed for each consultation or of fragmentation to work

medical intervention. But as with standardisation, co-ordinated care will be impossible unless costs and increase quality. different health providers can share and exchange

analytics in the background information. And here, in-house proprietary IT sys- not the only hurdle on the there is still some way to tems, hampering broader data exchange.

"We've been saying for toughest industries to crack many years that we're just for technology," says Dr a few years away from havfully co-ordinated ing

> **Guest column** - Forrester's Skip Snow writes at ft.com/ connected

through before a collaborahealth records," says Ms tive model can emerge,' Reel. "And yet for some reason we are still very siloed and not really achieving Moreover, in the early days, many hospitals and what I believe is possible." health systems developed Lack of interoperability is

road to the technological transformation of healthcare. In an industry that is more highly regulated than most, new technologies may run up against legislative

offering While apps advice on diet or exercise demand little regulation, as mobile devices become used as diagnostic instruments, regulators are likely to step in. "As we talk about giving more power to the patient, we have to clarify a lot of these issues," says Dr Gupta. "And there's not a lot of clarity at the

lag behind technological advances. While IT enables remote consultations, saving time and money, virtual consultations will fail to take off if doctors are not paid

ated with improved survival.

big deal for the medical sector.'

for communicating with patients via email or video. Data overload is another danger. "While everyone is excited about sensors and implantables, there's data everywhere and very little knowledge," says Prof Coughlin.

He foresees the advent of a new type of healthcare professional – the health information specialist who will be on hand to tes?" And will employers

Payment models also make sense of the mass of avoid hiring or investing in data being generated.

genetic possibility for vari-

ous diseases in a newborn.

That child could then be

given tools and information

to manage or prevent these

But what happens if that

conditions.

individuals whose genetic Technology also raises data points to the likelihood some tough moral issues. of illness, and therefore MIT's Prof Coughlin points lower productivity? to a time when a blood test Clearly in the adoption of will be able to assess the

healthcare technology, there are plenty of wrinkles to iron out and moral issues to grapple with. However, most agree that IT has the potential to transform an industry that badly needs new ways of coping with

individual chooses not to rising demand. take the advice, asks Prof "These technologies have Coughlin. "Do we pay for massive promise," says Mr the conditions when you Van Kuiken. "As they are wake up at 65 with heart perfected, you'll see an condition and type 2 diabeexciting new era in how care is provided.'

barriers.

moment.'

fared," says Dr Carlson. Patients with high adherence to

remote monitoring – measured as the weekly transmission of data to their healthcare providers at least 75 per cent of the time - were 58 per cent less likely to die than patients not

life of the drug adherence patch. Although PA is focusing the patch principally on the regulated healthcare market, there Small development: the patch developed by PA is the size of a 10p piece

The Connected Business

Google catches cold as debate over 'big data hubris' rages

Epidemiology Scientists are divided over the value of initiatives such as the search engine's flu trends analysis, writes Andrew Ward

warning system for looming epidemics by analysing internet search terms for signs that people were coming down with the bug.

The concept – easy to understand and unambiguously good for society became a favourite of commentators and policy makers evangelising about big data's benefits.

Six years after its launch, however, Google Flu Trends (GFT) is now more often cited as an example of the limitations and dangers of over-reliance on online data.

During the 2012-13 flu season, GFT predicted 10.6 per cent of the US population had influenza-like illness when subsequent patient data showed the true figure was 6.1 per cent. The algorithm was improved for the 2013-14 season but still GFT overestimated cases by 30 per cent.

Google's shortcomings were laid bare in March, when researchers from Northeastern university in Boston, Harvard and elsewhere published a paper in Science magazine called "The parable of Google Flu: Traps in Big Data Analysis'

Wanted: IT

of big data. Google Flu Trends was implicit assumption that big data are supposed to provide an early a substitute for, rather than a supplement to, traditional data collection and analysis"

Analysing flu reports provided to the US Centers for Disease Control and Prevention (CDC) by doctors remained more accurate than Google's predictions, the researchers found, even though there is a twoweek lag in the data.

"The comparative value of the [GFT] algorithm as a standalone flu monitor is questionable," the paper concluded.

What went wrong? Problems included people searching for information on flu symptoms when they really only have a cold; or because they are worried about getting it; or because they have been prompted by media coverage of flu outbreaks.

Moreover, when people search for information about flu - or anything else – through Google, a list of related search prompts encourages people to make further searches on similar subjects. This risks causing a snowballing in flu-related searches that distorts the data.

During its design phase, Google

t was once a symbol of the power "big data hubris" involving "the often than 50m search terms for potential correlations with CDC data on reported flu cases in prior years.

Some of the strongest correlations involved searches such as "Oscar nominations" and the "March Madness" US College basketball series which tend to coincide with peak flu season. Unhelpful examples such as these were filtered out and 45 search terms settled on that appeared to be good indicators of flu activity.

The flaws in the algorithm have been seized on by sceptics who believe the benefits of big data have been overblown. However, Google's own software engineers were open about its limitations when they launched GFT in 2008.

'This system is not designed to be a replacement for traditional surveillance networks or supplant the need for laboratory-based diagnosis," they wrote in Nature magazine. "The data are most useful as a means to spur further investigation and collection of direct measures of disease activity."

This was precisely the conclusion reached by this year's Science paper on the limitations of GFT. Beyond the headlines on "big data hubris", the researchers acknowledged that Google GFT, they said, was an example of software engineers analysed more data could improve the accuracy of

flu forecasts when combined with CDC data.

Other academics have since stepped in to defend the concept of using big data to improve epidemiology even if Google's first attempt was flawed.

A report from researchers at Harvard University and elsewhere in July concluded that the problems were mainly methodological, raising the prospect that GFT could become more accurate. "A methodological problem has a methodological solution," they wrote.

One possible way to build a more robust model emerged from a Pennsylvania State University study published in July, which claimed to have diagnosed with 99 per cent accuracy people with flu based on their social media activity.

Whereas GFT was based on correlations between search terms and population-wide flu data, the Pennsylvania researchers based their model on 104 individuals who had been professionally diagnosed with the virus in the 2012-13 winter.

The researchers looked at the Twitter accounts of those people to see if On flu symptoms when they left clues about their illness when they were suffering from flu. Just under half the people referred

This won't hurt a bit: a nurse in Hong Kong prepares to give a flu vaccination

were able to come up with a model that accurately diagnosed even those who did not mention their flu. This was done through analysis of

text searches, how they interacted with their Twitter "followers", and the intensity with which they were using the site compared with when they did not have flu.

researchers believe that basing disease-tracking algorithms on the online behaviour of people known to have had the disease could be the key to more accurate predictions. But they also acknowledge the privacy concerns surrounding such methods.

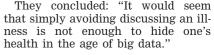
While their study focused on flu, they noted that the same technique could be used to identify people with more "stigmatised diseases", such as HIV, "where being able to determine if an individual is HIV positive without her knowledge and with only her Twitter handle could result in serious

They concluded: "It would seem that simply avoiding discussing an illhealth in the age of big data.'

directly to their condition in their own tweets. Yet, by analysing other patterns of usage, the researchers

The Pennsylvania

Problems included people searching for information social and economic effects" they really only have a cold





expertise with a human touch

Jobs market

Staff with healthcare and technical skills are highly prized, says Jane Bird

From electronic patient records and clinical administration systems to wearable fitness monitors, the healthcare industry is being flooded with data.

Making better use of such information could improve hospital efficiency and outcomes for patients but this can happen only if employees have the right combination of healthcare experience and technical qualifications.

The best staff typically have both, says Jason Bincalar, deputy director of informatics at Barts Health NHS Trust, the largest group of healthcare institutions in the UK. "Hospitals need to focus their hardpressed resources on medical practitioners, not IT departments," he says.

"People have to hit the ground running. We can't afford to spend two years training them, we need them to be as efficient as possible from day one."

But staff with these qualities can be hard to find, says Frank Myeroff, president of Ohio-based Direct Consulting Associates (DCA). "In the US, there is already a huge shortage of people in the healthcare sector with analytics and

informatics skills," he says. To meet the shortfall, US universities are starting to create courses on healthcare IT. These include Columbia University, New York, and Stanford University, California.

"Their aim is to fill the gap and get people trained in university rather than waiting until they are on the job," Mr Myeroff says.

Steve Nathan, chief executive at California-based Amara Health Analytics, agrees that people with healthcare and big data skills are in short supply in the US. "The job title 'data

scientist' has become really hot," he says. In the past, medical software involved capturing the mainly knowledge of experts, Mr Nathan says.

But now, with big data, search programs with powerful algorithms can find patterns and solve problems themselves, spotting bv symptoms that could give early signs of specific diseases, for example.

People who can design such systems tend to have a computer science background, often with a PhD in a subject such as artificial intelligence. They also need skills in natural language processing to extract meaning from unstructured data such as clinicians' notes, Mr Nathan adds. And they need techniques for han-

dling large quantities of data at high speed to provide real-time reporting on data being captured by a growing array of electronic monitors.

In the UK, the skills shortage in healthcare is less acute than in the US, says Andrew Gardner, senior divisional director at

'People have to hit the ground running; we can't afford to spend two years training them'

Reed Technology, a UK recruitment consultancy. Although the market is "not awash" with people who have the right mixture of IT skills and healthcare experience, finding them has not been too difficult in recent years, he says. "We have not had to go overseas

for talent' However, that could be about to change. Mr Gardner adds: "The market has been picking up since the end of 2013 and it could become a struggle to find people with technical skills in healthcare in the coming months.

The particular challenge greatly reduced their level money, Mr Myeroff says.



Vital signs: hospitals rely on complex systems Arno Massee

and 14,000 staff.

ing are over, he says.

dle its data infrastructure.

experiencing

in healthcare is that sys- of frustration and increased their productivity," Mr Bintems cannot be allowed to go down, says Mr Bincalar. calar says. One way to find IT staff The Barts Trust has six hos-

with experience of critical pitals, 50 community clinics environments that need "Given the sheer size of fail-safe computing is to such systems and the fact look in sectors such as that nothing is 100 per cent financial services, defence, reliable, the only way to utilities and nuclear power, ensure fail-safe computing he says. is to add extras and repli-

A further crucial skill for healthcare IT professionals is the ability to communicate systems, and that increases complexity," he cate. The human element is Another important skill very important because hosfor IT staff, given the compitals tend to be large plexity of most hospital organisations with relatively few IT staff, says Mr Bincalar.

information, is the ability to use the latest data pres-"We need people who can entation and visualisation listen intelligently when tools for troubleshooting hospital equipment. The they come into contact with days when you picked up clinicians and understand the phone to ask users if their requirements, so they can help people select the their computers were workbest product, check its func-"Staff need to be able to tionality, and make sure it work with toolsets that help is fit for purpose," he says. Since the recession, many visualise and interpret data," says Mr Bincalar, IT workers have been willwho looks for people who ing to transfer into healthare familiar with software care. There is also quite a from vendors such as lot of staff movement Extreme Networks, which between the software comthe Barts Trust uses to hanpanies that develop applications and hospitals where they are deployed. "Soft-Such tools help IT departments look inside networks ware developers find it useand see where users are ful to have people with problems. experience of hospital envi-This lets me target my ronments, and vice versa,'

investment," he says. The software helped says DCA's Mr Myeroff Salaries in the software reveal the fact that consultindustry tend to be higher ant radiologists were being than those in healthcare, held up when reviewing as do salaries in other sec-MRI and CT scans because tors. IT staff choosing to of bottlenecks between work in healthcare, particutheir computers and the larly in the public sector, system holding the images. tend to be motivated by "Solving that problem has other factors, not just

the way to securing trust

Public access to files points

Case study UK

Concern over privacy is a hurdle that can be overcome, writes Michael Dempsey

Roger Stedman is a passionate man. With 22 years of work in the UK's National Health Service (NHS) behind him, the medical director of Sandwell and West Birmingham Hospitals NHS Trust thinks the place of information in healthcare

is grossly misunderstood. "Improving the use of data is a massive issue," he says. "People haven't got to grips with the fact that medicine is an information industry and that 90 per cent of healthcare involves the transfer of information between professionals.' Dr Stedman works in a field where data

exploitation has an unhappy history and has recently been the cause of much friction between patients' groups and the authorities. In February, a plan to

create a vast database of patient records that could be accessed by medical researchers ground to a halt under pressure from privacy campaigners. identities from registration numbers and postcodes. With wider fears about

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confidentiality triggered by the Snowden saga contaminating trust in the public sector's grasp of privacy, the database plan was put on hold for six months.

This postponed project remains "fundamentally important", according to Simon Stevens, chief executive of NHS England. But public doubts about the security of health data, however ill-informed, are not going away. Dr Stedman recognises that privacy worries are genuine, but thinks the way forward is "to get to where the online banking industry has got in terms of trust in the data and the system"

Research indicates that he may be pushing at an open door. Half the British patients polled in a 10nation survey by Accenture on attitudes to online medical records thought the benefits of online access outweighed the confidentiality risks. Tellingly, the vast majority of the 1,000 UK respondents wanted more control over their own health data. This is where the real story lies, says Kaveh Safavi, who manages the consultancy's global healthcare business. "It's true there are concerns over privacy but these are not prohibitive. Patients are already active online so why not give them access to their own records for themselves?" Western societies face ageing populations and growing healthcare bills so using access to health data as a lever to promote patient involvement and responsibility has obvious

economic attractions. This view gets resounding support from Dr Stedman: "My campaign is to give ownership of the data to the patient," he says. His vision of a cloudenabled NHS has patients allowing their records to be stored and accessed online by themselves and any medical staff they encounter in their journey through the bewildering layers of UK state health provision. He talks of "social healthcare", a model

whereby each patient can opt to invite selected partners, healthcare practitioners or even patients with the same conditions into their personal online space. Dr



Stedman's vision is of a rising cohort of "expert patients" who can share their experience, what he calls "crowd-sourced, evidence-creating medicine" He admits this is an idealised view of the future. "There is nothing that will force the hospital that I work for to make available all the information it holds about patients through a cloud portal, or share that information with other providers of that patient's choosing.' But websites such as the

US PatientsLikeMe, where

patients share information

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james.aylott@ft.com.

and experiences, are

Both patient consent and the simplicity offered by cloud services could cut through the perplexing maze that is the NHS. Beyond its two hospitals, Dr Stedman's trust acts as a series of mini-health services including community healthcare nurses and therapists. "Patients view the NHS as a single entity, but in reality it is very

emerging and he insists it

is only a matter of time before these develop formal

links with healthcare

providers.

fragmented," he says. The divide between the GP's surgery, where most personal files are held, and the hospital where a patient may be treated is tremendous. Dr Stedman believes his proposed information-sharing agreement would bridge this gap and join up different points in the NHS compass.

For all its 1.7m staff and £109bn budget, the NHS is not a national monolith but a collection of small organisations. In such a dispersed system, grand projects are always going to prove troublesome and face critics.

The failed National Programme for IT, which included an attempt to overhaul all general practitioner computer systems and cost £9.8bn in the decade from 2002, looms large in public consciousness of healthcare and technology.

If more modest patientparticipation schemes using online access were pitched as both affordable and attainable, they might win over the popular vote.

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Although the information in the NHS patient database would be anonymised, concerns remained about the ability

of third parties to extract

The Connected Business

Networking finds fresh dimension

Conferences Smartphone apps and even holograms are changing the game, writes *Jane Bird*

ou are at a conference and the speaker on stage is walking up and down and gesticulating to emphasise his points as he talks to a female presenter. All quite impressive, considering he is not on stage at all, but is a hologram.

The technology was demonstrated at a recent London conference (see article, right) and the man was in a booth off-stage but organisers say he could just as easily have been in San Francisco.

Technology is revolutionising the conference experience and not just to create razzle dazzle entertainment for delegates. It is also transforming the economics.

Organising 140 conferences a year used to be a labour-intensive task says Marty Hoski, global manager for travel and meetings operations at ETS, a US-based education assessment organisation. His 14-member team had filing cabinets full of folders containing manually-prepared paper documents relating to contracts for exhibitors, speakers, catering staff and other participants.

Now the process is automated, using Cvent, a cloud-based software service that provides apps to help with everything from venue selection and online registration to travel booking, payment, email marketing and web surveys.

Using the apps enables each event to be managed as an individual project and it takes a fraction of the time, Mr Hoski says.

By subscribing to a service, rather than trying to build the software itself, ETS gets access to the latest technology and can sign up for whatever components it wants: "All we mational in proving return on investneed is a browser and internet access.'

In addition to helping with administration, apps from companies such as Cvent and Eventbrite allow conference organisers to monitor who attends which sessions in real time and to use this information for follow-up marketing.

Up to 25 per cent of marketing budgets is spent on events, says David Chalmers, marketing director of Cvent. "Software that lets you run campaigns and integrate them with your sales and marketing workflow tables where they can meet delegates



Voices off: a hologram at last month's Meet the Future conference

sounds dull and dry, but it is transforment for an event.

Organisers can also use the apps to analyse chatter on social media. They can assess the level of interest from people not attending the event, for example by seeing how many mes-sages are "liked" on Facebook or retweeted. This helps plan a better event next time, says Renaud Visage, chief technology officer and cofounder of Eventbrite.

"Delegates can be offered the chance to book seats at networking sessions, panel discussions or lunch

who want to discuss the same topics," Mr Visage says.

This has turned out to be one of the most popular aspects of the Eventbrite app. Another useful app, sli.do, allows delegates to submit questions during a presentation and to vote for their favourites so that those have more chance of being asked.

For Jackie Chi, manager of strategic initiatives at The Culinary Institute of America, based in Hyde Park, New York, being able to include maps and guides, and change them at the last minute, has been a big advantage of the app approach.

"There are often late changes, such

as a presenter dropping out or a new sponsor coming in," Ms Chi says. 'You couldn't reprint the guide but you can update the app in a few minutes.

Moreover, daily maps can be provided for areas where the location of exhibitor booths is changed each morning depending on the theme for the day. This is useful for event staff as well as delegates, Ms Chi says.

Apps are much more convenient to use than printed guides, she adds. "They are not just available online, but from a smartphone in the palm of your hand. That's much easier than rummaging in your handbag or briefcase to find details of the next speaker."

Not all conference apps have proved popular. Apps that let people exchange electronic business cards by "bumping" smartphones were introduced a few years ago but did not take off. They were too cumbersome and worked only for people with the same system.

Much progress has been made since then, says Daniel Curtis, a director of emc3, a London-based event organiser. "Nobody was interested in 2010 when we tried to introduce an app that let conference organisers register delegates as they arrived on iPads and print badges," he says. "But we had to build the software ourselves and it had glitches. Now you can buy or subscribe online to packages, although they can still be expensive for small organisations.

Futuristic technologies such as 3D holograms are beyond the financial resources of most conference organisers at present, says Eventbrite's Mr Visage. "And lots of technologies require high levels of bandwidth, which might not be available or require installation of special equipment.

Nor does technology solve all conference problems. There is no way at present to prevent leakages and restrict participants from sharing information from the event. "You just have to depend on people's honesty,' says Mr Visage. In the end, anything that makes conferences more exciting, engaging and fun is likely to get adopted, he believes. But in reality, many people still prefer to exchange traditional business cards.

Technology Conference delegates feel the buzz as microchip name badges help them tap into the future

Delegates arriving at the Meet the Future conference in London were handed name badges containing a microchip programmed with their details. Instead of swapping business cards when they met someone new, they could tap their badges together.

The badges lit up and vibrated as they exchanged contact information, using the near field communication (NFC) technology found in travel passes and contactless payment with mobile phones.

"The flashing and vibrating acts as an icebreaker and makes networking and meeting new people more fun," says Maria Schuett, conference producer for Central Hall Westminster, where last month's event took place. The data were made available to delegates after the conference.

Showing how technology could make conferences more enjoyable for delegates - and more profitable for organisers - was the purpose of the conference and to this end a special application to run it was devised. Creating an event app was much quicker and easier than having to design a conference website, Ms Schuett says. Delegates could use it for registration, checking the agenda, displaying the floor plan and seeing who else was there. The conference also featured other technologies, such as radio frequency identification (RFID), Bluetooth and iBeacon, holographic projection, audience polling, a demonstration of Google Glass and various 3D applications.

Bluetooth and iBeacon were used to send personalised welcomes to delegates' smartphones and other devices. Tapping the badge against kiosk screens in the exhibition area allowed people to pose for a picture of themselves against a

London skyline and have the image sent to all their social media contacts. In addition to taking the stress out of using Twitter and Facebook, this helped gain much more publicity for the event, Ms Schuett says.

Heads up: Google Glass headsets could aid speakers Bloomberg

Getting people to tap their badges as they entered the main conference hall enabled the organisers to know precisely when the seats downstairs were full, so that they could direct everyone else to the balcony. "We are considering offering those people an extra package for next year or guaranteeing them a seat downstairs," Ms Schuett says.

During the conference, there was also a demonstration of how a speaker wearing a Google Glass headset could see the audience ahead, while viewing a side display showing audience questions and live results of polls. The live polling required delegates to access a mobile app - sli.do - via a web link. At the beginning of the day, this needed the inducement of the chance to win a weekend in London at a fivestar hotel, but by the afternoon people had become so enthusiastic that they were logging on unprompted.

The event app also enabled people to see who in their social network was close by, locating them within concentric circles of 5m and 10m. "[It was] a visual and fun way to network," Ms Schuett says.

Visitors saw various 3D technologies in action. These included using a stereoscopic presentation to launch small products such as medical components, which can be filmed, projected, rotated and dissected on screen. On the merchandising side, people could be scanned in 3D then a colour plastic model of them "printed" out, 20cm tall, complete with facial expression.

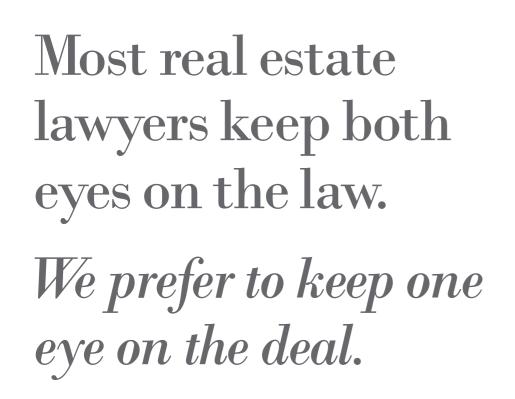
"People loved the 3D replica of themselves," Ms Schuett says. This is one type of bespoke souvenir that you could not produce commercially, she notes. "Another might be personalised toothbrushes at a medical conference."

After the event, delegates could download a spreadsheet containing contact details for everyone they had tapped cards with to integrate with their existing electronic address book. Meanwhile, the conference organisers could see who were the biggest networkers and when networking took place. "This will influence how we timetable next year's event," Ms Schuett

says.

JB

Consumer network cameras



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Paul Taylor

Video surveillance plays a vital role in securing many businesses, ranging from the corner shop to the large scale manufacturing facility. Historically these systems, which include CCTV (close circuit television) equipment that was often combined with video recorders, were complex, costly and usually delivered grainy images that were all but useless.

In recent years many companies and small businesses have replaced these systems with IPbased network cameras that either record to a NAS (network attached storage) drive, or are monitored by local or remote security teams.

These systems, made by a range of groups including Panasonic, Axis and Foscam, deliver much better video quality than old CCTV equipment and are more flexible, but they are still relatively costly to purchase and difficult to set up. Typically they require a corporate IT department or external specialists to do this. I have two weatherproof Panasonic network cameras set up at my home and connected to my Control 4 home automation system. One monitors our driveway, the other, a "pan-tilt-and-zoom" model, is installed on our porch to monitor the front door but neither device was easy to set up. Recently, however, I have tested a selection of

consumer network cameras - equipment that because of its ease of set up, flexibility and low cost is increasingly finding its way into businesses as part of the so-called consumerisation of

enterprise IT. This move has been led in large part by disruptive upstarts such as Dropcam, which was recently acquired by Google's Nest Labs unit. Most of this new generation of networkbased webcams does not require a hard-wired Ethernet connection, instead they hook up to a home or office WiFi network, are configured easily using a web app or browser and deliver alerts to users via their smartphones or laptops. Samsung's SmartCam HD Pro is a prime example of how easy the latest consumer webcams are to set up. Like most of its rivals it can capture high definition video and uses the cloud, web and mobile apps to provide a wide range of features including remote viewing. In design, it lacks the Apple-inspired

sophistication of the Dropcam Pro (see below) which costs a little more. But for image quality and functionality, they are very similar.

I connected the SmartCam to my home WiFi network before signing up with Samsung's free cloud-based service, which is accessible from either a browser or using the free iOS and Android smartphone apps.

Among its distinguishing features, the SmartCam HD | home security webcams

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Paul Taylor talks to Neil Cook, chief technology officer www.ft.com/ spam

Pro has an ultra wideangle lens capable of capturing an image spanning 128 degrees. If you position it correctly, that means you can monitor a large area with just one camera. I found that the SmartCam worked well even in difficult lighting conditions, producing clear, sharp images in both bright sunlight and dim internal lighting. In addition to remote monitoring, you can also

> Most of this new generation of webcams do not require a hardwired Ethernet connection

capture and store video clips on an SD (secure digital) card. Another product I have tried, the D-Link Outdoor HD Cloud Camera (DCS-2330L) is one of the newest consumer webcams from D-Link, which has an extensive range of devices aimed at both the consumer and business markets.

The DCS-2330L is actually one of the smallest weatherproof



and, based on my tests, one of the best performing in the dark. D-link claims the new webcam can be operated outdoors in temperatures as low as -13F or as high as 113F and can capture video of objects up to 15ft away in almost complete darkness an impressive feat and a useful feature if you want to keep an eye on a house or business at night.

The DCS-2330L captures 720p HD video rather than the full HD (1080p), so video is not quite as crisp or sharp as some competing devices, but I found it perfectly adequate for general viewing. However my favourite

webcam for use in the home or a small business is the Dropcam Pro, which shares many of the features of the Samsung SmartCam HD Pro including its wide angle lens, high-quality video and remote monitoring service. This includes an optional, low cost cloudbased recording service.

It also supports two-way audio (so you can scold the office cat remotely if required) and its free iOS app offers a pinch-to-zoom feature that enables users to zoom in to an image to see detail.

But most importantly, the Dropcam Pro incorporates a high quality, six-element, allglass lens and a larger image sensor to provide higher quality video in a wide range of lighting conditions.

Earlier this month Dropcam also introduced a feature called Custom Activity Zones, designed to give users more control over what motion alerts they receive. The new feature should be particularly useful when the device is monitoring a high traffic area such as a doorway and enables users to filter activity alerts so that they receive only the alerts they care about. I have yet to test the new feature but, based on my experience to date with Dropcam, I am optimistic

