comment

"David Prior's intervention was especially ill timed and misguided" **DAVID OLIVER**
"Online consultations with the worried well are not a high priority" **HELEN SALISBURY**
PLUS Strangled by research bureaucracy; editing "elderly" from medicine

CUT TO THE CHASE Gabriel Weston

Detainees need light and hope too

Window bars are set to be phased out in all UK prisons and replaced with toughened glass. This is safer in terms of preventing contraband, and giving prisoners a more homely environment can improve their prospects of rehabilitation.

There will always be those who believe that prison ought to be horrible, that the people who end up there deserve what they get. But our detention centres are crammed with many people we should consider patients.

An article published in *Lancet Psychiatry* in 2018 estimates that 90% of our incarcerated population have at least one mental or substance use disorder. The National Audit Office reported a 73% increase in acts of self harm in prison from 2011 to 2016. Medical Justice, a charity that campaigns for detainees' health rights, says that many of the 30 000 people detained every year in UK immigration removal centres have substantial unmet health needs, often having experienced torture and trauma.

Living with Buildings, a beautifully curated exhibition at the Wellcome Collection in London, interrogates how our built environment contributes to physical and mental health in a range of settings.

Standing in front of Andreas Gursky's massive 1993 photograph of the Mouchotte building in Paris with its rows upon rows of identical windows, you sense the desolation of the inhabitants in this building on the biggest housing estate in Montparnasse. By contrast, poring over Alvar Aalto's designs for his 1930s tuberculosis sanatorium in Paimio, Finland—with its jewel coloured interiors, ergonomic furniture, and light falling through every window—can really lift the spirits.

Near the end of the exhibition a video showcases patients with cancer enthusing about their local Maggie's Centre. More than 25 of these buildings have emerged around the UK in the past two decades, providing all manner of support to people with cancer. Designed by some of our most visionary architects, each centre is original while honouring a shared brief: to be light, inspire imagination, and, above all, make a person feel valued.

I've been inside several detention settings in the past year, including prisons, a secure psychiatric unit, and an immigration removal centre. One of these places was well appointed enough, but I found it most terrifying, even as a visitor.

Maggie's designers seem to understand intuitively that, when the architecture of our most intimate home—our own body—is disrupted by disease or catastrophe, what we need above all else is harbour, a view on to a hopeful landscape.

Perhaps one day we'll extend this consideration to the least regarded ill and vulnerable members of our community. If we're really interested in giving a road back, we need to start thinking much more creatively about the places they're forced to call home.

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Giving prisoners a more homely environment can improve their prospects of rehabilitation

PERSONAL VIEW Simon Rule, Steven LeGouill

Bureaucracy is strangling clinical studies

Many believe this is making research less safe

Clinical research is fundamental to the advancement of medical practice and improving outcomes for patients. This is without question, but evidence based medicine requires the generation of evidence and it is this process that has evolved to a place where it may become self defeating.

Year after year, clinical research teams and investigating physicians are subjected to an exponential growth in the administrative burden, paperwork, and regulation associated with clinical trials. The law has not appreciably changed since 2001, but those administering it or working within it are producing more bureaucratic demands. The universal explanation for this increasing workload is that it represents "good clinical practice" and supports the safety of the patient and research integrity. It is impossible to disagree with those aims; however this deluge of bureaucracy is in danger of having the opposite effect.

We are inundated with multiple amendments, many of which are of no clinical relevance; we receive information on side effects that have been known about for years; we get notification of suspected unexpected serious adverse reactions that are neither serious nor unexpected; and we field countless clinically insignificant queries. All of these have to be acknowledged via online, password protected systems that are different for each trial and can mean having to do this multiple times if you are running many studies with the same drug.

Many of these trials are run by contract research organisations working as intermediaries between drug companies and researchers. They have created an industry that has developed many of the processes, which take up an inordinate amount of time and help explain some of the rising costs of trials and new drugs.

Inspection processes

Where are the regulators in this process? Unfortunately, they have set the tone with their own inspection processes and bureaucratic systems. The justification is always that this is about patient safety. Many of us believe, however, that research is less safe today; the deluge of unimportant information that follows a trial opening means the truly important signals are lost and the length of, and language used in, consent forms mean patients no longer truly understand what they are involved in.

Is it "good clinical practice" to ask a patient to re-consent to a trial (often multiple times), to acknowledge new side effects of a drug they never received, or to re-consent to having fewer investigations? This continues even after they are no longer in the study. Consent forms are dozens of pages long, often confuse patients, and can scare them. The impact of this goes unrecognised, but any challenge to it is regarded as tantamount to serious professional misconduct. This is setting a tone that many investigators are no longer willing to tolerate.

The Declaration of Helsinki and the International Conference on Harmonisation-Good Clinical Practice are

BMJ OPINION Javad Hekmat-Panah

"Elderly" is outdated and has no place in the medical lexicon

Words convey meanings that can differ across countries, cultures, and eras. Some words lose their original meaning or convey unrelated messages; others become derogatory or insulting. In medicine, elderly is one such term: it is outdated, conjures up bias, and does harm.

While the word is still in use it has no clear definition. It conveys that a person is old, but not how old, or old in what capacity. In some cultures, it conveys "age 65 and above" or that a person is at retirement age, but with people increasingly retiring later and enjoying good health for longer, these meanings are becoming blurred.

Medicine is based on biological science. It has an internationally consistent terminology, which is used for diagnosis, communication, and treatment of diseases based on age, severity of illness, and comorbidities. "Elderly" offers no useful information about any of this. In medicine it can evoke false ideas about the person being described, introduce unfair generalisations, and generate ill conceived policies. Stating a patient's actual age is more informative.

Aging is not a disease, it is a progressive biological change and there may be vast differences in the health of people who are aged 65 and over. One older patient may not be able to tolerate a medical treatment because of accumulated comorbidities, but another of the same age may easily do so. Despite this, I've often come across investigators in medical research who've

These processes help explain some of the rising costs of clinical trials

there to provide a framework to ensure the quality, integrity, and safety of all research. These principles are fundamental and beyond question: they have not changed. The processes used to ensure compliance with these principles, however, have been allowed to run out of control and are in danger of defeating their purpose.

Review the whole system

We believe it is time for our health authorities to review the whole system in order to truly ensure patient safety and medical progress. This review should involve pharmaceutical companies, independent research organisations, funding charities, clinical teams running studies, and, most importantly, patients. A new framework is needed—one that changes the way research is administered to rebalance the system away from an industry that has created most of it, back to a focus on patients and those with the primary responsibility of looking after them.

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arbitrarily lumped everyone aged 65 and above in one group, instead of using the same sequential period as younger age groups. This averaging can result in treating a relatively healthy 65 year old patient identically to one much older or less healthy.

Medicine is the science and art of individualised communication, evaluation, recommendation, and treatment. Each patient has the right to be treated as an individual, according to medical standards based on their age, general condition, and comorbidities. To label everyone above a certain age as elderly and to treat them identically defies this principle, which should be at the heart of medicine.

Javad Hekmat-Panah is professor of neurology and neurosurgery at the University of Chicago

ACUTE PERSPECTIVE David Oliver

A leader's contentious views

In February NHS England's chair, David Prior, waded into the debate on the state and future of the NHS. At a meeting hosted by the Reform think tank he said that relentless edicts and targets from NHS central bodies had left local clinicians and managers feeling "learned helplessness" instead of exercising professional leadership.

Prior also criticised the commitment and discretionary effort of staff, lamenting that they wouldn't stay at work beyond contracted hours and that some were retiring too soon.

One might ask, "Why shouldn't he speak out?" Some may even find his frankness refreshing in a sea of technocratic uniformity and management speak.

But Prior is chair of a public body responsible for overseeing the entire NHS. Grandstanding, controversial comments about the staff who do all of the patient facing work don't sit well with such a role. His job description includes "stakeholder engagement," "ensuring commitment from external bodies on cross organisational priorities," and the need to "represent the board in the public arena" (note: the board, not personal views).

I'm not sure how well qualified or wise Prior is to be so critical of frontline staff, having never worked in a clinical or operational management NHS role. However, his experience should have given him some insight into public comments on record. He has worked in banking and law, as a Conservative MP, as a hospital trust chair, and briefly as a health minister in the House of Lords.

NHS England has recently produced a 10 year plan full of top-down edicts, priorities, investments linked to "must dos," and talk of "control totals." And NHS England just further tightened its central grip by becoming the dominant partner to NHS Improvement and, in effect, Health Education England. So, unless he disavows his own organisation, the "learned helplessness" claim doesn't wash. And I'm not sure that the language of blame in his comments is the way to "engage" the healthcare workers and managers who make up NHS England's stakeholders.

Only three days after Prior's remarks the Health Foundation published a study showing that more staff than ever were leaving, retiring, or going part time because of burnout, long hours, and the impact of the job on their own health or family life—making his intervention especially ill timed and misguided.

I suspect that the real reason he spoke out was to presage the subsequent announcements on possible relaxation of waiting time performance targets. I'd guess that some of the other comments were thrown in, impromptu, and not supplied by communications teams. His only saving grace would be that most NHS frontline staff are too busy coping with workload and workforce gaps to know who he is, what he does, or what he said.

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I'm not sure the language of blame is the way to engage healthcare workers and managers

Technology doesn't trump patients

Some technologies arrive gently, gradually replacing that which went before. This is what happened when motorised vehicles slowly challenged the horse and cart. Others sweep in, and overnight the whole landscape changes. Can you remember trying to organise anything before email?

The term "disruptive innovation" was coined to describe this kind of transformative development, when a new product or service overturns existing ways of working and creates new markets.

In business there's a tension between taking time to iron out the bugs in a new product and keeping ahead of rivals. In healthcare, where the stakes are high, we tend to proceed with caution. New drugs are tested against a placebo and existing treatments: before they're approved we must prove they are safe and at least as good as what they replace.

GPs are being encouraged to embrace video consultations, and our health secretary has endorsed Babylon, a commercial provider. This "disruptive innovation" may well create new markets and make money for entrepreneurs, but the medical community is still awaiting evidence. Will it provide safe care? Will it increase health inequalities? Will it satisfy an existing need or just create demand?

Babylon originally stated its online service, GP at Hand, was not suitable for patients with complex physical or mental health problems. By using enticing—but misleading—advertising, Babylon has targeted young, fit, and tech savvy patients, many of whom realise only later that, in signing up, they de-register from their previous GP. Traditional, geographically based practices then lose the capitation payments for these patients and may be pushed towards a financial cliff edge, putting the care of other patients at risk.

Technology isn't the problem. GPs already spend many hours on the phone to patients, and video consulting works well in some areas of secondary care. The real innovation is not the alternatives to face-to-face consulting but Babylon's use of rules that were designed to increase patient choice to cherry pick healthy, low cost patients. Despite patient safety concerns and the destabilising effect on other practices, Babylon has been allowed to expand its services to Birmingham, before an independent evaluation due to be published later this month. This seems foolhardy: would it not be sensible to wait until we're sure that the service is safe and cost effective?

Most general practices are running to stand still, and many are struggling even to do that. Ensuring we can look after our elderly, complex, and unwell patients comes higher up our priorities than providing online consultations to the worried well. There's a risk these elderly patients, and our traditional practices, may be left worse off in the dash to embrace all things shiny and digital.

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Will a new innovation satisfy an existing need or just create new demand?

LATEST PODCAST

Five years on: looking back at the Ebola response

In 2014, Oliver Johnson was a 28 year old British doctor working on health policy in Sierra Leone and Sinead Walsh was the country's Irish ambassador. Then the biggest recorded outbreak of Ebola happened in west Africa.

Five years on, they have co-authored a book about how they stepped into roles coordinating the international response to the disease and running a treatment centre:

Sinead: "For the first six months it was extraordinarily difficult to get international attention, which was baffling because we felt like we were facing Armageddon. People were dying left, right, and centre; the disease was increasing exponentially; and in August 2014 the Centers for Disease Control and Prevention in the US predicted that 1.4 million people could die in the next six months. Yet, for some reason, we couldn't seem to get the world to listen to what we were saying.

"We had this thought that there's got to be some sort of cavalry and it's going to arrive at some point. One of the things I learnt is that this notion is actually a mirage. When that response came in, it needed a huge amount of assistance to operate properly in the local context."

Oliver: "Often, in the early days, we were desperately short staffed. The reality was we could leave just one staff member on duty at night and they were often too afraid to go inside the unit. Sometimes I would arrive in the morning, I'd put on my protective suit, I'd go inside, and the devastating thing was I would see who had survived the night.

"We had a six bay ward and I remember one morning I found all six patients had died during the night. There I was, alone, in my hot sweaty suit, having to put six patients into body bags, one by one. And as quickly as I could, cleaning the beds for six new patients to come in."

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Edited by Kelly Brendel, assistant web editor, *The BMJ*

INCREASING OPERATIONS

Ensuring enough time to prepare for anaesthesia

Has NHS Improvement considered that a prompt theatre start requires not only a patient and surgical team but also a well informed anaesthetist (This Week, 2 February)?

Patients' anaesthetic plans are usually formulated on the day—after considering history, examination, and investigations, as well as the patient's anxieties and preferences. The patient journey from admission to operation is much more complex than checking into a hotel and turning up for a spa treatment.

Admission on the day of surgery brings cost saving and other advantages but severely restricts the time available before the planned theatre start. Current delayed starts are undoubtedly due in part to the allocated time being inadequate for proper preparation for anaesthesia.

Further pressure to start lists on time without seeking to ensure sufficient time for planning of, and preparation for, safe anaesthesia may encourage the sidelining rather than streamlining of care.

Emma Cannon, ACCS core training year 2, Mark Davies, consultant in anaesthesia and perioperative medicine, Liverpool

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GUIDELINE USE

NICE is committed to shared decision making

We share Mathew's view that clinical guidelines should not over-rule clinical reasoning and that doctors should have the freedom to step away from a guideline to do what they and the patient agree is right for them (Rammya Mathew, 2 February).

All NICE guidelines begin with text that seeks to ensure patient centred application. NICE is committed to the principles of shared decision making and is in the early stages of developing a guideline on this.

Martin A Allaby, consultant clinical adviser, Paul Chrisp, director, Centre for Guidelines, NICE

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Using guidelines ethically

We question the wisdom of rejecting guidelines based solely on patient wishes. All treatment decisions should consider the four pillars of medical ethics: beneficence, non-maleficence, autonomy, and justice.

The first line syphilis treatment recommended by guidelines, for example—two large volume intramuscular injections—is not the first choice of many. Yet, as the most effective, it is the treatment we recommend. Beneficence outweighs autonomy.

HIV treatment, usually a combination of three drugs, requires lifelong daily pills. Some combinations are available as single tablets, which are popular but costly. Most patients are happy to support NHS savings by taking the less convenient option.

Guidelines should not be followed mindlessly, but nor should they be ignored based on patient preference alone—this truly risks an injustice to others.

Laura J Waters, consultant, London, Simon Collins, advocate, HIV i-Base; Marta Boffito, consultant, London

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UK RESPIRATORY DEATHS

Idiopathic pulmonary fibrosis and asbestosis

Salciccioli and colleagues note the high mortality from interstitial lung disease in the UK (Research, 1 December). We found a significant association between death from the commonest form of interstitial lung disease (idiopathic pulmonary fibrosis) and mesothelioma.

This association is unexpected, as idiopathic pulmonary fibrosis has no identifiable cause, whereas most deaths due to mesothelioma can be explained by asbestos exposure.

Deaths from both conditions have risen steadily since the 1960s, in parallel with asbestos imports. We found the same association in 31 European countries. Although limited by the available data, we also found a significant association between asbestos use and idiopathic pulmonary fibrosis mortality.

We think a link between asbestos and idiopathic pulmonary fibrosis is a biologically plausible hypothesis.

Christopher M Barber, consultant, David Fishwick, professor, Centre for Workplace Health

Cite this as: *BMJ* 2019;364:l1041

MEDICAL CURRICULUM

Diversifying medical school

We agree that medical students need the knowledge, skills, and attitudes to deliver patient centred care to diverse patient populations (Personal View, 26 January). But we also need to ensure that teachers are competent in teaching these issues to students.

We also need supportive medical school policies and a culture that enables students and teachers to be competent in serving and teaching about diverse patient populations. Whole institution approaches are needed for sustainable and meaningful change.

Jeanine Suurmond, assistant professor, Amsterdam; Nisha Dogra, emeritus professor, Leicester; Olivia Carter-Pokras, professor, College Park, University of Maryland

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LETTER OF THE WEEK

Avoiding an opioid crisis in the UK

Deprescribing should be integral to every clinician's practice (Editorial, 16 February); the GMC emphasised the importance of regular review of a patient's medication in 2013. Deprescribing should be undertaken by anaesthetists and intensivists, as we can advise on the deprescribing of drugs that may have been started during critical illness, such as amiodarone for atrial fibrillation or opioids for the management of postsurgical pain.

Poor deprescribing has been pivotal in the global prescribed opioid crisis. Research from the US shows that the risk of opioid dependency after surgery in opioid naive patients may be as high as 6.5%. The three biggest risk factors for subsequent opioid dependence in the US are the use of modified release opioid preparations (such as Oxycontin), drugs on repeat prescriptions, and the duration of the prescription.

We must reflect on our prescribing habits. In view of the opioid crisis emerging in the UK, we need to avoid using modified release opioid preparations for acute pain, we need to avoid opioids prescribed for acute pain continuing on to repeat prescriptions, and we need to limit the size and duration of our prescriptions.

Nicholas Levy, consultant; Patricia Mills, consultant, Bury St Edmunds; William J Fawcett, professor, Guildford

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ANALYSIS

Clinical applications of machine learning algorithms: beyond the black box

To maximise the benefits of using artificial intelligence to diagnose and treat disease, we need to rethink our approach to explanation, argue **David Watson and colleagues**

Machine learning algorithms are an application of artificial intelligence designed to automatically detect patterns in data without being explicitly programmed. They promise to change the way we detect and treat disease and will likely have a major impact on clinical decision making.

The long term success of these powerful new methods hinges on the ability of both patients and doctors to understand and explain their predictions, especially in complicated cases with major healthcare consequences. This will promote greater trust in computational techniques and ensure informed consent to algorithmically designed treatment plans.

Unfortunately, many popular machine learning algorithms are essentially black boxes—oracular inference engines that render verdicts without any accompanying justification. This problem has become especially pressing with the passage of the EU's latest General Data Protection Regulation (GDPR), which some scholars argue provides citizens with a "right to explanation." Now, any institution engaged in algorithmic decision making is legally required to justify those decisions to any person whose data they hold on request, a challenge that most are ill equipped to meet.

These models may reliably discriminate between malignant and benign tumours, but they offer no explanation for their judgments

We urge clinicians to link with patients, data scientists, and policy makers to ensure the successful clinical implementation of machine learning. We outline important goals and limitations that we hope will inform future research.

KEY MESSAGES

- Machine learning algorithms may radically improve our ability to diagnose and treat disease
- For moral, legal, and scientific reasons, it is essential doctors and patients are able to understand and explain these models' predictions
- Scalable, customisable, and ethical solutions can be achieved by working together with relevant stakeholders, including patients, data scientists, and policy makers

Predictions versus explanations

Predictions tell us that x is true; explanations tell us why x is true. The past decade has seen enormous advances in our ability to predict complex phenomena using computational techniques. Explanatory breakthroughs, on the other hand, have been few and far between.

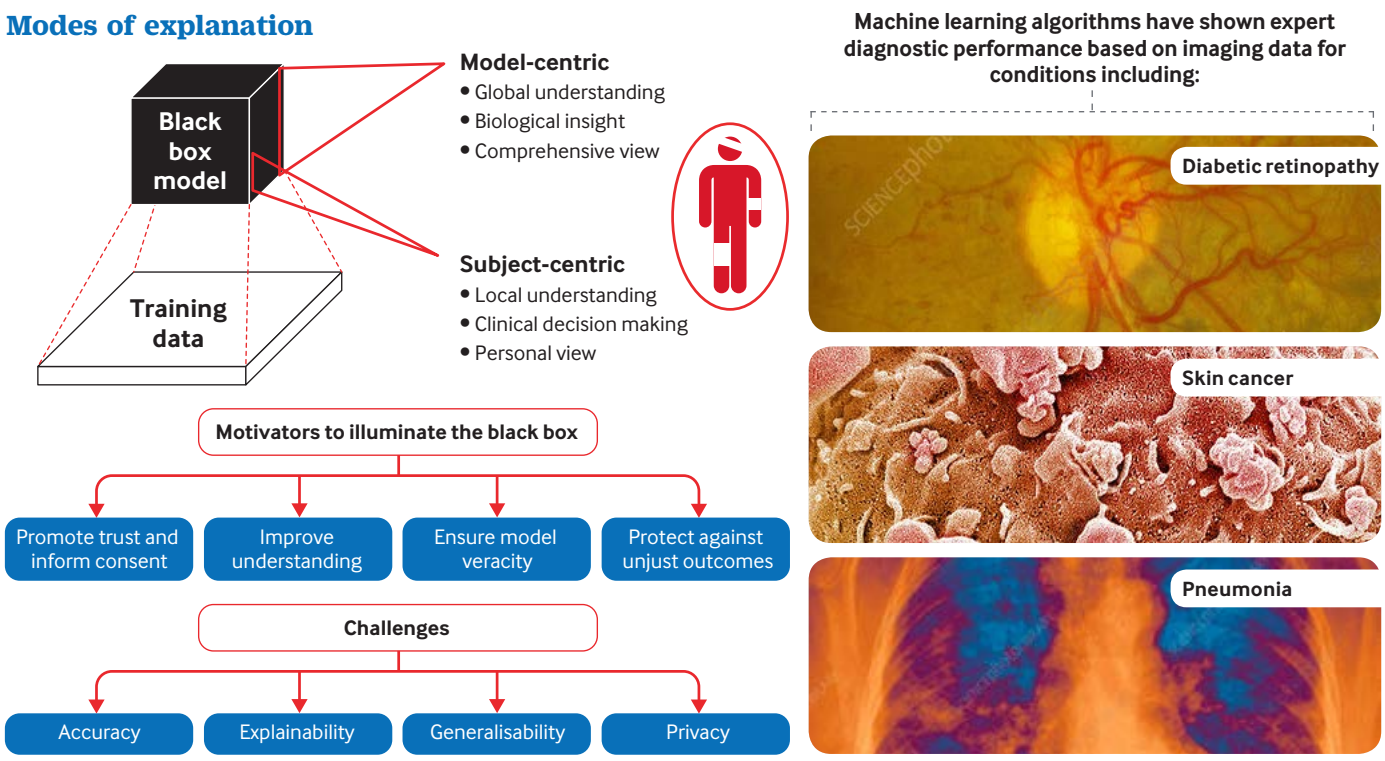
Machine learning algorithms have already shown expert diagnostic performance based on imaging data for conditions including diabetic retinopathy,[1] skin cancer,[2] and pneumonia.[3] Precision medicine seeks to go further, modelling molecular data to classify patients according to endotype,[4] defining disease mechanism and ontologies.[5] With the integration of electronic health records and wearable medical sensors, machine learning may usher in a new era of real time diagnostic updates, enabling earlier, more targeted interventions.[6]

Machine learning techniques are already emerging in clinical practice.[7] Microsoft's InnerEye offers a graphical user interface to algorithms that help radiologists diagnose cancerous tumours and plan precise surgical interventions.[8] DeepMind Health has partnered with Moorfields Eye Hospital to develop models for diagnosing common retinal pathologies based on optical coherence tomography scans.[9] IBM's Watson for Oncology seeks to provide personalised cancer care based on health records,[10] although the project has run into numerous procurement problems, cost overruns, and delays.[11]

One frequently cited obstacle to machine learning's wider clinical adoption is a lack of understanding among patients and doctors about how predictions are made.[12] This is especially true of some top performing algorithms, like the deep neural networks used in image recognition software. These models may reliably discriminate between malignant and benign tumours, but they offer no explanation for their judgments. Of course, clinicians are not always able to perfectly account for their own inferences, which may be based more on experience and intuition than on explicit medical criteria.[13]

Moreover, doctors do not optimally integrate all available evidence, and cognitive biases can be deeply entrenched.[14] Still, many think that, as a new technology, the burden of proof is on machine learning to account for its predictions. If doctors do not understand why the algorithm made a diagnosis, then why should patients trust the recommended course of treatment? Is informed consent even possible without some grasp of how the model reached its conclusion?

Not all algorithms are black boxes. Some sophisticated models, such as those based on regularised linear regression, provide a modest number of informative parameters.[15] Yet, although restricting the use of clinical machine learning to more intelligible algorithms is tempting, it would be a mistake. No single technique is optimal for all cases—a result known as the "no free lunch theorem" in computer science[16]—which means



Overview of the opportunities and challenges associated with black box models in clinical decision making

that any attempt to shoehorn all datasets into a particular family of statistical models is guaranteed to fail.

The opportunity costs of not using our best available tools for disease detection and treatment are substantial—12 million people a year receive misdiagnoses in the US, with about six million facing potential harm as a result.[17] Nearly one third of all preventable deaths in the UK are attributable to misdiagnosis.[18] The benefits of early disease detection are well known.

Yet clinicians are right to be sceptical of inscrutable models. Especially worrisome is the risk of overfitting to an unrepresentative sample. In one famous example, an algorithm designed to predict probability of death among hospital patients with pneumonia systematically classified asthmatics as low risk.[19] The correlation was spurious—patients with asthmatic pneumonia were sent directly to the intensive care unit, where they received continuous treatment that improved their prognosis so substantially that they seemed to have better than average chances of survival.

Mistakes like this show the potential dangers of naively accepting the outputs of a black box model. They also raise important questions about liability in cases of algorithmic error. Who is ultimately responsible for a computational misdiagnosis? Clinicians? Data scientists? Policy makers have tackled similar questions in other contexts and come to no clear consensus.[20]

Right to explanation?

The GDPR emphasises "explainability" as a top priority in machine learning research, provoking a worldwide debate over the right to explanation when individuals are subject to automated decisions. Whether or not this purported right is enshrined in the GDPR—a point of contention among legal scholars[21]—there are compelling reasons to endorse it in medical contexts. This will require a reorientation of priorities for data scientists, more used to optimising for accuracy than for intelligibility.

Before we can design new methods to tackle this challenge, we must agree on what constitutes a satisfactory explanation. Do we want to understand all the patterns

The opportunity costs of not using our best available tools for disease detection and treatment are substantial

the machine has learnt (model-centric explanations)? Or just those that are relevant to the patient (subject-centric explanations)?[22] The former aims to provide global understanding about the relative importance of all variables and how they interact to make predictions, which may shed new light on disease mechanisms; the latter provides local understanding about why this particular input led to that particular output, which could be relevant for individual patient prognosis.

Clinicians sceptical of machine learning tend to focus on the lack of clear model-centric explanations.[19] Deep neural networks, for example, routinely contain millions of parameters, assigning weights and biases to thousands of nodes in an architecture so complex that no human could plausibly be expected to grasp the whole model's internal mechanics. But if a computer truly outperforms doctors in making diagnoses, then we would like to know why. Understanding the biological patterns or processes it has uncovered could advance our knowledge and help build the medical community's trust in such systems.

Of course, patients are the most critical stakeholders in clinical machine learning. Enabling them to appreciate their algorithmically determined diagnosis and treatment options is crucial—but also complicated, especially when inputs include high dimensional genomics or imaging data. Researchers in the nascent field of interpretable machine learning have implemented methods for generating model-agnostic local explanations.[23 24]

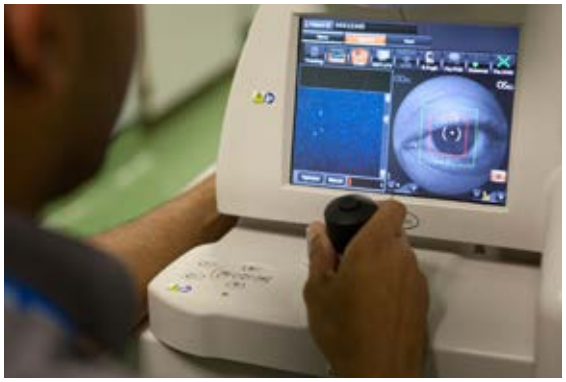
These approaches are promising, but more work is needed to extend them to clinical settings and support them with the appropriate medical ethics framework.

The path forward

Current proposals struggle to meet two important criteria for the clinical application of machine learning: scalability and customisability. With biological datasets often containing millions of variables per sample, the computational complexity of explanatory methods for molecular models must be constrained. This entails an inherent trade-off between completeness and simplicity. Ideally, users could specify a level of explanatory granularity that best suits their needs. Some may prefer diagnoses to be explained in terms of basic, familiar biological concepts; others may opt for a more detailed account in terms of molecular mechanisms.

Important unanswered questions remain about how best to measure the utility of a given explanation. Some authors have attempted to formalise the problem in a computable fashion,[25] whereas others advocate a more empirical approach driven by experimental psychology.[26] Both methods have their merits and drawbacks, but building a research programme around either will be difficult without first establishing a broad consensus.

Some caution with regard to transparency is advisable. A fully open source approach may enable misuse of the algorithm for harmful purposes outside the clinical context. This is particularly problematic when a diagnosis is based on easily accessible data, such as facial images or movement patterns.[27] Scrutiny of machine learning is important but should not expose people to disproportionate risks or privacy violations, especially when there is no immediate benefit to diagnosis, as is the case with currently untreatable conditions.



Moorfields Eye Hospital, London has worked with DeepMind to develop models for diagnosing common retinal pathologies based on optical coherence tomography scans

We are only just beginning to realise machine learning's potential for medicine, and although it remains exploratory the benefits should not be ignored. Patients, clinicians, and data scientists must collaborate to develop new methods for extracting model-centric and patient-centric explanations that can provide global and local understanding. Bringing algorithms into the clinic can advance knowledge and improve care, but only if we are prepared to devote sufficient resources to illuminating the black box for doctors and patients alike.

If a computer truly outperforms doctors in making diagnoses, then we would like to know why

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BMJ OPINION

Bring your daughter to cervical screening

At a time when cervical screening in England is at its lowest rate for two decades, with one in four eligible women not attending the test, something needs to be done. Public Health England stepped forward last week with a newly launched advertising campaign, but breaking down the barriers that prevent women from attending screening will be a multifaceted job.

If, as a healthcare professional, I feel nervous about sharing my experiences, then it is no wonder that many women cite fear and embarrassment as reasons for not attending cervical screening. The charity Jo's Cervical Cancer Trust found that young women who delay or don't go for cervical screening are scared (71%) or embarrassed (81%).

But last week I did something new at my smear test: I brought my 8 year old daughter with me. I thought that this would be an excellent way to have a chat about some anatomical terms and the importance of screening—which it was. And so she sat in a chair next to me, watching everything (except my vulva, which only the nurse could see). My daughter could see what the nurse was doing and could see my (hopefully) relaxed and pain-free facial expression. I felt that it was an important experience to share.

We can all help to demystify this test by talking more openly about it. Allowing our daughters to see our smear tests first hand as a routine, non-painful, dignified event would be a step towards banishing some of the shame and embarrassment that causes young women to shy away from screening.

Clare Bostock is a consultant geriatrician in Aberdeen. Twitter @ClareVBostock

David John Weatherall

Haematologist and geneticist whose work on thalassaemia showed the potential of molecular medicine

David John Weatherall (b 1933; q Liverpool 1956; MD, FRCP, FRCPE, FRCPCH), died from the complications of a fall on 8 December 2018

David Weatherall was a pioneering haematologist and geneticist whose work on thalassaemia showed the potential of applying molecular approaches to clinical medicine.

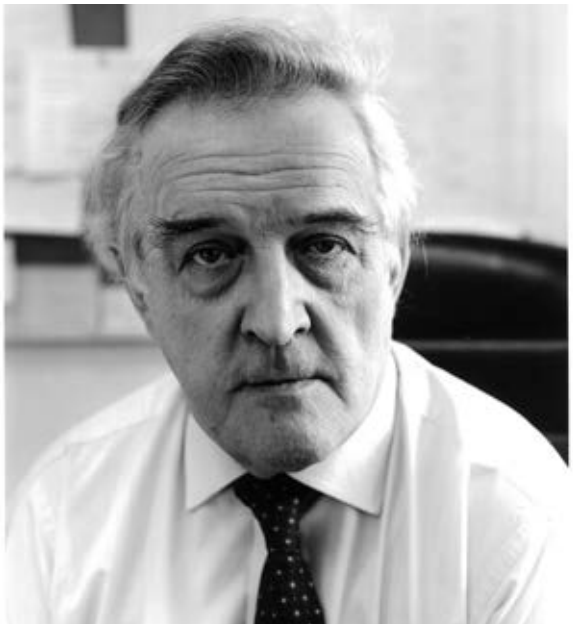
Born in Liverpool, Weatherall, as a student, was inspired by clinicians at the forefront of their specialism, including Rod Gregory, the discoverer of gastrin, and Harry Sheehan of the eponymous syndrome. He became interested in genetics while working as house physician to Cyril Clarke, who studied butterfly genetics as a hobby and would later identify the cause of rhesus haemolytic disease. A visit by the great geneticist JBS Haldane also inspired Weatherall.

An inauspicious start

Although Clarke and Haldane may have sparked Weatherall's interest in genetics, it was a fortuitous encounter with a patient in Singapore that would set him on his way. After medical school and house jobs, Weatherall signed up for national service, but because of a "fear of flying, snakes, and bullets" asked to remain in the UK. As he delighted in telling people, however, through the army's incompetence he was promptly dispatched to Singapore, where he was in put in charge of the children's ward despite having no paediatric experience. One of his first patients was the daughter of a Gurkha. She was severely anaemic and needed regular blood transfusions, but no cause could be found. Working with a local biochemist, Weatherall showed that she had thalassaemia, inherited from her parents, which until then had rarely been described beyond Mediterranean populations. His joy at seeing his first paper, entitled *Thalassaemia in a Gurkha Family*, published in *The BMJ* was short lived; he was soon hauled in front of the director general of the Royal Army Medical Corps for South East Asia and told he could be court martialled for publishing without the permission of the War Office. Furthermore, it was "bad form" to tell the enemy that there were defective genes in the "pukka Gurkha regiments."

Molecular medicine

Undeterred, Weatherall constructed his own electrophoresis apparatus with car batteries and filter paper, so that he could pursue his studies of haemoglobin disorders in the local population. On leaving the army he visited Herman Lehmann, the "father of haemoglobinopathies." Lehmann told him the subject was finished because there was nothing new to discover, and he should change direction. Thankfully, Weatherall did not take the advice of his betters. Instead he went to Johns Hopkins Hospital in Baltimore, USA, where he combined his interest in genetics, haematology, and general medicine. He developed new methods for measuring the synthesis of α and α chains of haemoglobin, and showed that the disease was caused by an imbalance of the synthesis of the two chains. This was the first clear evidence of how the disease arose, linking the genetic and clinical phenotypes. It was one of the first examples of applying the advancing specialism of molecular genetics to clinical medicine, spawning the new discipline of molecular medicine. Weatherall's discoveries made it possible to establish genetic screening and counselling, leading to the eradication of thalassaemia in some parts of the world. His book *The Thalassaemia Syndromes*, first published in 1965, is now in its fourth edition and still considered the bible in the discipline. At Baltimore, he also met his wife, Stella Mayorga-Nestler, a Colombian postgraduate student working in an adjacent laboratory.



NICK SINCLAIR

Weatherall's discoveries made it possible to establish genetic screening and counselling for thalassaemia

On returning to Liverpool in 1965, he built up the clinical haematology department alongside his laboratory research group, wishing to combine his career as a clinician with that of a scientist, a novel concept in Britain at the time. In 1974 he became the Nuffield professor of clinical medicine in Oxford.

Weatherall developed further the concept of molecular medicine, establishing in 1989 the Institute of Molecular Medicine, which was later renamed after him. He galvanised the development of Oxford's research programmes in south east Asia and Africa and coedited the *Oxford Texbook of Medicine*. He mentored generations of clinician scientists, many of whom are now leaders in their areas. "Academic medicine has a lot to offer," he once advised, "provided one follows one's nose, does not take too much notice of those who offer career advice, and is willing to work an 18 hour day." He was working on manuscripts until a few weeks before he died, and, although frail, retained his Scouse sense of humour to the end.

Weatherall leaves his wife, Stella; a son; and five grandchildren.

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Vallikalayil Verghese Abraham

General practitioner Liverpool (b 1935; q Kerala 1961), died from metastatic prostate cancer on 13 February 2018

In 1969 Vallikalayil Verghese Abraham moved from his native Kerala to the UK. At first he held various locum posts; subsequently he practised as an anaesthetist until 1977, when he switched to general practice. He trained at Netherley Health Centre in Liverpool, and on 1 January 1979 he was made a partner. He also worked for the Blood Transfusion Service in Liverpool and north Wales and provided emergency medical cover for Ellesmere Port Speedway competitions and amateur boxing matches in Liverpool. After leaving Netherley in 2005, he did regular work for several urgent care teams in the Liverpool area. Outside work, he was an active member of his church, Fairfield Gospel Hall, and a keen photographer. Verghese leaves Moni, his wife of 51 years; three daughters (all doctors); and five grandchildren.

Sarah Abraham

Cite this as: *BMJ* 2019;364:l776

Diana Chan

Consultant in old age psychiatry, Southampton (b 1976; q Sheffield 2000; MRCGP, MRCPsych, MSc), died from complications of sepsis on 14 December 2018

Diana Chan (Vugler) completed her GP training in Hemel Hempstead and London. She enjoyed aspects of being a GP, but she found psychiatry particularly interesting during her training. With the full support of her neuroscientist husband, Anthony Vugler, she decided to retrain as a psychiatrist. Diana had always held a particular interest in helping older people, and she accepted a consultant post in Southampton in 2014. Diana's consultant colleagues have described her as a dedicated, compassionate psychiatrist, who was well regarded by her patients and their families. They also said that she excelled at teaching, inspiring a number of junior doctors to follow her path. Diana leaves Anthony and their two sons, as well as her mother, three brothers, and three sisters.

Anni Innamaa, Caroline Jacob

Cite this as: *BMJ* 2019;364:l771

Cornel Fleming

General practitioner (b 1936; q Sydney University, Australia, 1961), died from pneumonia, secondary to metastatic cancer of the prostate, on 29 January 2019

Cornel Fleming was born in eastern Europe and grew up in Czernowitz. In 1945 he and his family moved to Czechoslovakia on an armoured train before eventually emigrating to Australia. Cornel qualified in medicine in Sydney, before travelling further afield, including to Israel and the UK. He served in the Israeli Air Force as well as undertaking a degree in aviation medicine at RAF Farnborough. A survivor of the Holocaust, Cornel knew how important it was to fight for those who felt nobody was fighting for them. He saw his role as a GP and as a leader in multiple professional organisations as that of an advocate and champion for his patients and their families. He leaves his wife, Marsha, and two children.

Simon Fleming

Cite this as: *BMJ* 2019;364:l782

Peter George Eames

Consultant neuropsychiatrist (b 1940; q Cambridge and the London Hospital, 1964; MRCP, MRCPsych), died from vascular dementia and chronic obstructive pulmonary disease on 19 July 2018

Peter George Eames developed an interest in neurology during his training at the London Hospital and in neuropsychiatry during an early career in the Royal Air Force. After leaving the RAF in 1971 and undertaking further training, he started work at St Brendan's Hospital in Bermuda, where he furthered his interest in neuropsychiatric rehabilitation. At St Andrew's Hospital in Northampton, he set up the Kemsley unit, a nationally renowned centre for brain injury rehabilitation. In 1985 he moved to the Burden Neurological Hospital in Bristol. Peter retired from clinical practice in 2004. His work, his energy, and his persuasive abilities improved the lives of many hundreds of patients with brain injury and of their families. He leaves Lesley, his wife of 45 years.

Jonathan Bird

Cite this as: *BMJ* 2019;364:l778

Gerald Haase

Expert in drug regulatory affairs Hampton Wick, London (b 1950; q Glasgow 1973), died after a myocardial infarct on 14 January 2019

Gerald Haase worked in haematology at Stobhill Hospital, Glasgow, and then with the Scottish Blood Transfusion Service in Edinburgh. In 1984 he left clinical medicine to work in pharmaceutical companies in the UK, France, and Switzerland. In 1991 he became a senior medical assessor in the licensing division of the UK Medicines Control Agency. After 14 years he returned to the commercial world (Parexel), and from 2008 to 2017 he ran his own consultancy. He spent his all too brief retirement enjoying travel, fine dining, and music. Most of all, however, he enjoyed playing bridge. He achieved national and international successes and continued to represent Scotland in recent years, including at the Commonwealth Games in Brisbane in 2018. He leaves his partner, Carol Pelzers; a daughter; and two sisters.

Barry Cooper

Cite this as: *BMJ* 2019;364:l773

Anthony Knudsen

Consultant histopathologist (b 1924; q Middlesex Hospital, London, 1947; MD, FRCP, FRCPath), died from biliary sepsis on 7 February 2019

Anthony Knudsen ("Tony") served in the Korean war and was based in Japan, where he was pathologist to the Commonwealth Division. He was appointed consultant histopathologist to the West Middlesex Hospital in 1958, provided an excellent and very efficient departmental service, and still produced a dozen papers of note. He also provided general pathology services at the Royal Masonic Hospital and the Nuffield Hospital at Wexham and was appointed lecturer at Charing Cross Hospital. After retiring in 1988 he continued to provide the Royal College of Pathologists with his expert opinion in complex gastrointestinal pathology well into his late 80s. Predeceased by Mary, his wife of 67 years, he leaves three children, seven grandchildren, and three great grandchildren.

Stephen Kownacki

Cite this as: *BMJ* 2019;364:l779