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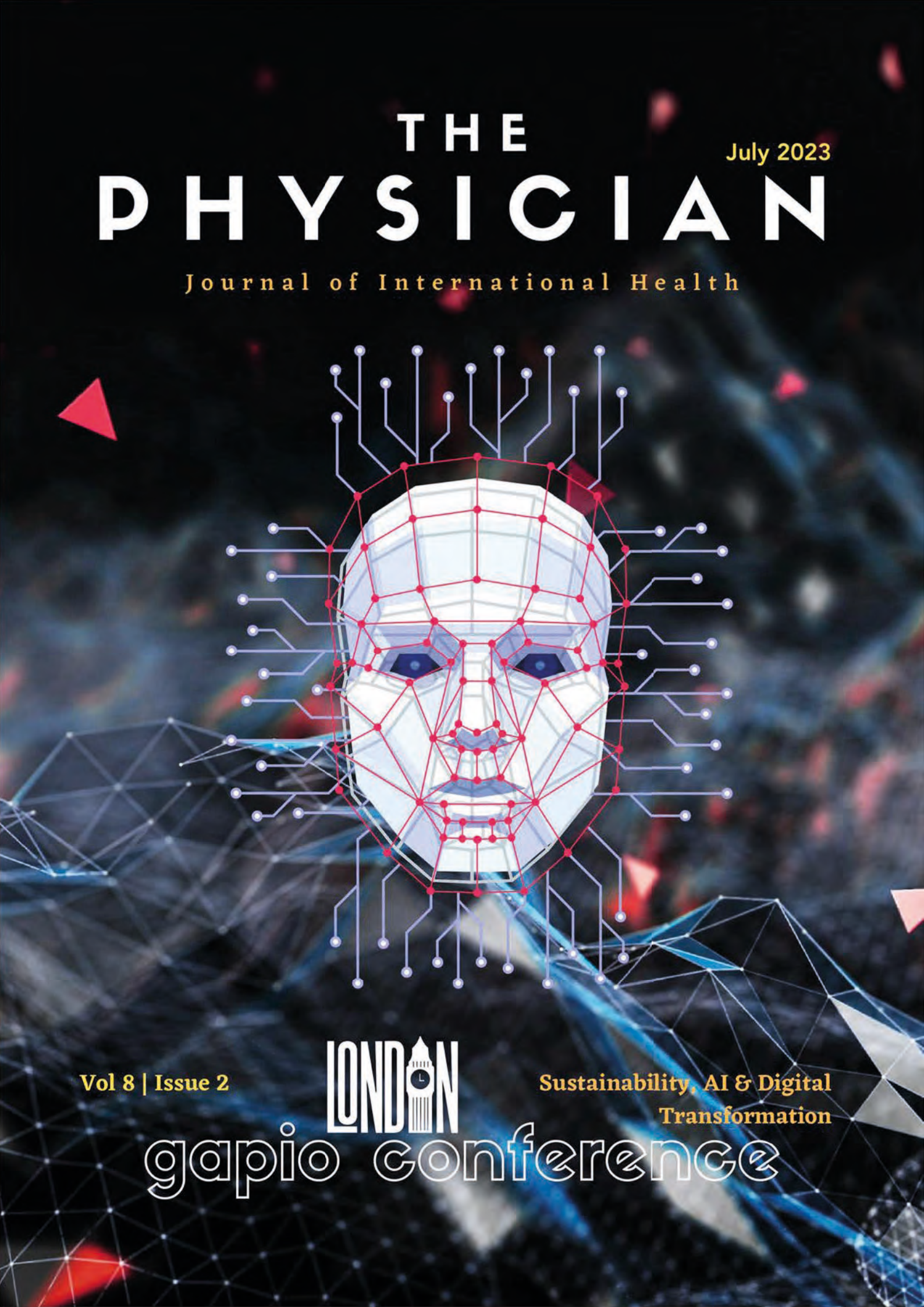

Vol 8 | Issue 2

LONDON

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About The Physician

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Scope
The Physician will accept submissions from across the healthcare spectrum but is particularly interested in issues that impact the health of migrants, international medical/ nursing graduates, diaspora studies, and differential outcomes in patients and professionals based on ethnicity or other protected characteristics. The editorial board welcomes submissions from new or emerging researchers and early-career clinicians.

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Each print/ PDF whole issue has a current circulation of >10,000 among health professionals in the UK and is also available globally to download for free and purchase at a cost price from the website.

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The Physician has been published since 2012 in print, previously in time with BAPIO national conferences, including conference abstracts. Since Jan'20, it has been published online and in regular print editions.
It is a member of Crossref, and all published articles are registered with DOI and cited in Google Scholar and ScienceOpen. It will be submitted for indexing in PUBMED in 2023, once accepted, all archived content will be available retrospectively.

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In 2020-2021, the journal offered to fully subsidise article processing charges for all submissions. In subsequent years, article processing charges will continue to be reasonable as BAPIO is a not-for-profit organisation and fully subsidised for BAPIO members and associates.

GAPIO MIDYEAR CONFERENCE 2023

GAPIO
Global
Association of
Physicians of
Indian Origin

9 BAPIO
CPD Points

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BAPIO TRAINING ACADEMY

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BAPIO

22 JULY 2023 SATURDAY
GLOBAL TRENDS IN HEALTHCARE SUSTAINABILITY

09:00

Registration

09.30: Inauguration: Lighting the lamp
HE Sri Vikram Doraiswami, High Commissioner of India
Nandkumar Jairam (President GAPIO)
Ramesh Mehta (President BAPIO & COMHAD)
Parag Singhal (Exec Director BTA)

10:00

Digital Revolution in Healthcare

Chairs: Anjana Samaddar (President AAPI, USA) & Yashwant Patil (Past Int President, COMHAD)

- Keynote - Sir David Behan, Chair of NHSWTE – "Innovation Culture in the NHS."
- Guest - Anupam Sibal, Past President GAPIO & Group Med Dir, Apollo Hospitals Group: "Can India Become the Vishwa Guru in Healthcare."
- Panel - Uday Bodhankar (Exec Dir COMHAD, India) & Abhijat Seth, (President NBE, Delhi)

11:15

Challenges to Sustainable Healthcare Goals

Chairs: Geeta Menon (BAPIO UK) & Sudhir Parekh (GAPIO, USA)

- Navina Evans, Chief Workforce Officer of NHS England
- P Singhal - "Staff & skill shortages in the Global Village."
- Panel: Neal Simon (President AUA USA), Ged Byrne (Global Director HEE), Iqbal Singh, Chair Centre of Excellence Safety of Older People

12:15

WORKSHOPS

- **Health promotion and prevention**: Lead: Mala Rao & O P Kalra, Moderator: Bhupinder Sandhu (UK) - Sankalp Chaturvedi, Gandhi Centre for Innovation, Imperial College
- **Frugal Innovation:** Lead Dhananjaya Sharma, Govt Medical College, Jabalpur, India, Moderator: Gautam Bodiwala Panel: Navina Evans, Ged Byrne, K C Mehta (Knee Surgeon Apollo Ahemadabad), Uttam Shirodkar (ENT Surgeon UK)
- **AI Revolution in Healthcare**: lead: Anindya Chakravorty, Narsee Monjee Institute of Management Studies, Moderator: Sunil Daga (UK); Panel: Jay Chatterjee, Consultant Gynaecology, Guildford; Sam Shah, Digital Health Research Lead UCL

13:15

LUNCH

22 JULY 2023 SATURDAY
GLOBAL TRENDS IN HEALTHCARE SUSTAINABILITY

14:15

Opportunities in Healthcare Technology

Chairs: Rahul Chodhari & Beryl De Souza

- Digital Future of Surgery - Proker Dasgupta, Professor of Robotic Surgery and Urological Innovation, King's College London
- Emergence of Gene Therapy - Manohar Balu Narasimhan, CEO of Stempeutics Research
- Panel: Rajesh Sivaprakasam, Barts Health, Arun Gupta,

15:15

Debate

"The house believes that the need for bedside clinical skills is exaggerated.
Ajay Shah vs Vasanta Nanduri: Moderator: Abhay Chopada

16:00

Healthcare Education & Training - Global Perspectives

Rajeev Yeravdekar, Provost, Symbiosis Int Uni, India
Chairs: Priyanka Singhal & Suma Sreeshyla (UK)

16:15

Embracing the Mindset and Skills for Healthcare Entrepreneurship

Geeta Nargund, Create Health Foundation
Chairs: TBC

16:30

Entrepreneurship in Healthcare

Chairs: Arvind Shah & Geeta Agnihotri (UK)

- Shuchin Bajaj, Director- Ujala Cygnus Health Services, India
- Sunil Khetarpal, Dir Assoc of Healthcare Providers, India
- Prashant Jindal, Vitonnix, UK

17:15

Reflections & Vote of Thanks

Sangeeta Agnihotri & Abhay Chopada

18:00

Drinks & Gala Dinner

Entertainment

23 JULY 2023 SUNDAY
GLOBAL TRENDS IN HEALTHCARE SUSTAINABILITY

09:30 — **Registration**

10:00 — **Challenges to Sustainable Healthcare Goals**

Chairs: Geeta Menon (BAPIO UK) & Sudhir Parekh (GAPIO, USA)
Navina Evans, Chief Workforce Officer of NHS England
P Singhal - Staff & skill shortages in the Global Village
Panel: Neal Simon (President AUA USA), Ged Byrne (Global Director HEE), Iqbal Singh, Chair Centre of Excellence Safety of Older People

11:00 — **3D Technology in Medical Education**

Chairs: Mahadev Bhide & Ashok Khandelwal

- Sridhar Subramanian, Director Vinformax Systems Ltd, UK

11:15 — **Debate**

Paid Healthcare is Essential to Maintaining Quality
For: Bhushan Pandya (USA) Against JS Bamrah (UK)
Moderator: Subarna Chakravorty (UK)

11:45 — **Artificial Intelligene in Medical Education**

Chairs: Indranil Chakravorty & Veena Daga

- Bipin Batra (India)
- The utility of augmented & virtual reality in medical education - Amir Sam, Imperial School of Medicine
- Panel Sivaramakrishnan Venkateswaran, CEO, Apollo Knowledge, Bakul Parekh (Consultant Paeds, Mumbai)

12:30 — **Digitalisation in Primary Care**

Chairs: Richa Singh & Hasmukh Shah

13:15 — **Vote of Thanks**

Beryl D'Souza

BAPIO FOUNDATION

For excellence, equality and diversity in healthcare
through workforce wellbeing, advocacy, training, research, publishing and leadership

GAPIO Mission

GAPIO
Global Association of Physicians of Indian Origin

N K Jairam, President

The Global Association of Physicians of Indian Origin (GAPIO) is an ambitious collaboration of physicians of Indian origin spread across the globe on a professional platform of a collaborative essence. A non-profit organization established in 2011, GAPIO was co-founded by a trinity of renowned and revered stalwarts: Padma Vibhushan Prathap C Reddy, Chairman, Apollo Hospitals Group; Sanku Rao, Past President, AAPI, USA; and Ramesh Mehta, President, BAPIO, UK. As a potent collective force of 1.4 million physicians of Indian origin, this non-profit body seeks to steer pathbreaking healthcare innovations globally and in India. Our presence in 57 countries includes medical practitioners across various specialities, sub-specialities, and super specialities, a robust Indian diaspora actively working in the living waters of healthcare spread across the Middle East, South East Asia and Africa.

Guided by its vision of 'Improving Health Worldwide', GAPIO is empowering physicians of Indian origin to achieve the highest professional standards, provide affordable good, quality healthcare, contribute to local and regional community development, and collectively help minimize health inequalities and human suffering across the globe, and lead the concerted movement to transform the silent Global South (Latin America, Africa, Asia and Oceania) into a salient Global South.

In this era of post-pandemic disruptive innovation, Indian physicians are playing a pivotal role globally through pathbreaking collaborations and co-creations. Talking of the phenomenal impact and footprint of the Indian diaspora across the globe, the clinical advancements of our physicians have emerged as the crowning glory of India's value proposition for the world at large. GAPIO is
channelising the power of Indian physicians by a potent and purposeful organizational thrust to make a lasting difference in healthcare worldwide. GAPIO is committed to making the most of the new-age tools, techniques, philosophies, and paradigms to keep pace with the shifting priorities of a new era of disruptive innovation in healthcare.

In the future, GAPIO has chalked out a comprehensive action plan encompassing the following:

- To provide an international forum for physicians of Indian origin to exchange notes on crucial issues, including how to avert a worldwide biological disaster like the Covid-19 pandemic, arriving at a consensus on contemporary health challenges and evolving constructive and tangible ways of making healthcare affordable and accessible to all citizens. Such interactions will also promote multi-disciplinary and cross-systemic learning.
- To participate in global health agendas by liaising with public, private and voluntary organisations to identify barriers and opportunities to improve policies and practices and the availability and distribution of resources towards improving health.

- This priority encompasses a host of activities like exploring the possibility of collaborations to foster manufacturing (medical devices) and service innovations, improving the quality and reach of medical, nursing and technical education, and using tech-enabled media to conduct upskilling programs, reimagining the role of nurses, and formalizing allied healthcare workforce.
- To promote initiatives that empower individual physicians to achieve professional excellence. This will involve exploring ways and means to establish a potent mechanism where physicians become the gatekeepers of people's health and continuously update and upgrade their knowledge to deliver appropriate care to patients through focused leadership development programs. The underlying purpose is to create a pool of competent and conscientious physicians to deliver value through clinical excellence and leadership skills.
- To liaise with appropriate statutory and registering bodies internationally for recognition of qualifications and experience of Indian physicians and access to equal rights in their careers.
- To promote a greater understanding of challenges faced in addressing healthcare issues and strive to ensure safe and affordable services. Solutions would be sought to address sticky challenges, including paucity of medical staff, low government spending on healthcare, poor insurance coverage, flawed universal care programs, poor primary and secondary care facilities and infrastructure, and lack of parity in healthcare delivery.
- To actively contribute towards medical education, training and research to develop highly competent and well-rounded physician leaders. The priorities under this initiative include critical areas like clinical excellence, evidence-based medicine, precision and personalised medicine, tech-enabled clinical practice and innovation, and ethics and morality in medical practice.
- To encourage its members to support social and cultural organisations in promoting better health awareness amongst the local communities. The purpose is to make the target audience aware of the critical need for preventive health practices, mental health and wellbeing, early detection of disease and disorders, and routine examinations and check-ups.
- To facilitate professional networks to develop academic and clinical initiatives for mutual knowledge sharing. This will help build a repository of clinical insights for the fraternity and promote holistic academia-industry conversations around key Clinical, Research, Academics, and Training initiatives.
- To offer support and encouragement to statutory and non-statutory institutions to further the aims of GAPIO. The underlying purpose is to widen the circle of GAPIO's influence for better global reach and impact.
- In the future, a new era of personalised medicine and targeted therapies is beckoning us from the mists of the future. By doing its best to bring about a transformation through a systemic change - from making communication skills integral to the medical curriculum to changing legacy mindsets to embrace innovation wilfully - GAPIO seeks to pave the way for establishing a thriving culture of patient-centric healthcare is undoubtedly the lifeblood of care and cure.
- GAPIO is leaving no stone unturned to ensure the collaboration and cohesion of our bright minds, such that their combined intellectual and technical prowess becomes the vital force to enable the Indian healthcare sector to move up the value chain of innovation, excellence, and sustainable growth. To this effect, we are already in the process of institutionalizing better protocols and parameters for ensuring patient safety, developing effective methods for reducing medical errors, making GAPIO membership truly global by ensuring its representation in every country where the Indian diaspora is present, increasing community awareness about Non-Communicable Diseases and promoting good clinical practices aimed at wellness and well-being, and, providing organisational support to charity driven programmes in India and other developing countries.

BAPIO NATIONAL CONFERENCE 2023

★ 6-8 Oct 2023 ★

Mutually Beneficial Immigration is Key to Global Healthcare Sustainability

Ramesh Mehta CBE & Indranil Chakravorty MBE PhD FRCP
British Association of Physicians of Indian Origin, Bedford, UK

Cite as: Mehta, R., Chakravorty, I. (2023) Mutually beneficial immigration is key to global healthcare sustainability. The Physician vol8;Issue2:1-9 DOI 10.38192/1.8.2.6

It is estimated that this unequal world we live in will need 80 million health workers to meet the demands of the global population by the end of the decade, double the number in 2013.1,2 The population distribution across the globe is skewed (Fig 1) with high densities in Africa, South Asia and South America which characteristically remains mismatched to their gross domestic product and net wealth, which is enjoyed by nations with the least population densities (Fig 2). Healthcare provision within geo-politically separated nation-states continues to be driven by local social, political and economic factors. Therefore, the adage of 'no size fits all' is applicable. No two countries have the same healthcare system anywhere we know today. Yet the desire to achieve 'Health for All' should be universal.3 Implementation of the fundamental principle that health promotion and prevention must be prioritised before the resource-intense diagnosis and management of maladies is believed to be the only way to achieve any form of sustainability in healthcare provision.

In addition to population densities, the fundamental difference in nation-states in the 'global south' are the bulging strata of young people compared to the ageing populations of the 'global north'.4 What this means in terms of the growth of industries and services, including healthcare providers is that the manpower essential for success and sustenance resides in the global south. Much of the global industrial production or remotely managed services have moved over the last fifty years to countries like China, India, Bangladesh and Brazil, benefiting from the availability of a vast pool of trained manpower. The power emanating from a steep economic-political gradient has allowed for the exploitation of the lower socio-economic norms, poor governance and the easy corruptibility of political leadership in such countries to drive profits. In principle, healthcare is not different to this global phenomenon except for one key fact – that healthcare provision requires physical proximity between the caregiver and their client. This fundamental requirement leads to the challenge of balancing the inevitability of migration and the right-wing rhetoric of 'foreigners taking away jobs'.5 This is the geopolitical faultline6,7 where organisations that provide advocacy for the rights of immigrant professionals, such as the Global Association of Physicians of Indian Origin and its constituent member organisations AAPI and BAPIO, sit, as well as those that represent nursing professionals and so on.

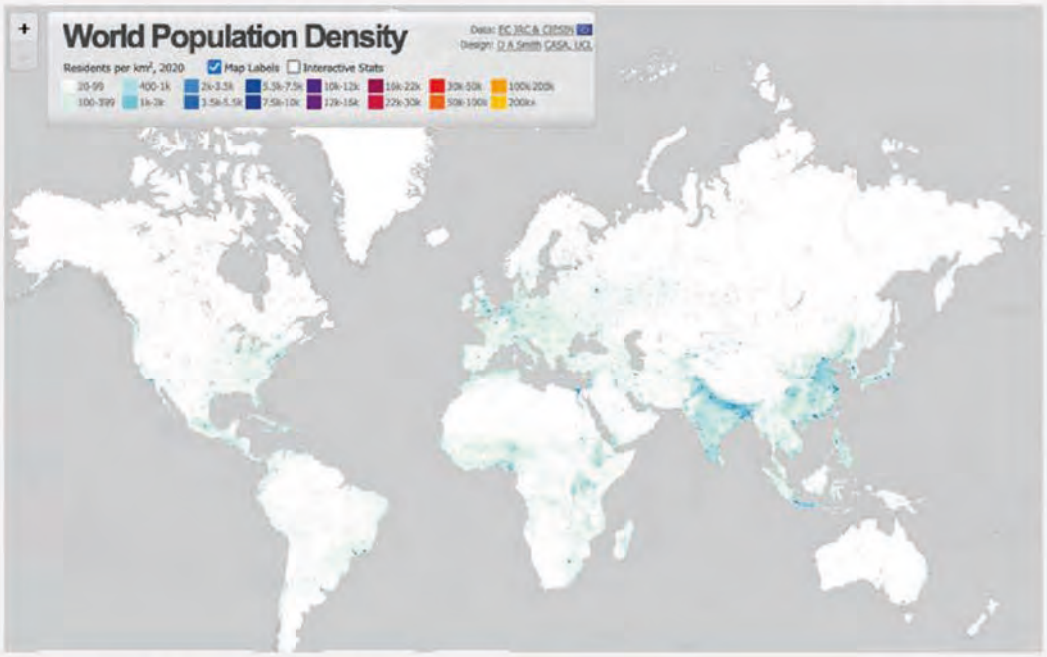

Fig 1 - World population density

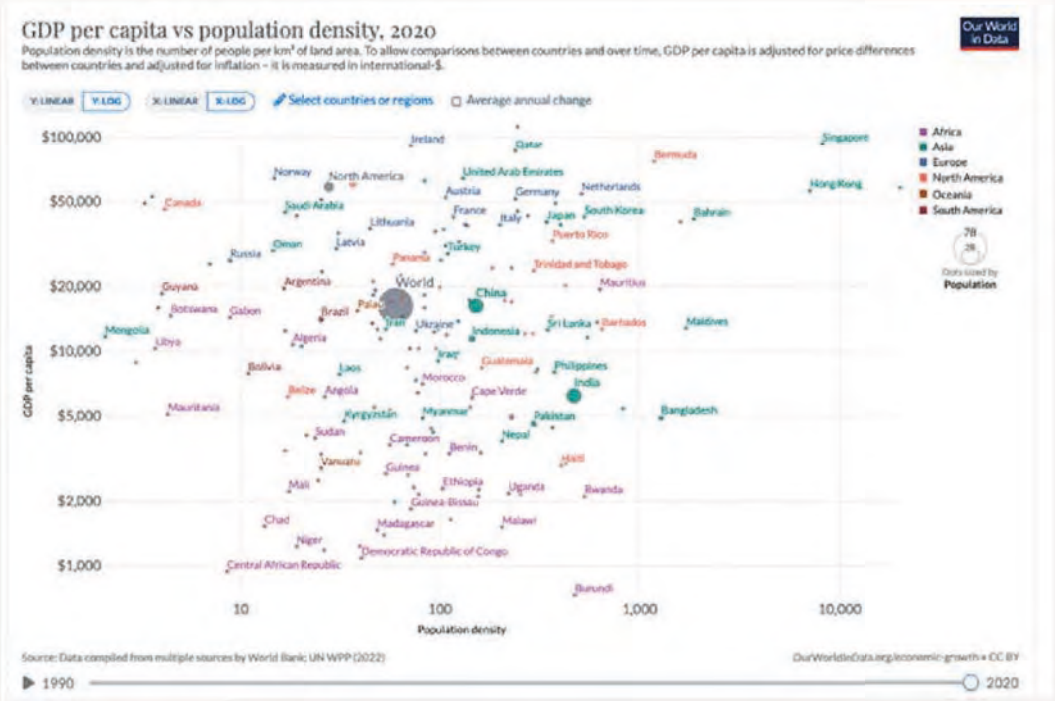

Fig 2 - World population density and Gross Domestic Product

Registration-Regulation & Managed Migration

Society's need to regulate healthcare professionals comes from the immense power to do good and harm that comes with the territory. Hospitals or places to care for people in sickness have existed from antiquity, as have learning centres for healers or doctors.8 In the UK, the College of Physicians in London was one of the first to receive the royal charter in 1518, which allowed to set the standards and certify doctors from Bishops who held the power to license health practitioners from 1411 AD.9 This role was taken over by the Registrar of the General Medical Council in 1858.10 Since then, the UK has professional regulation bodies for nine regulated healthcare professionals. The need to protect the public from 'quacks' has driven the need for registration and the protection from harm by acts of omission or commission by 'errant or rogue' health professionals drive regulation. Therefore, assessing the authenticity of a health professional's education and training is vital to the safety of healthcare provision in any nation-state.

Education and training of health professionals have been conducted from antiquity by personal apprenticeships and then by higher education institutions (HEI), aiming to provide a level of standardisation and move away from the power of knowledge held by individual practitioner-teachers. Even with the move to HEIs, medical education required several years of theoretical and practical learning and enormous resources. In most countries with a state-sponsored healthcare system, this is borne by the public purse. Resources are not infinite; hence there is unlikely to be a time when even the wealthiest nation-state can be self-sufficient. Mostly, there is a semblance of workforce planning which attempts to match production to projected demand. However, the long training period makes it impossible to accurately predict demand in 10-20 years.11

There are exceptions, such as in the West Indies, where there appears to be a surplus of doctors to local requirements. Studies of factors that drive migration also demonstrate the influence of push and pull dynamics.12 In most situations, the driver for migration appears to be economic- either poor opportunity in home countries with impoverished healthcare to areas of abundance.

Immigrant Health Professionals

Overall, there will always be a need for the migration of health professionals, which is increasing in volume and complexity. Immigrant health professionals, particularly doctors and nurses, are a vital part of global healthcare sustainability. They underpin effective responses to health emergencies and the achievement of Universal Health Coverage. They also bring cultural diversity, additional skills, and knowledge to the health systems they work in. Migrant doctors, also known as international medical graduates (IMGs) or foreign-trained physicians, are medical professionals who have obtained their medical degrees in a country other than the one they are currently practising or seeking to practice in. Data from over 80 WHO Member States indicate that over a quarter of doctors and a third of dentists and pharmacists are foreign-trained and/or foreign-born across countries. 13,14 The WHO Global Code of Practice on the international recruitment of health personnel is a crucial global governance instrument adopted in 2010, which sets out ethical norms, contributes to sharing data on migration, and fosters international cooperation.

The desire is to self-regulate the managed and sustainable migration of HCPs without overwhelming or compromising the healthcare workforce in adopter and host countries. Many high-income countries rely on internationally trained doctors to staff their healthcare workforce. Around one-third of doctors practising in the UK or USA and up to 41% in Australia or countries in the Middle East received their primary medical qualification abroad. Simultaneously, around 2% of doctors leave the UK medical workforce annually to go overseas.15 The migrants' integration experiences depend on their cultural awareness, discrimination, proficiency of language and communication skills, availability of social and professional support networks, social integration and personal attributes.16

Sustainability

Overall, migrant doctors provide buoyancy by addressing gaps in healthcare provision, meeting dynamic demand, and enriching the diversity and cultural competence of the workforce.17,18 They may have received training in different countries, worked in various healthcare settings, or have experience in specific medical specialities. This diversity can enrich the overall quality of care and contribute to innovation within the healthcare system. Migrant doctors have multi-cultural and multi-linguistic competencies that allow them to communicate with patients from different backgrounds effectively. But there are challenges.

Migration is a fundamental human behaviour driven by anything from curiosity to survival. Yet, unfortunately, such movement of people (whether by volition, compulsion or coercion) across arbitrary boundaries of nation-states often perpetuates injustice and inequality. Migrant doctors face several challenges when practising in a new country. These challenges may include language barriers, cultural differences, adapting to new healthcare systems, understanding local medical guidelines, and building professional networks. Host nations and their healthcare systems can be a hostile environment for these migrant professionals seeking equality of opportunity, fairness and justice. 19

Alliance for Equality in Healthcare Professions

Bridging the Gap

The British Association of Physicians of Indian Origin (BAPIO) was founded in 1996 to promote excellence in healthcare through the pillars of equality, diversity, leadership, innovation, and education. The 'Alliance for Equality in Healthcare Professions' (AEHP) chaired by the was founded in 2020, in the early days of the arrival of SARS-CoV-2 in the UK, with its primary task to address the differential outcomes for professionals from minority ethnic or multiple deprivation backgrounds.

The AEHP brought together over 52 organisations representing the breadth of UK health and social care professionals. The arm's length body undertook this work at the BAPIO Institute for Health Research (BIHR). The seminal report 'Bridging the Gap' (BTG21) set out in 2021 the most comprehensive consensus recommendations covering the full range of differential attainment (DA) in the entire scope of the medical professional's journey, from before entering the profession to the end.

Dignity at Work Standards21

There is a high level of incivility prevalent in healthcare organisations. However, these organisations should theoretically be places with empathic, caring, high achieving, highly trained staff working in scientific and technologically advanced - complex systems. Most healthcare environments are high-stakes, high-risk, emotionally challenging workplaces. When combined with a high workload and the imbalance between resources and demand, this highly charged environment creates a toxic soup where incivility prevails.

Incivility predictors include communication or coordination challenges, safety concerns, lack of support, and ineffective leadership. This incivility disproportionately affects migrant doctors. BAPIO, in collaboration with the AEHP partners, developed standards to raise awareness of uncivil behaviour and establish effective methods to eradicate it. Working with its academic partners in the Universities of Glasgow and East Anglia, the project will deliver a toolkit for supporting a diverse workforce and improving the organisational environment and, ultimately, better patient outcomes.

Locally employed doctors (LED) Charter

In the UK National Health Service (NHS), LED is a group of doctors hired Locally employed doctors by trusts to provide services. They are non-training, non-Staff and Associate Specialist (SAS), and non-consultant groups. According to the General Medical Council, over 100,000 of these doctors work in the NHS, most of whom are International medical graduates (IMG). Even though they are vulnerable and at high risk of making mistakes that jeopardise patient safety, they receive less help and education. There is no defined support system for this group of doctors. The Health Education England (HEE) schools are not responsible for these doctors. They do not have access to Professional Support and Wellbeing (PSW) or other possibilities for development. BAPIO, in collaboration with the AEHP, looked at the challenges confronting this group of doctors and proposed solutions to improve the quality of their experience and patient safety. 22–24

Way Forward

The migration of doctors from low-income or resource-limited countries to more affluent nations can contribute to a phenomenon known as 'brain drain'. 25,26 This highlights the loss of highly skilled professionals from their home countries, which can further exacerbate healthcare disparities in those regions.

Efforts are being made globally to address this issue and encourage doctors to return or contribute meaningfully to their home countries. It is crucial to address ethical considerations when recruiting migrant doctors. This includes fair and transparent recruitment practices, respect for labour rights, and providing adequate support systems for migrant doctors to ensure their well-being and prevent exploitation.27 Investing in the training and professional development of migrant doctors can contribute to long-term workforce sustainability. Offering opportunities for skill enhancement, mentorship programs, and career advancement can help retain migrant doctors in the healthcare system, maximizing their potential contributions. Retaining doctors in the healthcare workforce is crucial to addressing the shortage. Factors such as challenging working conditions, inadequate compensation, limited career advancement opportunities, and lack of support systems can contribute to doctor attrition. Efforts to improve working conditions and provide professional development opportunities can enhance workforce retention.28

Conclusion

The events of 2019-2020, from the #Blacklivesmatter29 movement to the #COVID-19 pandemic30, have exposed the cracks in civilisation and changed the mindset of a critical mass of people worldwide. It is no longer acceptable to continue propagating inequalities and injustice for different people. The world needs and demands change. Fortunately, we are seeing some green shoots globally. Examples from the UK are: the NHS equality, diversity, and inclusion (EDI) improvement plan sets out targeted actions to address the prejudice and discrimination – direct and indirect – that exists through behaviour, policies, practices and cultures against certain groups and individuals across the NHS workforce. 31 The GMC published the latest report on its progress in combatting inequality as a regulator and employer. 32 Addressing the global shortage of doctors requires a multi-pronged approach, including expanding medical education programs, promoting equitable distribution of healthcare professionals, improving working conditions and incentives, and leveraging technology to enhance healthcare access. Collaborative efforts between governments, healthcare institutions, and international organizations are necessary to tackle this complex issue and ensure that communities worldwide can access adequate healthcare services.

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The Importance of an Innovation Culture in the NHS

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It is just 18 days since we celebrated the 75th anniversary of the founding of the NHS. In 1942 Sir William Beveridge published his seminal report. In it, he envisaged that there would be a national health service free at the point of delivery. This was picked up by Nye Bevan, the Labour politician who, after much debate and controversy, turned Beveridge's vision into reality on 5th July 1948. It was a historic moment, the NHS was born, and the result was that everyone could access free healthcare at the point of use, irrespective of their means.

Looking back over the past 75 years, the NHS has been characterised by change and innovation driven by advances in science, technology, pharmacy and engineering. Amanda Pritchard made these changes in her recent speech to the NHS Confederation Conference. Vaccines for childhood illnesses such as polio and diphtheria and, more latterly, for AIDS/HIV and covid; CT scans, transplant surgery, IVF, genomic science, and robotic surgery are just some of the services built by innovation.

The diseases that drove demand for health care and killed people in the middle of the 20th century have largely been eradicated.

New Challenges

As we look forward, the challenges as we move into the middle of the 21st century are different to those of the middle of the 20th century. The burden of obesity, cancer and coronary health disease poses today's challenges.

Demography is also responsible for increased demand. We are living longer, but healthy life expectancy is not keeping pace with life expectancy. In the next 15 years, the number of people aged over 85 years is set to increase by 55% Demand, and needs are changing with rising levels of multimorbidity and complexity with significant implications for service delivery. By 2037 unless demand can be moderated, two-thirds of over 65 yr olds will have multiple co-morbid health conditions, and a third will have mental health needs.

As an important aside, the biggest driver of the healthcare system alongside demography is the cost of labour. We have around 122,000 vacancies today, but the workforce has increased by 25% since 2010. However, the number of staff needs to catch up with demographic demand. Compared to other OECD countries, the UK sits below the average for the number of doctors and nurses per head of the population and also for investment in capital and infrastructure, with the consequence that we do not compare well on measures such as scanners and beds per head of population.

Whist demography is changing the demand for health services, and innovations in research, science, technology, digital, and data are progressing.

Genomics and artificial intelligence (AI) will transform our ability to prevent, diagnose, treat and manage disease, supporting a shift towards better disease prevention and more personalised care outside the hospital. Advances in precision medicine, machine learning can help with routine administrative tasks; ambient technology can help with recording in real-time; decision-making support tools will become much more commonplace; remote surveillance and support through wearable and monitoring apps such as are used in virtual wards will become more commonplace; remote consultations will also help whether via video or apps such as the NHS app.

What technology has also aided is the democratisation of health knowledge. It is not uncommon for patients to present themselves to a clinician after consulting Google; many patients with long-term conditions may know as much about the science of their situation as the clinician they are consulting. This access to knowledge changes the relationship between the person receiving care and the person providing it; it changes the power dynamic. Patients are much more empowered today than ever, and this trend is set to continue. This advancement of technology is causing changes to the role of professions.

Eric Topol and Sir John Tooke have reviewed the impact of science, technology, digital and data in the past few years and concluded that AI could help the clinician by releasing the 'gift of time' or 'time to care' augmenting rather than replacing clinicians.

Implications for Education & Training

It also has implications for the education and training of the future workforce, and I will return to this later.

What is also true is that the pace of change we see in technology, knowledge and data is set to accelerate.

Our ability to keep up with these changes will be tested. Experts argue that digital change is rapid our ability to keep up is increasingly difficult. The gap between digital technology's opportunities and our ability to convert those opportunities into practice is getting wider.

The global healthcare crisis is also affected by broader influences beyond traditional thinking about healthcare. Accelerated by the pandemic, the WHO set out the importance of the relationship between planetary, animal and human health in their One Health strategy. The war in Ukraine demonstrates that complex geopolitics will continue to shape the political and economic choices facing governments.

Where does this line of argument lead? The NHS has a remarkable track record of innovation, as the last 75 years demonstrate. However, the adoption and spread of that innovation have been more challenging. How innovation is taken to scale and standardised. Just a tiny example -when I was CEO of CQC, I could never understand why all hospitals that undertook surgery did not use the WHO-approved 'surgical checklist', which was proven safe and effective. Why is there such unwarranted variation in practice and outcomes when simple tools have proven effective? When we compare the NHS to other sectors and industries, we do not compare how innovation is adopted well.

The challenge for the future is not developing a culture of innovation but a culture of adoption and spread alongside innovation. In many respects, this is more challenging.

A key challenge of the adoption and spread of innovation is the culture of the NHS – the human behaviours and attitudes that either embrace or resist change.

Yes, financial investment is vital, but more is needed. Complex problems have more complex, single-answer solutions.

One contribution to that solution is education and training -it has a fundamental role. The NHS Long Term Workforce Plan begins to set out how we can take a much more strategic, multiyear approach to workforce planning. It sets out the importance of investing in the human capital of health and care – the workforce. It argues that we should see the workforce as not a cost but an investment. I am sure that Navina will touch on this in her contribution later today, so I do not wish to steal her thunder. I wish to make the critical point that we will need more staff and teams working differently as we look to the future. Also, given that 50% of the current workforce will be working for the NHS in 20 years and given the speed of innovation, we will need to help existing staff re-skill and upskill.

In discussions about the future of the workforce, we often focus, as I have so far today, on the changes taking place in services – the shape of care. There are, however, two other areas that need to be considered – the shape of work and the shape of education.

In preparing the LTWP, we explored how education was changing – the shape of education. When I visit Universities, I am asked,
"How is the NHS changing, and what will it look like in the future?" - a legitimate question.

In return, I am curious to understand how education is changing. The same drivers of change: technology, science and digital are shaping what Anthony Seldon has called the Fourth Education Revolution.

What are some of those changes?

I have met many younger doctors who argue that their education has been biased towards 'knowledge retention' and that their role is solving complex problems. They can access real-time, up-to-date knowledge using digital technology, and decision-making tools can help them. What is the balance between knowledge retention and problem-solving skills today, and how will that shift in the future?

Virtual and augmented reality, simulation, and group supervision using real-time technology are becoming increasingly common in undergraduate and post-graduate education.

The shelf life of medical knowledge is advancing rapidly and is now measured not in years or months but in days. An essential skill for all professionals in the future is learning how to learn. As both Tooke and Topol have concluded, what technology will not replace is the role of clinicians. Where machine learning and precision medicine will provide more accurate and rapid diagnoses in the future, the clinician's role will be to interpret what a diagnosis means and explain the next steps. In the end, there will be a greater emphasis on clinicians' emotional intelligence and interpersonal skills. Paradoxically, we often call these the 'softer skills'. I think that they may be the 'harder skills'.
These 'softer' skills are also essential for multi-disciplinary teams to work together successfully.

There will also be a need for initial training and education and the ongoing CPD to focus on acquiring new skills in digital and analytics.
I also see the emergence of new roles and an expansion of specialist roles such as data analysts, data scientists, bioinformaticians, biostatisticians and engineers and some that have not yet been developed. Complex problems are best served by diverse teams working collaboratively.
The development of the future shape of education is vital as we develop our approach to investing in human capital in a global labour market and ensuring that they have both the knowledge and skills to support the continued evolution of digital solutions.

I have been challenged to think about different generational attitudes towards work- the shape of work. As a baby boomer, I compare myself to my children, who are millennials. They work just as hard as I do and care about issues as much as I do, but they have a much more sophisticated, nuanced approach to work-life balance than I ever did. They want the flexibility to work and learn but also to live.

Some commentators argue that the differences between generations are overstated. My view is that the shape of work is changing and that generational attitudes to work are driving that change, and there is a need to adapt. We have made strides in building an inclusive workforce in the NHS, but as the staff survey demonstrates, there is much more to do on race, disability. We need to add intergenerational inclusion to our agenda.

These different generational attitudes provide real opportunities for the future and challenge how best to harness generational differences and create successful multi-generational workplaces.

Conclusion

I hope I have met the brief the organisers have set me in this presentation. Please read the LTWP the story of innovation in health runs through the whole document, and section 4 has an entire section on digital. I am confident that digital technology will profoundly influence how health and care are developed and delivered in the future. We anticipate some of the ways this will occur and others in the next 15 years (the lifetime of the LTWP) that I, for one, cannot envisage. I am less worried about whether a culture of innovation will continue and more concerned about how we create a culture of adoption and spread of that innovation. This is the leadership challenge we face, whatever our roles.

What is my call to action this morning? It is to ask you to argue for a change in the behaviours as we embrace a future that will continue to be shaped by advances in science and technology required by the professions and educators as science and technology. The NHS is built on a culture of innovation. We now need to develop a culture of adoption and spread. Help to create that culture; help to make that future.




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The Digital Future of Surgery

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In 2019 the Topol review reported on the technologies that would influence healthcare between 2020-40 and the changes needed to adapt. Robotics is one of those technologies which has been around for more than 20 years and continues to evolve. Smartphone apps, wearables and virtual reality also feature prominently in the Topol review, a must-read for aspiring healthcare entrepreneurs.

The unique Da Vinci robotic system, which has revolutionised surgery, faces market competition from other international companies with their versions of next-generation robots. To challenge the current gold standard, these new systems must be at least as good, if not better. The alternative is to be significantly cheaper, thus attracting a wider variety of institutions who could not afford the Da Vinci. Open consoles, 3D enhanced vision, lighter instruments, and greater portability will be recurring themes in these new systems.

These new machines can reduce the cost of robotic surgery to be like that of laparoscopy, although the initial hardware outlay may still be substantial. Cambridge Medical Robotics (CMR), UK, have introduced competitive cost models with their Versius robot, which covers maintenance, instruments and even assistants as a comprehensive package. The first international report on the urological use of Versius was an IDEAL stage 1/2a study, which showed that this modular robot could be used to perform a variety of procedures such as radical prostatectomy, nephrectomy and pyeloplasty without conversion to open or Da Vinci surgery and with excellent oncological and functional outcomes [1]. The Versius has also been used in gynaecology and colorectal surgery with encouraging results and at a lower cost.

More recently, the first UK use of the HUGO RAS system from Medtronic at Guy's Hospital made headline news as a potential means of reducing the post covid
waiting lists. This robot had already seen its first launch in India and Europe.

There is even interest in automation and, more importantly, trustworthiness in robotic surgery. The STAR robot can suture the bowel better than a human hand. A water jet robot can now treat an enlarged, benign prostate semi-autonomously. Whether this will change the attitudes of surgeons, patients and policymakers over time remains to be seen. It is, however, unlikely that fully autonomous systems will take over anytime soon as they cannot make critical decisions where human judgement is essential [2].

The two other aspects of digital surgery that are causing excitement are artificial
intelligence (AI) and faster communication. The concept of AI is not new, going back to the genius of Alan Turing, who, with his decoding skills, significantly impacted the outcome of World War II.

Machine Learning (ML) is a subset of AI using decision-making computer algorithms to grasp and respond to specific data. For example, an algorithm could make the machine learn whether a given image is that of cancer or not, thus reducing the variability in MRI readings by radiologists. The PANDA challenge, an open online dataset of 10,000 digitised prostate biopsies, shows that AI is as good as human pathologists for the diagnosis and Gleason grading of prostate cancer [3]. With robust external validation, it reduces the difficulty that AI faces with reproducibility because of unpublished codes in 90 per cent of published articles. AI will still replace our friendly pathologists. It will be an adjunct to human reporting by improving accuracy and reducing the variability amongst pathologists. AI can be used as a triage tool to reduce their routine workload and instead allow experts to focus on the more difficult
cases where an accurate pathological diagnosis would directly impact decision-making and patient care.

The other area where AI is increasingly used is 3D imaging of organs and surrounding structures in surgical planning. AutoProstate can automatically
segment and report MRI scans, although the false positive readings need to be improved [4]. Likewise, MonaAI Label can segment prostatic zones and cancers
and produce a 3D image of the prostate, sphincter and neurovascular bundles, which can be 3D printed and taken to the operating room for "personalised surgery".

The video recordings of surgeons performing robotic surgery can now be converted through a "black box" into Automated Performance Metrics (APMs) and demonstrate paradoxical findings in that, not all high-volume surgeons are necessarily those with the best outcomes. These APMs may help with the training and performance of the next generation of robotic surgeons [5].

The UK government, amongst others, has declared significant investment in AI to engage with new talent and remain a world leader in this emerging field. An ambitious project called Responsible AI UK will create an eco-system to engage with researchers, the public, industry and policymakers over the next few years to develop responsible and actionable AI while maintaining the sensitivities around data trust and ethics [6].

Robotic surgery may be further democratised in coming years by augmented reality and the advent of low latency ultrafast 5G/6G connectivity. The Internet of Skills could make remote surgery and mentorship easily accessible, irrespective of the location of the expert surgeon [7].

This could reduce the international travel of surgeons and reduce their carbon footprints. The impact of these developments on patient care will be of considerable interest to the broader public.

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A World Without Childhood Blindness

The GAPIO Collaboration with Eye Foundation of America

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Background

Very little data is available on the prevalence of childhood blindness from population-based studies. Prevalence and incidence data from blind registers underestimate the figure because of under-reporting. Globally, the prevalence of blindness among children is estimated to be approximately one-tenth of that in adults, at around 0.7 per 1000.

However, blindness in childhood has far-reaching implications for the affected child and family, and throughout life, profoundly influences educational, employment, personal, and social prospects.1 A World Health Organisation meeting on Childhood Blindness in 1990 estimated that there were approximately 1.5 million blind children worldwide, of which 90% live in developing countries. It was also estimated that about 500,000 children go blind each year worldwide, of which 60-80% die within the subsequent 1-2 years from the diseases which contributed to their blindness or from neglect consequent upon being blind.

The prevalence of blindness in children is closely related to the availability of health care for children (nutrition, immunisation etc.) and, therefore, to child survival and under-five mortality rates (U5MR). Countries with high U5MR (over 170/1000) are likely to have a prevalence of childhood blindness over one per thousand, while those countries with low U5MR (below 30/1000) probably have a prevalence of between 0.2--0.5/1,000 children. 2 The only data on the incidence of childhood blindness come from blind registrations in developed countries. Robinson reviewed the prevalence of congenital blindness in British Columbia from 1945-1984, showing a reasonably constant figure for congenital blindness of 4/100,000 births from 1955-80. From the population survey in India, from a cohort of over 6000 children, the prevalence of childhood blindness was estimated to be 0.17% (95% confidence interval 0.09 to 0.30).3

Causes of Childhood Blindness

In a study from the Republic of Ireland, 56% of children had lesions due to factors acting before the perinatal period (genetic causes), 27% had lesions due to factors acting in the perinatal period (birth asphyxia and prematurity), and 13% had lesions due to factors acting in childhood. 4 In a study from Southern India, a treatable refractive error caused 33% of blindness, followed by 17% due to preventable causes (8% each due to vitamin A deficiency and amblyopia after cataract surgery). The major causes of the remaining blindness included congenital eye anomalies (17%) and retinal degeneration (17%).3 Microphthalmos, retinitis pigmentosa, optic atrophy, and cataracts were the leading causes of childhood blindness.5

Childhood blindness has a far more significant impact on the individual and the society compared to adult blindness considering the total number of disability-adjusted life years lost (the number of years that a blind person lives after going blind), the difficulty in integrating the child socially and functionally, and the long-term burden on the caregiver and society. The World Health Organization (WHO) chose childhood blindness as one of the five avoidable ocular conditions under the VISION 2020-Right to Sight initiative.

In India, the initiative has been clubbed under the National Program for Control of Blindness (NPCB), and numerous measures have been started. These include setting up and upgrading paediatric ophthalmology units, school screening programs, and providing facilities for refraction and low-cost spectacles in children. 6

Controlling childhood blindness was a priority of the World Health Organisation's (WHO) global initiative to eliminate avoidable blindness by 2020.7 Since VISION 2020 was launched in 1999, controlling blindness in children has been a high priority. Child Eye Care Centres are being established with trained, equipped teams, particularly in Asia. Programmes for detecting babies with retinopathy of prematurity (ROP) are expanding in Latin America, India, China, and other countries in Asia. Many school-going children are having their visual acuity measured, and those with a refractive error are being provided spectacles. Finally, there is improved availability of affordable consumables and equipment, such as paediatric low-vision devices, small-diameter intraocular lenses, and spectacles for children.

However, the goal of eliminating avoidable blindness in children (ABC) is still some distance away. In 1977, while living in London, the author returned to India with personnel and equipment. He offered his first eye camp to remove cataracts, and synthetic implants replaced prescription glasses. The purpose of an eye camp is to provide patients living in remote areas the opportunity to receive quality, inexpensive treatment that would otherwise be unavailable. Eye camps have been organised, managed, and conducted on a "crash-program" basis as the only practical way of reaching cataract patients. Without any reasonable alternative, the eye camp concept seems to be the only piratical method of bringing visual relief to rural Indians. 8 While there are benefits of outreach facilities via eye camps, and outcomes may be similar, there are some disadvantages- such as loss of follow-up, which eventually affects the management of amblyopia and postoperative complications.9

Eye Foundation of America

The West Virginia Ophthalmology Foundation was created in 1982 and became the Eye Foundation of America (EFA) in 1992. The EFA's mission is to eliminate avoidable childhood blindness around the world.10 The EFA operated on three guiding principles: service, teaching, and research.

Collaboration among medical practitioners, trainees, and researchers from the United States and developing countries was crucial to accomplishing the EFA's mission. Medical care was provided free of charge. The EFA not only trains medical practitioners to join the global fight against blindness but also instructs school teachers on how to screen for early eye problems in children and educates the public on eye care and prevention. Research is critical to determine the best and most efficient ways to implement strategies that will further the EFA's mission.

In the late 1970s, surgical eye camps were in vogue in India. During this era, in addition to the hundreds of screening camps it held, some organisations set up a few surgical eye camps, which proved to be very resource intensive. In these surgical camps, operations were performed at the site: a school, a college, a community hall, or a local hospital. Intracapsular cataract extraction (ICCE) was the surgical procedure at that time. The postoperative stay at the campsite ranged from four to seven days. Patients had to lie down with their eyes bandaged in a complete resting position to avoid wound leak or iris prolapse, and they were given soft food to eat. The operated patients were issued standard +10 D aphakic spectacles at discharge and advised to come for follow-up at the base hospital or campsite a month later. The model has shifted to screening camps and operations done in fixed, state-of-the-art facilities. 11

Community ophthalmology encompasses a broad spectrum of components that can supplement the delivery of eye care: Creating awareness of eye health in the community through various strategies, conducting epidemiological research and community-based surveys, planning and management of sustainable eye care services, integration of critical components such as school children screening, community-based rehabilitation, and primary eye care and training of primary eye care workers.12 There are many risks to consider when offering eye care services outside of established eye care facilities. Risk assessment and careful planning keep patients, staff members, and community members safe.13

Accessibility & Sustainability

The World Bank claims that combatting childhood blindness is the single most cost-effective health intervention. These services are often rendered through travelling eye camps and permanent hospitals built by the EFA, including the Gautami Eye Institute10,17 in rural India. Parents, their families, and the more significant communities benefit from preventative medical care, free procedures, and access to education. By preventing avoidable blindness in children, such initiatives give the gift of 75+ years of a whole and productive life.

The most effective way to reach fringe or rural outreach communities is to train and integrate primary eye care workers into the existing primary health care systems. Ideally, a resident of these communities is identified and prepared for this work — what most projects call a community-based rehabilitation (CBR) worker. These primary eye care workers are best placed to penetrate the 100-metre barrier around a blind person's home. 14

Most health systems still need help implementing Comprehensive Eye Care, mainly due to political, economic, and logistic barriers. Shortage of eye care human resources, lack of educational skills, paucity of funds, limited access to instrumentation and treatment modalities, poor outreach, lack of transportation, and fear of surgery represent the significant barriers to its large-scale diffusion. In most low- and middle-income countries, primary eye care services are defective and must be more adequately integrated into primary health care and national health systems. Social, economic, and demographic factors such as age, gender, place of residence, personal income, ethnicity, political status, and health status also reduce the potential for success of any intervention.

Cost-effectiveness analysis of outreach eye camps shows that they can be time-consuming for the ophthalmologist and only result in net profit for the institution if the ophthalmologist converted most cataract patients into accepting surgery and refractive error patients into purchasing glasses from the hospital optical shop. Such a model of cataract surgery programs must reduce the cost of imported consumable surgical products, reduce operation time, and, most importantly, reduce the number of very costly surgical camps providing essentially free surgery. 15

Practitioners often adopt strategies to improve the sustainability of their services by maintaining 'sustainability funds' to retain financial autonomy over income; avoiding granting government user fee exemptions to elderly patients who are the majority of service users; expanding or contracting outreach services as economic circumstances change; and accessing peer support for problem-solving and advocacy. 16

Goutami Eye Institute and the EFA

Goutami Eye Institute and the EFA have facilitated 700+ physician exchanges and over 340,000 eye surgeries, 30,000 eye surgeries on children, and the treatment of 3.5 million outpatients since the inception of the Eye Foundation of America.

Future Opportunities

With the collaboration of the Global Association of Physicians of Indian Origin, the EFA will continue to offer eye camps in more than 35 developing countries, train medical personnel to serve the needy and educate the population on preventative eye care and healthy lifestyle choices. In addition to constructing a new Gautami Eye Institute, which has a wing dedicated to children, the EFA is adding a secondary service and research hospital in India where no child will be denied treatment and children from around the world can come to receive world-class services. The EFA are also committed to finding new cures for age-old eye diseases in children. The EFA operates on donations. However, more money, qualified people, pharmaceuticals, and state-of-the-art equipment are always needed. By focusing on prevention, education, and supporting primary medical services in developing countries, the potential is limitless. It embodies the concept of ways to do more with less.

Eye Foundation of America (UK)

World without Childhood Blindness

Conclusion

The Lancet Global Commission on Global Health reported that in 2020, an estimated 596 million people had distance vision impairment worldwide, of whom 43 million were blind. Another 510 million people had uncorrected near vision impairment simply because of not having reading spectacles. Many affected (90%) live in low-income and middle-income countries (LMICs). However, encouragingly, more than 90% of people with vision impairment have a preventable or treatable cause with existing highly cost-effective interventions. Eye conditions affect all stages of life, with young children and older people mainly affected. Crucially, women, rural populations, and ethnic minority groups are more likely to have vision impairment, and this pervasive inequality needs to be addressed. By 2050, population ageing, growth, and urbanisation might lead to an estimated 895 million people with distance vision impairment, of whom 61 million will be blind. Action to prioritise eye health is needed now.18

Vision facilitates many daily activities, enables better educational outcomes, and increases work productivity, reducing inequality. An increasing amount of evidence shows the potential for the image to advance the Strategic Developmental Goals by contributing towards poverty reduction, zero hunger, good health and well-being, quality education, gender equality, and decent work.

Vision loss has many causes that require promotional, preventive, treatment, and rehabilitative interventions. Cataracts, uncorrected refractive error, glaucoma, age-related macular degeneration, and diabetic retinopathy are responsible for most global vision impairments. Research has identified treatments to reduce or eliminate blindness from all these conditions; the priority is to deliver treatments where they are most needed

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Reducing Risks in Healthcare by Prioritising Workforce Well-being

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Abstract

Considering risks to healthcare covers a wide variety of topics. This cover's an extensive area such as sustainability, including funding; planning, long-term policy development; and trends, including the emergence of publicly funded versus private healthcare or a hybrid offering. Other topics include workforce planning, involving the consideration of self-sufficiency versus importing; examination of delivery modes of hospitals versus community; and final consideration of balancing affordability with expectation and need. As part of a consideration of risk is an anticipation of what dangers may arise. This can be borne out of existing knowledge of known threats, which remain ongoing, trends and predicted risk patterns, and unexpected risks.

Workforce Challenges

Healthcare is a risky business with high levels of stress and often adverse outcomes for patients, staff and a considerable liability for organisations when things go wrong. The new understanding of the vicarious liability of the NHS for mistakes made in its service, the development of clinical governance, and the creation of bodies such as the Commission for Health Audit and Inspection and the National Patient Safety Agency are promising interventions, demonstrating that the UK is turning to the right direction.1 When assessing risks in healthcare, a broad range of topics encompass sustainability, funding, long-term policy development, and emerging trends such as publicly funded and private healthcare debates.

Workforce planning is crucial, which involves exploring different delivery models for healthcare, such as hospital versus community-based care or prioritising prevention and health promotion versus spiralling investment in specialised treatments. The sustainability of healthcare delivery systems is challenged by ageing populations, complex systems, increasing rates of chronic disease, increasing costs associated with new medical technologies and growing expectations by healthcare consumers. 2

A significant risk arises from the challenges faced by the workforce and how this has a profound impact on workforce planning and, therefore, the delivery of excellence in patient care. Despite substantial workforce planning efforts, the effectiveness of this planning could have been better, resulting in persistent vacancies, poor morale, and now industrial action. Responses to workforce shortfalls have included a reliance on foreign and temporary staff and changes in skill mix, which are often reactionary and adversely impact team cohesion and the work environment.3 Impending stressors for the UK health and care workforce include growing multimorbidity and an increasing shortfall in the supply of unpaid carers.

There has been a relative decline in the attractiveness of the National Health Service (NHS) as an employer internationally.3 Currently, the NHS leadership are vexed by the hurdles of recruitment and retention of the medical workforce, often determined by the decline in employee well-being and support, and how safe systems at local levels can improve patient safety and reduce risk to patients and the workforce.

A report by the UK General Medical Council (GMC), "The state of medical education and practice in the UK, Workplace experiences, 2023"4 and the NHS England "NHS Long Term Workforce Plan"5 published in June 2023, attempts to provide a way out of this dilemma. The NHS plan notes over 112,000 vacancies across the NHS and is forecast to leave a shortfall of 260,000 and 360,000 staff by 2036/37. The UK health organisations, including the regulator, are known to prioritise the protection of patients, often at the risk of compromising the health and well-being of staff. Barriers to successfully initiating and implementing health and wellbeing services in the NHS range from front-line logistical issues with implementation to high-level strategic and financial constraints.6 However, patient care and a supportive work environment are interdependent and essential for patient safety.7 The GMC report highlights that urgent action is needed to break a 'vicious cycle' of unmanageable workloads, dissatisfaction, and burnout that is causing UK doctors to take steps to quit.

The NHS Long-Term Workforce Plan has recognised three areas of action:

- Train: significantly increasing education and training to record levels and new roles designed to meet patients' changing needs better and support the ongoing transformation of care.
- Retain: ensuring that organisations retain more of our staff within the health service by better-supporting people throughout their careers, boosting the flexibility offered to work in ways that suit them and work for patients, and improving the culture and leadership across NHS organisations.

- Reform: improving productivity by working and training in different ways, building broader teams with flexible skills, changing education and training to deliver more staff in roles and services where they are needed most, and ensuring staff have the right skills to take advantage of new technology that frees up clinicians' time to care, increases flexibility in deployment, and provides the care patients need more effectively and efficiently.5

Analysis of the intentions of the workforce found that 18% of doctors are likely to leave the UK profession permanently. The NHS Plan notes that in 2022 when people have chosen to leave an NHS trust, some of the most common reasons were pay and reward, work-life balance, progression and continuing professional development, and health and wellbeing.8 So, what risks are facing our doctors, and how can we help them?

Complaints to the Regulator

It is widely accepted that an investigation by the regulator into a doctor's fitness to practice can be an extremely stressful experience. Investigation can impact their professional career, personal life, and mental well-being. In 2022, 7,367 complaints were made to the UK medical regulator, the GMC. The main types of allegations that the GMC has investigated are Knowledge, skills, and performance, Maintaining trust, Communication, partnership, teamwork, safety and quality. This shows the most common areas of complaint against doctors in the UK. Therefore, there should be some consideration of the types of complaints facing doctors and how more support in the workplace can help to alleviate patient/colleague dissatisfaction and lead to earlier resolution of these concerns before they reach the regulator.

On the other hand, the GMC reported that doctors named the following common risks they faced in 2022:

- 77% reported working beyond their rostered hours
- 68% have difficulty taking breaks each week
- 42% reported being unable to cope with their workload every week
- 25% of doctors were categorised as being at high risk of burnout
- 44% of doctors said providing adequate patient care at least once a week was difficult.4

Unsurprisingly, there is a direct link between the concerns doctors have reported and the types of complaints made against doctors. In an environment of working additional hours; being unable to take breaks; having an unmanageable workload; and burning out, a doctor may need more time to prioritise training and time for learning and growth in knowledge. However, as knowledge forms one of the highest complaints at the GMC, steps need to be taken to ensure that learning opportunity is available and that this time is protected, as well as keeping skills updated and developing as science and medical technology evolve. Also, for doctors returning to work after a period of absence, there must be a supported return to work and an appraisal and update of skills. Again, it is unlikely that the doctors will be able to gain a full opportunity to do this in the existing culture.

All this impacts a doctor's performance. Without the opportunity of building and enhancing knowledge, and refinement and development of skills, coupled with unmanageable workloads and burnout, this is not conducive to a doctor being given the opportunity to perform to the standard required and the best of their ability, which creates an unsafe working environment for the delivery of safe patient care. This is evidenced by the data showing that doctors have reported difficulties delivering good patient care.

Staff Sickness

It is common knowledge that sickness or unplanned absences harm organisational performance and safety, particularly in high-performance, high-risk organisations such as health services. In January 2023, it was reported that 5.3% of the 1.3 million NHS workforce was off sick. Anxiety, stress, depression and other psychiatric illnesses were the most commonly reported reason for sickness, accounting for over 520,470 full-time equivalent days lost and 23.3% of all sickness absences in January 2023.[9] The GMC said that 70% of doctors and 82% of GPs always or often felt worn out at the end of the day; and that in 2022, 22% of doctors took a leave of absence due to stress in the last year.[4]

These are not insignificant numbers, and the impact on the delivery of patient care is notable. The data clearly shows that psychiatric illness significantly contributes to sickness absence levels reported. These figures are high when doctors raise concerns about unmanageable workloads and burnout, which places employers responsible for reducing work's contribution to a doctor's mental well-being.

Disability

In the GMC report, doctors with a disability had a less positive experience across multiple measures.[10–12] This is likely to prevent these doctors from making the full contribution to healthcare service delivery of which they are capable, despite their workplace challenges being potentially remediable. Only 44% of disabled doctors were satisfied with their work, and 47% of disabled doctors were categorised as struggling with their workload, compared with 37% of non-disabled doctors. In a struggling workforce, it is almost inconceivable that the full potential of doctors with disabilities is not being utilised as support has not been put in place to help this group work and maximise their potential. Again, this has a further detrimental impact on the delivery of patient care.

Impact on Patient Care

There are concerns that doctors themselves have about their work, and the data shows the impact of ill health, lack of support for those with health issues and disabilities, how valuable skills and experience are being lost, and reducing the number of doctors available to deliver patient care. It is not unreasonable to consider that it is dangerous for a patient to be treated by doctors who are tired, overworked, stressed, anxious, and feeling unsupported, unhappy, and dissatisfied in their workplace. In the GMC report, more than six out of ten doctors (62%) felt confident raising concerns about patient care, yet almost one out of five did not (18%). A substantial minority of doctors may feel they cannot provide adequate patient care and are hesitant about voicing concerns.[4] Not only is it clear that there are issues at ground level affecting the delivery of care to patients, but a significant proportion of doctors feel that they need help to do something about this, which poses an additional risk to patients. Doctors must be able to raise their concerns in a safe space and be followed up and addressed.

What can we do?

Industrial action is a clear example of doctors' frustration. If nothing is done now, the healthcare workforce cannot be sustained, meaning delivering patient care to the required standards will not be possible. The GMC suggested the following short-term recommendations:

- Ensure doctors feel valued by their employers and have a strong sense of belonging
- Enable effective and supportive team working to improve belonging
- Evolving and developing what it means to be a leader
- Develop a flexible rota design
- Providing workplace rest and refreshment facilities

The NHS Plan has planned to focus on:

- Rolling out the interventions that have proven to be successful already. For example, ensuring staff can work flexibly, access health and wellbeing support, and work in a well-led team.
- Support the health and wellbeing of the NHS workforce and, working with local leaders, ensure integrated occupational health and wellbeing services are in place for all staff.
- Support NHS staff to use the extended childcare support to working parents over the next three years to help the team stay in work.
- Every staff member should be allowed to have regular conversations to discuss their well-being and what will keep them at work, including pension flexibilities, flexible working options, and health and well-being.

These recommendations are familiar, and the foundations are set. It is taking ownership to action these recommendations to put them in place and keep them in place that is needed.

Summary

Common symptoms frequently reported by doctors and the GMC include burnout, work-related stress, anxiety, and depression, resulting in sickness absence and disability discrimination. Dissatisfaction with work, fear of voicing concerns, compromised patient safety or care, and complaints regarding performance further contribute to this detrimental cycle. As a result, UK doctors are increasingly compelled to consider leaving their profession. The leading causes of this situation include excessive work hours, difficulty taking breaks, overwhelming workloads, failure to implement reasonable adjustments, and the absence of a supportive culture that encourages open communication.

It is clear to see the commonalities between the recommendations from the GMC report and the NHSE report. Whilst the NHS has identified areas of recommendation, the GMC has provided practical solutions that can be implemented immediately. There is a strong focus on flexible working and how this can support staff and create more opportunities for engagement with work and retention. We would encourage all to start those conversations about flexible working; identifying areas where they need more support for their well-being; speaking up about rota design, rest breaks, and workload; and reaching out for help. The best way to look after patients is for doctors to look after themselves first. Now is the time for proactive measures to be taken from within. By taking the first small step to improve a doctor's working day, their well-being will be enhanced, and their entire team will benefit from improving patient care. This collective effort will help mitigate the identified risks and bring about positive changes in healthcare delivery.

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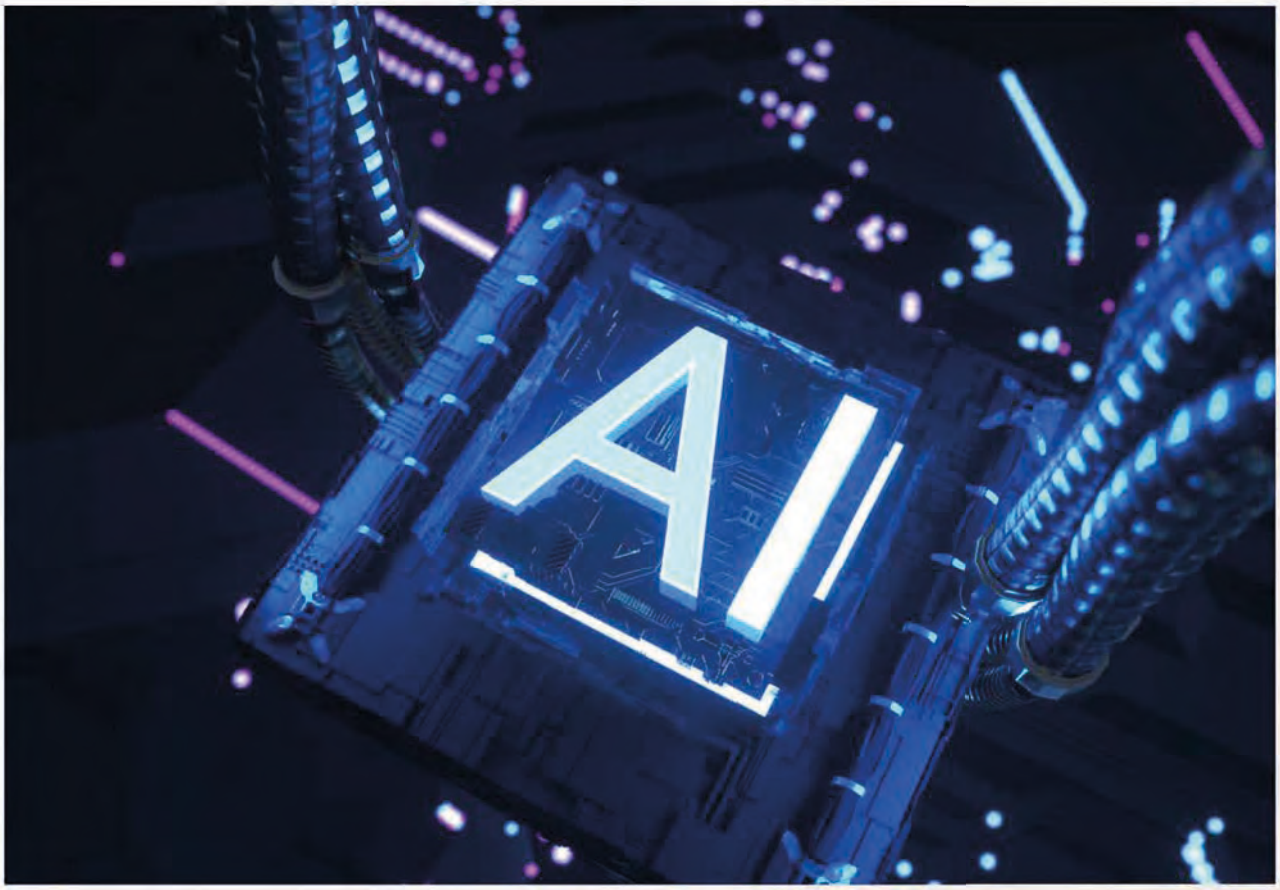
Introduction to Artificial Intelligence Prediction for Healthcare



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Introduction

Artificial intelligence (AI) aims to mimic human cognitive functions. It is bringing a paradigm shift to healthcare, powered by the increasing availability of healthcare data and rapid progress of analytics techniques.1 AI can be applied to various types of healthcare data (structured and unstructured). Popular AI techniques include machine learning methods for structured data, such as the classical support vector machine and neural network, modern deep learning, and natural language processing for unstructured data. Major disease areas that use AI tools include cancer, neurology and cardiology.

In recent months, we see an increasing interest in AI and its potential impact on every aspect of human endeavour. In medical diagnostics, many AI tools are in use, including drug discovery and development, drug repurposing, improving pharmaceutical productivity, and clinical trials, among others; such use reduces the human workload and achieves targets quickly.2 In protein structure discovery, Deep Minds AI model AlphaFold holds a special place in the annals of beneficial outcomes of AI where what used to take professionals months and sometimes years to predict the protein structure now AI does in mins.3 The neural network-based model, AlphaFold, demonstrated accuracy competitive with experimental structures in most cases and significantly outperformed other methods. AlphaFold used a novel machine learning approach incorporating physical and biological knowledge about protein structure, leveraging multi-sequence alignments into the algorithm. Alphabet, the company that owns Deep Minds, has released these algorithms and millions of complex protein structures for free as it can help detect the virus causing the Covid-19 pandemic (SARS-COV-2) behaviour.4

Doctors need accurate predictions for the outcomes of their patient's diseases. In addition, for accurate predictions, timing is another significant factor influencing treatment decisions. Machine learning aims to mimic the intellectual abilities of humans with machines. Representation and generalisation are used in machine learning. Representations of data instances and functions evaluated on these instances are part of all machine learning methods. Generalisation is the property according to which a machine learning method can provide predictions for previously unobserved data instances. Both supervised and unsupervised methods are used in machine learning.5

Supervised Versus Unsupervised Learning

Theoretically, both learning methods vary in structure. In supervised learning, the model describes the outcome that one set of observations (inputs) has on other observations (outputs). Thus, the inputs and outputs that include mediating variables are at opposite ends of the causal chain. Nevertheless, in unsupervised learning, all observations are assumed to be caused by latent variables, which are presumed to be at the end of the causal chain. This approach leaves the probability of the inputs undefined. However, if the inputs are modelled, the missing inputs cause no difficulty because they can be deemed latent variables, as in unsupervised learning.

Natural Language Processing

There is a large volume of natural language text in the connected world, though having a significant content of knowledge. Still, it is becoming increasingly challenging to disseminate it by a human to discover the knowledge or wisdom in it, specifically within any given time limit. This information is usually stored in unstructured and non-standardized formats in electronic healthcare systems, which makes it difficult for the plans to understand the information contents of the narrative information. Thus, NLP techniques can capture unstructured healthcare information, analyse its grammatical structure, determine its meaning, and translate the information so that electronic healthcare systems can easily understand it. Consequently, NLP techniques reduce costs as well as improve the quality of healthcare.6

Despite considering various predictions of NLP jobs for individuals or groups of individuals, these assessments could not give the complete result. It is tough to get a precise orientation because of the differences or inconsistencies between the scientific estimates and discrepancies in the methodological evaluations.7

This paper aims to do the same for the medical community, where no code AI tool can be used for free and will help healthcare professionals save time, train/ test their juniors, and ultimately help them in saving more lives with the help of an untiring third eye which has a very high level of accuracy.

Using OrangeAI/DM tool
OrangeAI

OrangeAI is an advanced, low-code, no-code AI tool that assists healthcare professionals in detecting COVID-19 and pneumonia through chest X-ray analysis. It leverages the power of OrangeDataMining, a powerful data mining and machine learning platform, to analyse medical images and provide accurate diagnostic results. OrangeAI utilises machine learning algorithms to identify patterns and features in chest X-ray images that may indicate the presence of COVID-19 or pneumonia. Like how a human mother teaches her child to differentiate between a cat and a dog, the OrangeAI tool is trained on large datasets of labelled chest X-ray images to recognise specific features associated with these diseases. The tool then uses this knowledge to analyse new images and provide accurate diagnostic results.

Advantages of Using OrangeAI in Healthcare

One of the most significant benefits of using OrangeAI is its ability to speed up the diagnostic process. Traditional diagnostic methods, such as manual image analysis by healthcare professionals, can be time-consuming and prone to human error. OrangeAI offers a fast and efficient alternative, enabling healthcare professionals to make quicker decisions and provide timely treatment to patients. OrangeAI's machine learning algorithms have been trained on extensive datasets, allowing the tool to provide highly accurate diagnostic results. OrangeAI can help healthcare professionals make more informed decisions and provide better patient care by reducing the risk of misdiagnosis and false positives. As the COVID-19 pandemic strains healthcare systems worldwide, the need for scalable diagnostic solutions has become increasingly apparent. OrangeAI's low-code, no-code approach allows healthcare professionals to rapidly implement and scale the tool, making it an ideal solution for managing large patient volumes and reducing the burden on healthcare facilities.

OrangeAI's low-code, no-code nature makes it accessible to healthcare professionals with limited technical expertise. This user-friendly approach enables medical professionals to harness the power of AI without requiring extensive knowledge of programming or machine learning algorithms.

Applications of OrangeAI in Healthcare

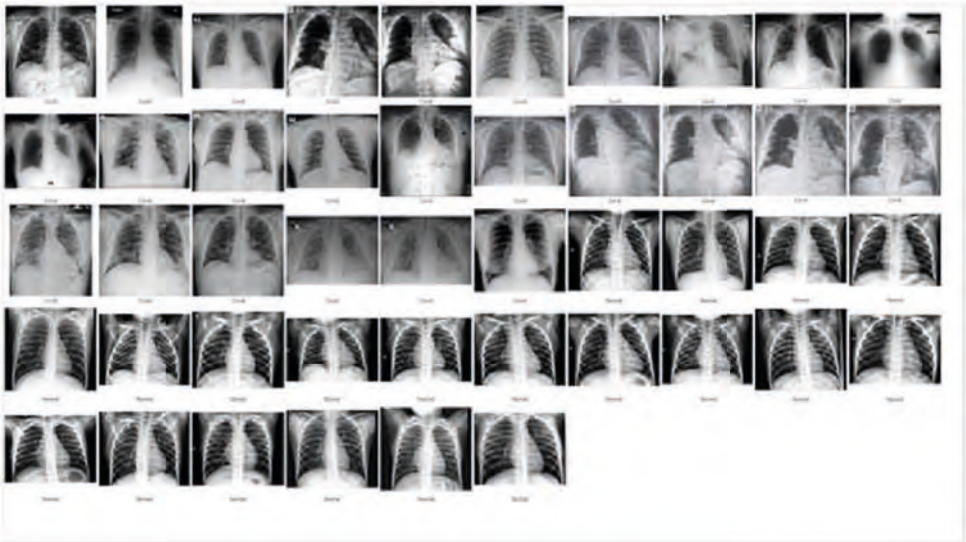
COVID-19 Detection
The ongoing COVID-19 pandemic has highlighted the need for fast, accurate, and scalable diagnostic tools. OrangeAI's ability to analyse chest X-ray images and detect the presence of COVID-19 makes it a valuable tool in the fight against the virus. Early detection and diagnosis can lead to more effective patient management and reduced transmission rates, ultimately helping to control the spread of the virus.

Pneumonia Detection
Pneumonia is a common and potentially life-threatening lung infection that requires prompt diagnosis and treatment. OrangeAI's ability to accurately identify pneumonia in chest X-ray images can significantly improve patient outcomes by enabling healthcare professionals to make timely treatment decisions.

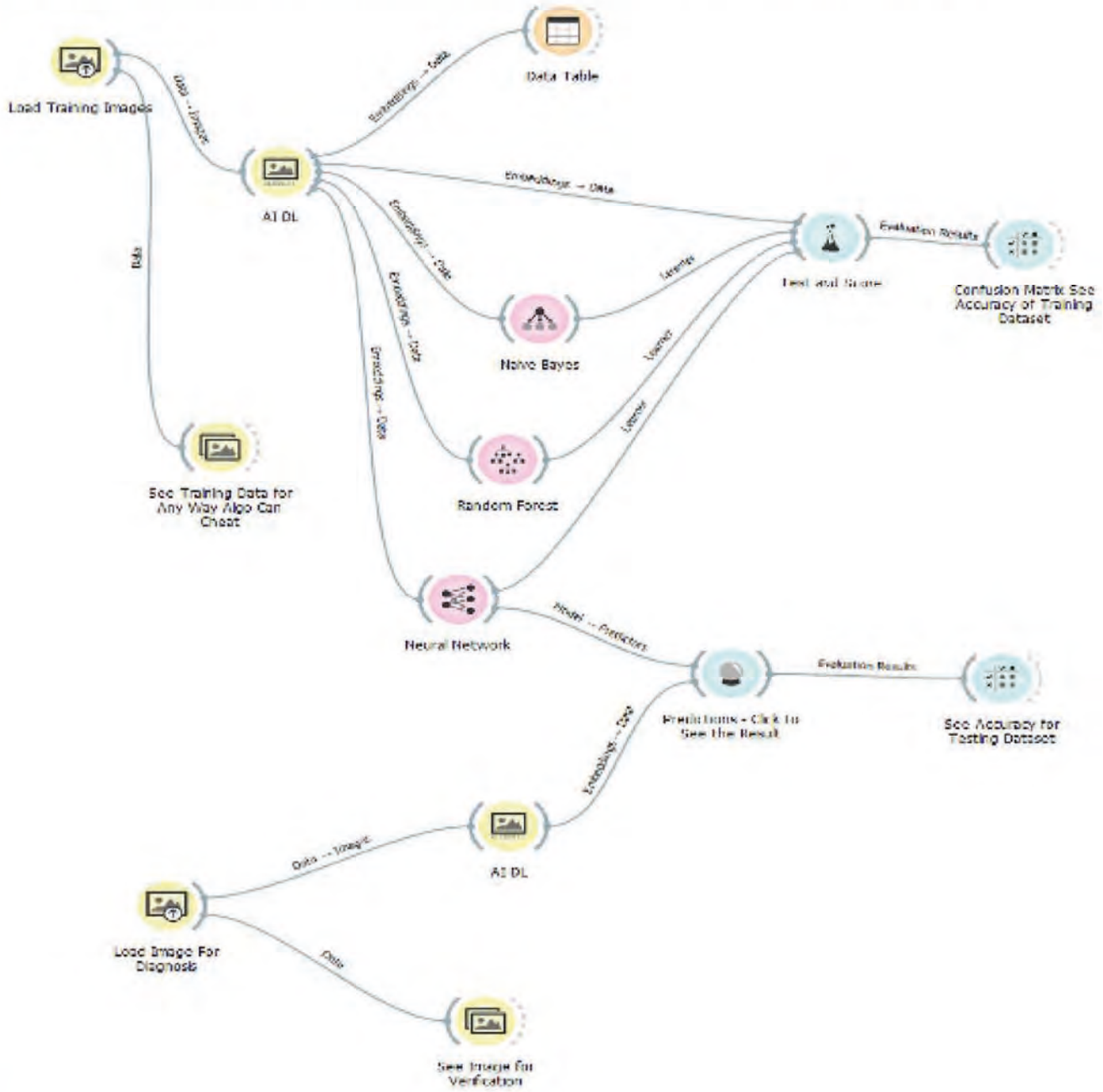
Triage and Resource Allocation
In addition to its diagnostic capabilities, OrangeAI can assist healthcare professionals in triaging patients and allocating resources more effectively. By quickly analysing chest X-ray images and providing accurate diagnostic results, the tool can help healthcare professionals prioritise patients based on their needs and ensure that resources are allocated to those who require them most urgently.

This is how a data set looks like- (Training)

This is how a dataset looks like- (Testing):



This is the AI Tool OrangeAI and what the Algorithm workflow (AI Model) looks like.



Deep Learning breaks the images into hundreds of elements and gives weight to each. The rapid evolution of artificial intelligence (AI) and machine learning (ML) technologies has revolutionised various sectors, including healthcare. One such development is the OrangeAI low code no code tool, which is helping healthcare professionals speed up the diagnostic process, particularly in detecting COVID-19 and pneumonia through chest x-ray analysis.

This article explores the potential of OrangeAI as a valuable tool for medical professionals and ciscusses its various features, benefits, and applications in the healthcare sector.

Challenges and Limitations of OrangeAI

As with any AI tool that processes sensitive medical data, data privacy and security are critical concerns when using OrangeAI. Ensuring that patient data is stored and processed securely and complies with relevant regulations is essential to maintaining patient trust and safeguarding sensitive information. Machine learning algorithms, including those used by OrangeAI, are only as accurate as the data they are trained on. The tool's diagnostic accuracy may be compromised if the training data is biased or unrepresentative. Ensuring that OrangeAI is trained on diverse and representative datasets is crucial to mitigating algorithm bias and ensuring accurate diagnostic results. Integrating OrangeAI with existing healthcare systems and workflows can be challenging, particularly in facilities with limited technical resources.

Seamless integration allows healthcare professionals to utilise the tool effectively without disrupting existing processes. Despite the promising results, several challenges and limitations are associated with using AI in medical imaging.

- Heterogeneous study methodologies: Differences in study design, patient selection, and AI model development make comparing and generalising results across studies difficult.
- Risk of bias: Inconsistencies in reporting, potential selection bias, and lack of transparency in AI methodologies may limit the validity and reliability of AI models.
- Black box problem: The complex nature of AI models can make it difficult to understand and explain the rationale behind their decisions, which could impact trust and adoption among healthcare professionals.

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Future Developments and Potential of OrangeAI

Expanding Applications & the Scope of AI in Medical Imaging.

As AI and machine learning technologies continue to evolve, the potential applications of OrangeAI in healthcare are vast. In addition to COVID-19 and pneumonia detection, the tool could be adapted to detect other diseases and conditions using medical imaging data, further enhancing its value to healthcare professionals.

As AI technology advances, it will likely play an increasingly significant role in medical imaging. Potential applications include predicting disease progression, evaluating treatment response, and identifying high-risk patients.

Improving Algorithm Accuracy

Continued research and development in machine learning algorithms will likely lead to even more accurate diagnostic results from tools like OrangeAI. As these algorithms improve, healthcare professionals can expect to benefit from increased diagnostic accuracy and better patient outcomes.

Integration with Telehealth Platforms
Integrating tools like OrangeAI with telehealth platforms could offer significant benefits as telehealth becomes increasingly popular. By providing accurate diagnostic results remotely, healthcare professionals can offer patients faster, more efficient care regardless of location.

In conclusion, OrangeAI is a robust low-code, no-code tool with significant potential for improving the speed and accuracy of the diagnostic process in healthcare. By harnessing the power of AI and machine learning, OrangeAI can help healthcare professionals detect COVID-19 and pneumonia more effectively, ultimately leading to better patient outcomes and more efficient use of healthcare resources. While challenges and limitations exist, the future of OrangeAI and similar tools in healthcare is promising, with potential applications and improvements likely to enhance their value even further.

Integrating AI into Clinical Practice
To fully realise the potential benefits of AI in medical imaging, it is essential to integrate AI models into clinical workflows seamlessly. This may involve developing user-friendly interfaces, providing adequate training and support for healthcare professionals, and establishing effective communication between AI models and human readers.

OrangeAI low code no code is crucial in helping healthcare professionals speed up the diagnostic process for detecting COVID-19 and pneumonia in chest X-rays and CT scans. By providing an accessible and efficient platform for developing AI models, OrangeAI enables healthcare professionals to harness the power of AI for improved patient care. As AI technology advances, it is vital to address the challenges and limitations associated with its use in medical imaging to ensure its safe and effective integration into clinical practice.

Prospects of AI in Medical Imaging – Future Directions?

Expanding the Scope of AI in Medical Imaging
As AI technology advances, it will likely play an increasingly significant role in medical imaging. Potential applications include predicting disease progression, evaluating treatment response, and identifying high-risk patients. Many more diseases like cataracts, breast cancer, acne and others are places where AI can be helpful.

CONCLUSION
When we have a hospital dataset of COVID-19 Pneumonia and routine chest X-rays, we can train an AI model to understand and classify them. Here, one needs to understand what the Deep Learning algorithm is doing to find the pattern and how it understands what COVID-19 and pneumonia are, and what normal human beings will not know how exactly it is doing. There are three common AI problems.

- Lazy algorithm

The lazy algorithm is one such phenomenon where the dataset has been taken from varied sources; in artificial intelligence (AI), a lazy algorithm refers to an approach where most computation is deferred until the algorithm is required to make a prediction or provide an output. Unlike eager algorithms that pre-process and generate a model or summary of the data upfront, lazy algorithms postpone most of their computation until the last moment. This characteristic allows lazy algorithms to be more flexible and adaptable to changing data but can also lead to increased computational costs.

• Coded Bias

When the dataset contains only one species/race, coded bias in AI refers to the inherent biases and discriminatory outcomes that can emerge from developing and implementing artificial intelligence systems. While humans create AI algorithms, they can inadvertently reflect and perpetuate biases present in the data used to train them or in the design choices made during their development. This phenomenon raises significant concerns about fairness, accountability, and the potential for reinforcing societal inequalities.

One aspect of coded bias in AI is the reliance on biased datasets. AI algorithms learn from historical data, which can often contain tendencies present in society. For example, suppose historical data used to train a hiring algorithm primarily consists of resumes from male applicants. In that case, the algorithm may learn to favour male candidates, unintentionally perpetuating gender bias in hiring practices. Similarly, biases related to race, age, or other protected attributes can also be encoded into AI systems if not carefully addressed.

The impact of coded bias becomes particularly concerning when AI systems are deployed in critical domains such as criminal justice, healthcare, or lending. Biased AI algorithms can lead to unfair outcomes, perpetuating discrimination against marginalised groups. For instance, biased predictive policing algorithms may disproportionately target minority communities, leading to over-policing and unjust treatment. Biased healthcare algorithms may result in differential access to medical treatments or misdiagnosis for specific demographics.

Coded bias can also emerge from the design choices made during the development of AI systems. For example, if a facial recognition system is predominantly trained on lighter-skinned individuals, it may struggle to recognise or misidentify darker-skinned individuals, perpetuating racial bias accurately. Similarly, language processing algorithms may exhibit biases in interpreting or translating specific languages or dialects, reinforcing cultural or linguistic prejudices.

Addressing coded bias in AI requires proactive measures. One approach is to ensure diverse and inclusive representation during the development and decision-making processes. By involving individuals from different backgrounds and perspectives, biases can be more effectively identified and mitigated. Additionally, data collection practices must be critically examined to ensure that training datasets are diverse, representative, and carefully curated to minimise bias.

• Cheating algorithms

When data has been taken and used from particular sources with metadata giving away the secrets, cheating algorithms, also known as cheating detection algorithms or cheating detection systems, refer to computational methods designed to identify instances of cheating or fraudulent behaviour in various contexts. These algorithms aim to detect and prevent dishonest practices in academic, gaming, or online platforms.

In academia, cheating algorithms are used to identify instances of plagiarism, where students may submit work that is not their own or contains substantial portions of copied content without proper attribution. These algorithms compare submitted assignments or papers against a database of existing sources to detect similarities and potential instances of plagiarism.

Challenge definition

How can complex Image analytics CT scan reports be read by AI by healthcare professionals so that with no outside help and maintaining medical data privacy rules which are divergent and strict, they can still use the wonder of AI?

Limitations

A larger dataset is needed—an actual user dataset of the required community. Remove algo cheating opportunities. It is ensuring transparency and reproducibility in AI model development and evaluation. In conclusion, the utilisation of the OrangeAI tool for COVID-19 versus pneumonia prediction has the potential to save the time and effort of healthcare professionals significantly. The COVID-19 pandemic has placed an immense burden on healthcare systems worldwide, with an overwhelming number of patients requiring prompt and accurate diagnosis. Differentiating between COVID-19 and pneumonia early is crucial for effective treatment planning and resource allocation.

OrangeAI, as a powerful machine learning tool, offers a promising solution to expedite the diagnostic process and improve patient outcomes.

The findings presented in this paper demonstrate that the OrangeAI tool exhibits a high level of accuracy and efficiency in distinguishing between COVID-19 and pneumonia cases. By training the model on a large dataset of clinical data and imaging studies, OrangeAI can recognise patterns and features that might not be immediately apparent to human observers. This enables it to provide reliable predictions and support healthcare professionals in making informed decisions.

One of the critical advantages of OrangeAI is its ability to rapidly analyse large volumes of data, allowing for quick and efficient processing. In the context of COVID-19, where time is of the essence, this tool can significantly reduce the workload on healthcare professionals. By automating the initial screening and triage process, OrangeAI can swiftly identify urgent cases, streamlining the workflow and ensuring that critical patients receive immediate care.
Moreover, OrangeAI can be seamlessly integrated into existing healthcare systems, making it accessible to many medical professionals. Its user-friendly interface and intuitive design enable healthcare practitioners to interact with the tool and interpret the predictions easily. This eliminates the need for extensive training or expertise in machine learning, making it a practical solution for healthcare facilities of varying sizes and resource availability.

The implementation of OrangeAI as a diagnostic aid has the potential to enhance resource allocation within healthcare systems. By accurately identifying COVID-19 cases, healthcare professionals can proactively allocate the necessary resources, such as isolation facilities, ventilators, and personal protective equipment (PPE). This optimisation of resources improves patient care and reduces the strain on healthcare infrastructure during times of crisis.

While OrangeAI shows great promise, it is essential to acknowledge its limitations. The tool heavily relies on the quality and representativeness of the training data. Therefore, continuous updates and refinements to the dataset are crucial to maintaining its accuracy in an ever-evolving healthcare landscape. Additionally, OrangeAI should be viewed as a diagnostic aid rather than a substitute for clinical judgment. The predictions provided by the tool should always be interpreted in conjunction with other clinical information and expertise.

In conclusion, implementing the OrangeAI tool for COVID-19 versus pneumonia prediction offers a valuable solution to expedite the diagnostic process and save time for healthcare professionals. By leveraging the power of machine learning and data analysis, OrangeAI can accurately differentiate between these two conditions, allowing for prompt decision-making and resource allocation. However, ongoing research and development efforts are necessary to enhance the tool's performance and ensure its integration within existing healthcare systems. With the potential to revolutionise the diagnostic process, OrangeAI represents a significant advancement in the fight against COVID-19 and pneumonia.

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Resources:
There are many datasets of Covid19 & normal and pneumonia on medical data-sharing websites, hospitals, and GitHub forums. The best ones are in GitHub. They adhere to the norms of keeping the training set diverse and from the same X-ray centres.

- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8594127/
- https://imgcreator.zmo.ai/ai-generator
- Joseph Paul Cohen PhD, Director Institute of Reproducible Research, AWS Heath AI, Covid dataset, GitHub, Butterfly Networks
- The RadImageNet Database
- COVID-19 Data Repository by the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University: This repository provides comprehensive global data on COVID-19 cases, including confirmed, recovered, and deceased cases. (Website: https://github.com/CSSEGISandData/COVID-19)
- Kaggle COVID-19 Open Research Dataset (CORD-19): Kaggle, a popular data science community, provides a dataset that comprises thousands of scholarly articles related to COVID-19, SARS-CoV-2, and related coronaviruses. (Website: https://www.kaggle.com/allen-institute-for-ai/CORD-19-research-challenge)
- COVID-19 Image Data Collection: This dataset contains chest X-ray and CT images of COVID-19 cases, pneumonia cases, and normal cases. It can be useful for developing machine learning models for image-based diagnosis. (Website: https://github.com/ieee8023/covid-chestxray-dataset)
- Open COVID-19 Dataset by Google Cloud: This dataset includes various COVID-19-related data, such as cases, deaths, and testing, from multiple sources worldwide. (https://console.cloud.google.com/marketplace/product/bigquery-public-datasets/covid19-dataset-list)
- COVID-19 Data from the World Health Organization (WHO): WHO provides a comprehensive dataset containing COVID-19 cases, deaths, testing, hospitalizations, and other related information from various countries. (Website: https://covid19.who.int/)
est-x-ray-image-data-sets/)
- MIMIC-CXR: This dataset consists of chest X-ray images from over 65,000 patients, including pneumonia, normal cases, and other conditions. It is available through PhysioNet, a research resource supported by the National Institutes of Health (NIH). (https://physionet.org/content/mimic-cxr/)
- COVID-19 Data Hub: The COVID-19 Data Hub offers various COVID-19-related datasets from various sources, including global cases, vaccination data, and more. (Website: https://covid19datahub.io/)
- Radiological Society of North America (RSNA) COVID-19 Imaging Data Repository: RSNA provides a dataset of chest X-ray and CT images of COVID-19 cases, pneumonia cases, and normal cases. It is intended to facilitate the development of AI models for diagnosing COVID-19. (Website: https://www.rsna.org/COVID-19/COVID-19-Imaging-Data-Repository)
- UCI Machine Learning Repository: The UCI repository hosts various datasets related to health and medical domains, including pneumonia and respiratory-related data that can be used for analysis and model development. (https://archive.ics.uci.edu/ml/index.php)
- COVID-19 Data Lake: The COVID-19 Data Lake is a comprehensive collection of datasets related to COVID-19, including cases, vaccination data, mobility data, and more. It provides a centralized repository for accessing various COVID-19 datasets. (Website: https://covid19datalake.org/)
- IH Chest X-ray Dataset: This dataset contains chest X-ray images, including cases of pneumonia, from the National Institutes of Health (NIH) Clinical Center. It is a widely used dataset for pneumonia classification tasks. (Website: https://nihcc.app.box.com/v/ChestXray-NIHCC)
- ChestX-ray8: The ChestX-ray8 dataset consists of 108,948 frontal-view chest X-ray images from 32,717 patients, including cases of pneumonia. It can be used for various medical imaging tasks, including pneumonia detection. (Website: https://www.kaggle.com/nih-chest-xrays/data)
- RSNA Pneumonia Detection Challenge: This dataset is part of a Kaggle challenge and contains chest X-ray images labeled for pneumonia detection. It includes both bacterial and viral pneumonia cases. (Website: https://www.kaggle.com/c/rsna-pneumonia-detection-challenge/data)
- MIMIC-CXR: As mentioned earlier, this dataset from PhysioNet includes chest X-ray images from over 65,000 patients, including cases of pneumonia, normal cases, and other conditions. (Website: https://physionet.org/content/mimic-cxr/)
- Montgomery County X-ray Set: This dataset consists of chest X-ray images collected from the Department of Radiology, Montgomery County, USA. It contains 138 images, including cases of normal and tuberculosis pneumonia. (Website: https://ceb.nlm.nih.gov/repositories/montgomery-county-xray-set/)
- Shenzhen Hospital Dataset: This dataset includes chest X-ray images obtained from the Shenzhen Hospital in China. It comprises 662 images, with 326 images labeled as pneumonia and 336 as normal. (Website: https://ceb.nlm.nih.gov/repositories/tuberculosis-chest-x-ray-image-data-sets/)
- Chest Radiograph Dataset of Pneumonia: This dataset contains 5,856 chest radiographs, including cases of pneumonia, collected from various sources. It is commonly used for training and evaluating pneumonia detection models. (Website: https://www.kaggle.com/paultimothymooney/chest-xray-pneumonia)
- Mendeley Pneumonia Dataset: This dataset provides chest X-ray images of pneumonia cases obtained from Mendeley Data. It comprises 3,500 images, including bacterial, viral, and COVID-19 pneumonia cases. (Website: https://data.mendeley.com/datasets/rscbjbr9sj/2)

- Chest Radiograph Dataset of Pneumonia: This dataset contains 5,856 chest radiographs, including cases of pneumonia, collected from various sources. It is commonly used for training and evaluating pneumonia detection models. (Website: https://www.kaggle.com/paultimothymooney/chest-xray-pneumonia)
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- Guangzhou Women and Children's Medical Center Dataset: This dataset contains chest X-ray images of pediatric pneumonia cases collected from the Guangzhou Women and Children's Medical Center in China. (Website: https://github.com/ieee8023/covid-chestxray-dataset)
- Stanford CheXpert: The CheXpert dataset includes chest radiographs labeled for various pathologies, including pneumonia. It consists of over 200,000 images from more than 65,000 patients. (Website: https://stanfordmlgroup.github.io/competitions/chexpert/)
- RSNA Pneumonia Detection Challenge Stage 2: This dataset is an extension of the RSNA Pneumonia Detection Challenge dataset, containing additional chest X-ray images labeled for pneumonia. It was used for the second stage of the challenge. (Website: https://www.kaggle.com/c/rsna-pneumonia-detection-challenge/data)
- Pneumonia Detection on Chest X-rays Dataset: This dataset, available on Kaggle, contains chest X-ray images labelled for pneumonia. It includes images from pediatric patients,

BAPIO PUBLICATIONS

CREATING A PLATFORM FOR OPPORTUNITIES & DIVERSITY IN PUBLISHING

THE PHYSICIAN * SUSHRUTA * HARMONY

Frugal Surgical Innovations are the Need of the Hour

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Background

Dictionaries define innovation as "a new idea, device, or method; or the act or process of introducing new ideas, devices, or methods." However, Surgical Innovation (SI) is more difficult to define. Familiar narratives include why-where-how-what-who, novelty, degree of change, safety, ethical standards, level of impact, and peer acceptance. [1, 2] We have proposed a simpler, more egalitarian and 'inclusive' definition: "a SI is 'any' new surgical idea which improves patient welfare by solving an existing problem; and which like a three-legged stool is balanced by the three legs which represent surgical-precision, surgical-wisdom and patient-safety". [3]

Frugal Surgical Innovations (FSIs) are low-cost surgical innovations designed for economic reasons. These are all about 'doing more and better with less for more people'. [4] FSIs make up for their lack of sophistication or complexity in affordability without scrimping on safety or effectiveness.

The three constructs of FSIs are affordability, adaptability and accessibility. [5] The philosophy of FSIs originates from grassroots, resource-constrained settings (RCS), where the most abundant of all-natural resources — human ingenuity — is used to optimize limited resources to solve problems. [6] Clinically meaningful inclusive research can be performed 'only' by surgeons working in RCS, as 'only' they understand the difficulties and nuances of various problems and can provide simple, affordable solutions for their patients. [7]

Characteristics of FSIs can be easily remembered by a simple mnemonic – 'CHANGES'; as seen in Table 1.

The key to FSIs in RCSs lies in: 'simplifying the idea/ technique/ device' to find patients' needs-driven low-cost innovative surgical solutions which can be used on a broader scale to achieve health equity for underserved populations. This has shaped our motto of: 'modify-simplify-apply'. Using a 'global' philosophy, i.e. global wisdom tailored to local technology and resources, ensures incorporating the best of both worlds in any FSI. It involves wisely choosing the need-based appropriate technology which is locally available, affordable (cost-effective), easy to maintain at the local level, 'transparent' (understood by locals) and if created new, involves the locals in its 'co-creation' (skills transfer).

Successful FSIs bring many advantages to them. These include: attaining global health equity; allowing capacity building in grass-root surgeons; improving indigenous research capacity; increasing the global knowledge base; minimizing the health expenditure; minimizing the dependence on international support/ collaboration; the potential to reduce the 'brain drain' and encouraging reverse brain drain; positively affecting the researchers' career and success stories can result in increased institutional support for basic and clinical science research. [7]

SI, per se, is a complex process that gets further complicated in the case of an FSI, as it is an unconventional solution. As reporting of innovation differs materially from the reporting of research, many FSIs lacking a structured template are frequently published as informal communications, thus ending up under the radar. This prevents their proper evaluation and recognition by reviewers, editors and readers. This has prompted us to propose guidelines for scientifically unambiguous, unequivocal and transparent 'structured' reporting of SFIs. [8] It includes a 30-point checklist encompassing the whole process of SFI, from ideation to development, to its possible usage and diffusion.

IDEAL (Idea, Development, Exploration, Assessment and Long-term monitoring) framework based on a five-stage description of a new surgical idea's development process ensures rigorous and scientific evaluation so that the introduction and adoption of SIs, including FSIs, are governed by evidence-based principles. [9] However, compliance with this framework is far from consistent, and it requires more support from the surgical practice leaders and editors of journals. [10, 11]

Ethical principles demand the right balance between encouraging creativity and innovation while maintaining ethical awareness and patient responsibility. [12] This can be done by making patients a partner in the transparent process of FSIs for their informed consent. [13] The adage "if the passionate (evangelists) do the surgery, then the dispassionate (sceptics) have to evaluate the ethics" holds, and Institutional Ethical Review Boards have to set the bar very high. The four core principles of modern bioethics: autonomy, beneficence, non-maleficence and justice are available to guide such decisions.

Unfortunately, many FSIs face challenges with their dissemination and wider adoption; and their benefits are often confined to few 'pockets of excellence' or 'improvement islands' even after their successful publication in peer-reviewed journals. [14, 15] This confirms the old adage, ' In health care, innovation is hard, but dissemination is even harder'. [16] In RCSs, where the disparities in surgical care are immense, the opportunities are correspondingly abundant, and their widespread adoption can multiply their benefits. [17]

Table 1 Characteristics of FSIs [3]

	Criteria	What does it imply
C	Contemporary	It should sync with present-day scientific practices
H	Handy	It should be easy and affordable to use
A	Accessible	It should be freely usable/ scalable across RCSs
N	Novel	It should be a new and better alternative to an existing solution
G	Geographical	It should sync with geographical factors and their solutions
E	Estimable	It should be adequately measurable and validated by peers*
S	Safe	It should be safe and ethical

*Peer reviewed and published

FSIs provide low-cost, affordable, local-evidence-based customized solutions for their patients; they deserve better than being unsung-unrecognized ideas after clearing the rigorous peer review and publication process. The innovator's job is not complete with its publication, but they have to take another step of its effective dissemination to ensure its widespread adoption. As there is no such framework, we developed a conceptual framework, 'DISSEMINATE', for their effective and structured dissemination and adoption by the end-users in RCSs. [18]

FSIs are the need of the hour for the progress of the rapidly developing field of Global surgery, which aims to provide equitable surgical care to underserved populations of low- and middle-income countries. [19, 20] Surgical ecosystems worldwide have finally started recognizing FSIs and are successfully promoting this culture of finding 'simple', 'scientifically proven', 'ethical', 'safe' and 'better' solutions for their patients' needs. [21] FSIs can assist in providing equitable health for all, which is the unfinished agenda of democracy. In a true sense, FSIs represent philanthropic altruism performed with a Scalpel; and sync with the philosophy of Noblesse oblige, which is the obligation of those with a unique talent to be helpful and generous towards the underprivileged. [3]

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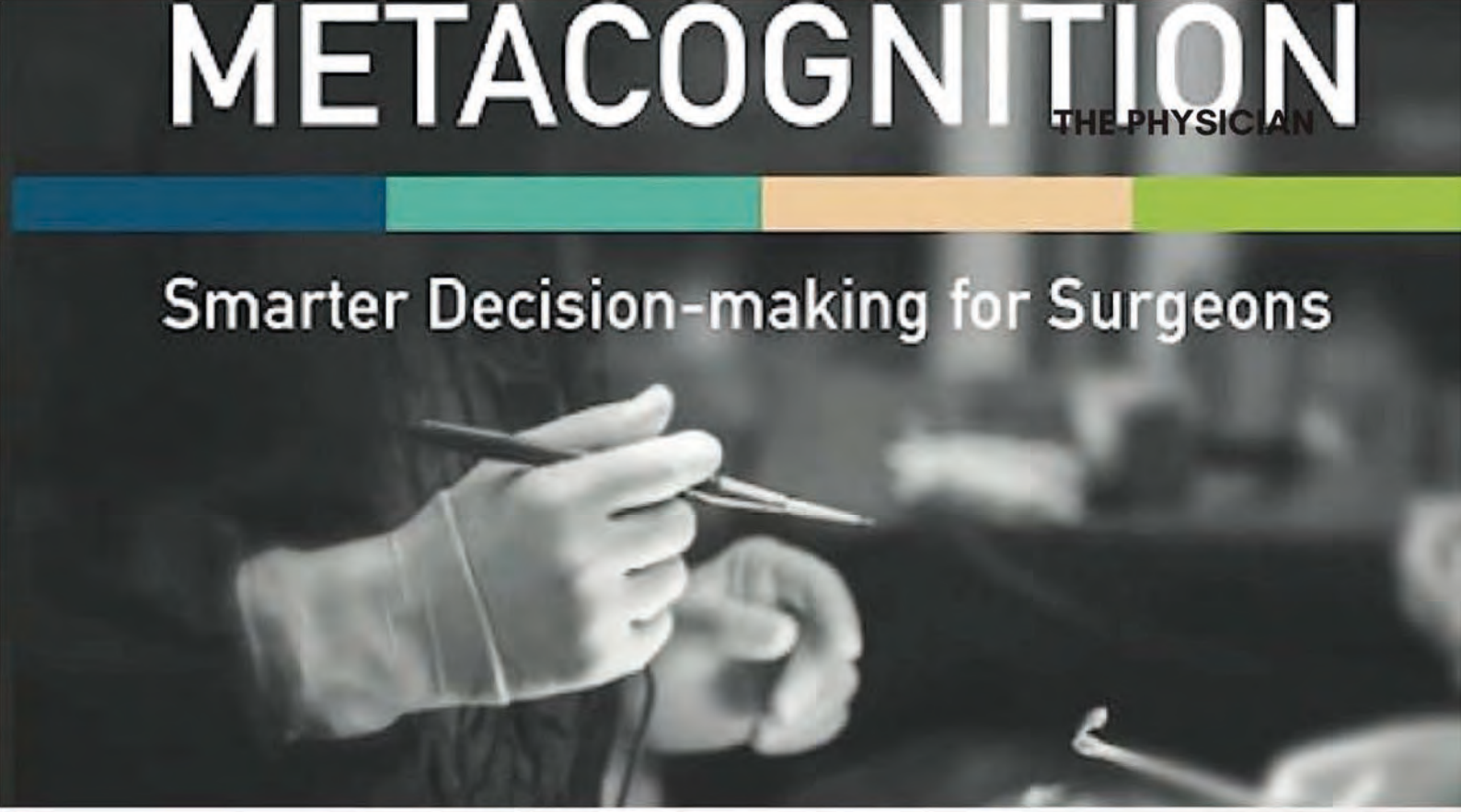
METACOGNITION
THE PHYSICIAN



Metacognition for Every Clinician

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Just prior to his retirement, the neurosurgeon Henry Marsh decided to look back on the forty years of his career, considering whether his mistakes had been negligent carelessness or acceptable 'errors of clinical judgement':

To my distress .... I could not deny that many of the mistakes I was remembering fell into the first category – I had been careless. They were also the mistakes I found most difficult to remember and I suspect that some of my worst mistakes remain buried in my subconscious or have been completely erased. It was also striking that the great majority of the mistakes had been mistakes in decision-making..... And yet, like most doctors, I like to think that I am a good doctor. 1

Although his career is over, and he will no longer benefit professionally from his reflections, he offers lessons for those of us who can. These few lines give many lessons. Despite his international acclaim as a neurosurgeon, Mr Marsh admits to committing severe errors in his career. And he is candid about having been in denial about these mistakes for a long time.

There are lessons one can learn from his reflections.

- The tendency to deny limitations and problems in decision-making, thinking, 'I am a good doctor'.
- That one doesn't need to wait until retirement to take remedial measures.
- To understand a type of thinking called metacognition is the ability to understand and reflect on decisions and your underlying thinking processes. Using these skills, Mr Marsh dove deep into his memory, brought forgotten cases to his consciousness, and analysed his core thinking. This isn't the mere recollection of what happened; it is an essential attribute of a good decision-maker: exploring thoughts. This is metacognition in action.

Anyone desiring to be an expert should proactively develop metacognitive skills, as these are seen almost universally among experts across various fields.

Unfortunately, compared to other medical specialities, the stereotypical image of a surgeon is of an actor rather than a thinker. There are two reasons this is unfortunate. It is a misperception, and sadly, although some surgeons tend to buy into it, this perception is inaccurate as surgeons don't think any less than other clinicians. It could be said that due to the gravity of many of their decisions, surgeons think more than most clinicians. They may seem to think less because they are not necessarily analytical or verbalised. Although a significant amount of surgical thinking is non-analytical and non-verbal and is instead visual, tactile, or kinaesthetic, it is still 'thinking.' However, although it is not true that surgeons use less cognition, they may tend to use less metacognition.

Therefore, we come across surgeons who need help to improve their decision-making. It is not because they cannot or do not want to improve but instead because they are less able to appreciate the differences between their thinking and that of those who perform better. Fortunately, it is now well established that metacognition can be taught and learned, allowing a great potential to improve our decision-making abilities. 2

What is metacognition?

Metacognition is the process of 'thinking about thinking.' It involves understanding how you think and how you regulate the way that you think. The regulation of thinking is done by monitoring and evaluating the thought process and planning of thoughts (figure 1). 3 Thus, metacognition is a person's ability to manage their thinking. Although the word may be new to the reader, metacognitive actions are everyday.

Please take a look at the following two questions.

• When was the last time one failed to recall someone's name but was sure you knew it? These frustrating 'tip-of-the-tongue' events are daily and may increase as we age. They are metacognitive because you think, "I am sure I know the person's name", about the cognitive action of memory, of remembering a name.

Figure 1 The roles of cognition and metacognition.

·How often does one use a shopping list or see others do so? Lists indicate an awareness that we are at risk of forgetting, so we use an external aid.

Understanding the limits of one's memory is a form of metacognition because it is based on your awareness of your memory and the limitations of your thinking. These examples also make it clear that metacognition is not a single concept but multifaceted. An analogy from management is that cognition is like a clerk whose role is to process and action the manager's decisions, whose metacognitive role is to oversee and supervise the clerk's activities. Just as a manager is supposed to keep an eye on the clerk's performance and take managerial decisions, metacognition regulates thinking and the planning of decisions. Clinical metacognition includes checking clinical reasoning for possible errors and assessing what one needs to know about a treatment option. 4 Surgeons are expected to be self-directed learners throughout their careers, and metacognitive skills are critical in addressing what, when, and how to learn—cognition and metacognition overlap (figure 2).

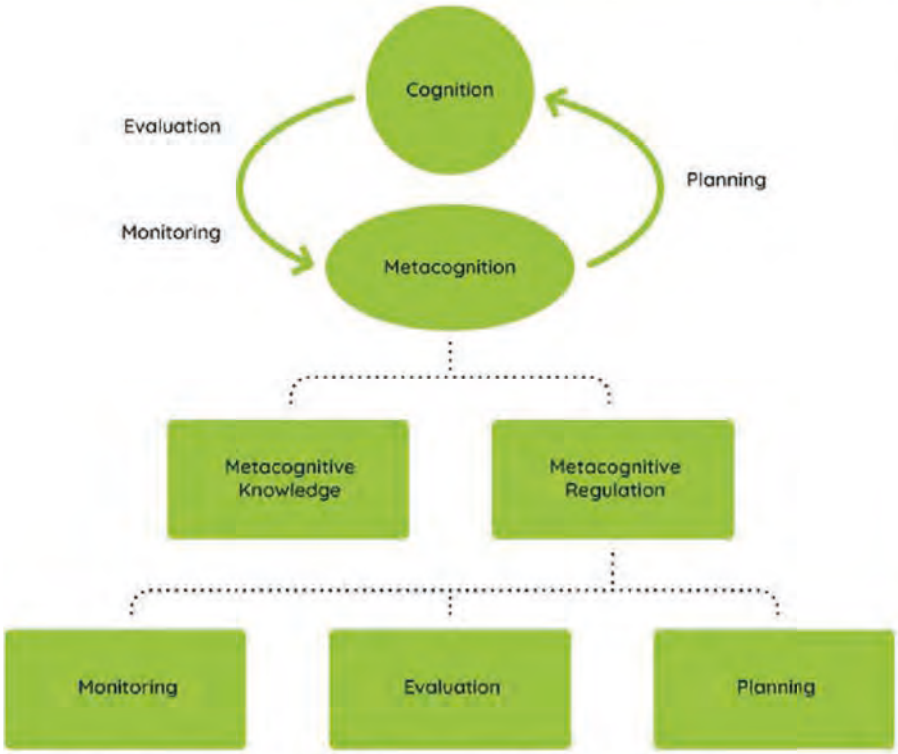

Figure 1 The roles of cognition and metacognition.

Just as a manager may need to get involved in processing and actioning a decision, especially when the clerk is not around, on the other hand, a clerk may have to make managerial decisions. A clinical example of the difference in their roles is shown when performing a diagnostic procedure or an investigation. Cognition is knowledge of the technique and test results. Metacognition is the capacity to review the result, determine if it is clinically consistent, and repeat the test if required or plan the next step. An example of different facets of metacognition used in studying includes recognising one's weaknesses in a topic, using mnemonics as memory aids and following up on your weak points by focusing study on them or reaching out to colleagues for help. These are all aspects of metacognition: metacognitive knowledge, monitoring and control, respectively.

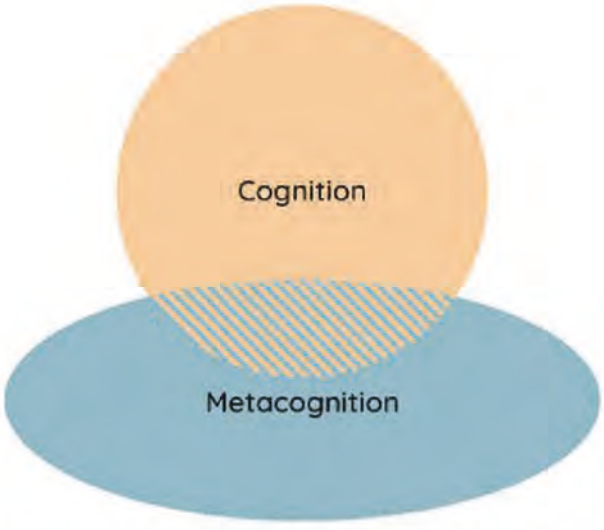

Figure 2 The overlap of cognition and metacognition.

Metacognitive abilities exist on a spectrum, from someone unaware of their thinking process to disorganised awareness, organised thinking that can be verbalised, and finally, the reflective learner who can quickly adapt their thinking as the situation requires. Metacognition is necessary for lifelong learning and is essential in developing professionalism. 5 An exciting difference between cognition and metacognition is that, while cognitive abilities decline at varying rates after a certain age, 6 metacognitive capabilities remain. 7 Thus, senior surgeons with changing cognitive abilities would be expected to maintain and use metacognitive abilities to improve their performance in practice.

Lack of insight and metacognition

Some clinicians could improve at self-assessment and be more confident in their ability levels. Distractions, fatigue or competing interests may also limit their ability. Such a combination is often compounded by a lack of awareness (or acceptance) of a problem. In short, they need insight. They don't know that they don't know; they are ignorant of their ignorance, making their decision-making error-prone. Sometimes the inability of a clinician to learn how to make clinical decisions is not because they cannot learn but because they are less able to appreciate the differences between their performance and that of others. Fortunately, there is good evidence that increasing metacognitive capacity, their ability to understand and reflect on both the context of decision-making and the underlying thinking processes they employ can improve their overall performance. 8

Improving metacognition

To achieve unconscious competence, you must go to the next stage: knowing what you don't know. The fact is that most clinicians are not familiar with metacognition and may not be aware of how complex, overarching, and crucial surgical decision-making is.

Even if they know the complexity, most need to know how we process complex decisions. As a profession, we have yet to try to understand how clinicians make thoroughly or should make difficult decisions, why they sometimes go wrong and how experts sometimes make brilliant decisions. Moreover, the efforts that the profession has so far taken to optimise decision-making have yet to yield results. Despite this, some clinicians may still question the value of metacognition and improving decision-making. Clinicians make hundreds of decisions daily; it is a continual and deep-rooted aspect of the profession. Most are automatic, and the vast majority do not result in problems. And even when there are problems, various factors other than the clinician's thinking are usually held responsible. So, there are strong reasons why the decision-making process is not examined more closely, just as we don't pay much attention to other 'automatic' functions like breathing.

However, there is stark evidence that we do indeed need to improve both our individual and collective clinical decision-making:

- Clinical error is one of the leading causes of death in the developed world. 9
- Clinical decision-making can be considered a significant threat to patient safety. 10
- More than 30% of healthcare costs are wasted on inappropriate care, and suboptimal care is increasingly connected to the quality of clinical decisions. Approximately 80% of healthcare expenditure results from clinicians' decisions. Therefore, improving healthcare necessitates improving clinical decisions. 11
- Analysis of clinical decisions has revealed that many errors occur because of inappropriate thinking. 12
- Adverse events are linked to failures in cognitive skills such as situational awareness and decision-making. 13
- Following guidelines for interventions have been shown to improve patient outcomes and reduce costs, but the degree of guideline implementation is variable. For example, with hernia repair, it is as low as 32% and an average of 65% of procedures. 14

These studies make it clear that there is significant room for improvement in decision-making.

Medical training and professional development

Those responsible for training often need to be made aware of recent developments in decision-making and how best to improve it. In the last few years, training has moved from immersion learning to more formal, structured programs. Work schedules are regulated with a resulting reduction in clinical exposure. This loss of decision-making experience needs to be compensated by alternative methods. Also, reduced working hours mean trainees and trainers more frequently miss seeing the consequences of their decisions. These factors make the need to teach decision-making even more important actively.

Despite their career-spanning importance, decision-making skills should be addressed mainly in professional development, often only covered ad hoc and unstructured. Although clinicians are assumed to have learnt metacognitive skills throughout their careers and how to learn via self-directed learning, there is ample evidence that this may not be the case. 15 Studies also show that metacognitive skills vary among clinicians; unfortunately, some find it challenging to improve their skills. 16 Undoubtedly, there have been efforts to address the issue.

Articles and books have been written on this subject. In the epilogue of one of those books, Surgical Decision-making: Beyond the Evidence-Based Surgery by Rifat Latifi, the author writes:
If you thought that by the end of the book, you would understand entirely how surgeons make decisions, I'm afraid you may not be delighted. While we have explained several aspects of this complex issue, much remains to be discovered, and further work is required. This work should be done by surgeons in collaboration with those trained to understand the mind, how the brain works and how the brain can be directed or trained. 17

In a sense, what the author raises only at the end of his book – psychological factors – are the focus of this article: what can "those trained to understand the mind, how the brain works and how the brain can be directed or trained," tell us about clinician's decision-making? The lateness of our profession to acknowledge the importance of psychological factors parallels aviation safety history, where 'human factors' were only identified as crucial contributors to aviation accidents after decades of focusing predominantly on technological improvements. But once they were recognised as a key cause of accidents, aviation safety improved significantly by implementing training and protocols that addressed human factors, such as checklists. 19

Although we urgently need a similar 'human factor' revolution in understanding and reducing clinical error, we also require solutions that address 'intra-human' factors, i.e., cognitive factors. As the author suggests, to optimise decisions, we need to understand what and how clinicians think while decisions are made. Other professions have made significantly more headway in this direction, including marketing and the financial sector, and a new discipline of 'decision science' has developed.

Decision Science
How decision-making works using a multidisciplinary approach incorporating information technology, mathematics, economics, and psychology (figure 3). It has provided new evidence for how decisions are made and how they can be improved, and it has demonstrated that decision-making is a skill that can and needs to be honed. Much of this new understanding directly applies to surgical decision-making, with exciting potential for improving surgical performance.

Popular metacognition

If one is overconfident or thinks we have more reliable information than we do, we run the risk of not changing our minds when we should make the right decision. 19 On the other hand, if we are underconfident, we may remain indecisive even when the way forward is clear. More generally, poor metacognition can leave us stuck with decisions we should have reversed or discarded long ago. Indeed, studies have demonstrated a direct link between metacognition and more careful, considered decision-making. 20

Expert metacognition

It is not a chance observation that experts exhibit better metacognitive skills than non-experts. What we don't know so far is if having metacognitive skills makes someone an expert or if one gains such skills after becoming an expert; a 'chicken or egg' conundrum! Regardless, although some may have this ability naturally, most people need to nurture it to become an expert. By consciously understanding and improving our professional metacognitive skills, as all experts do, we can identify our strengths and limitations precisely and find the most appropriate information and method needed to become an expert, thereby reducing the stress and time involved in achieving expertise. Moreover, metacognitive skills help to maintain expertise. Indeed, some experts opine that maintaining expertise is more complex than achieving it, as you are expected to handle more complex cases as your reputation and the stakes increase.

Metacognition is also suitable for you, not just your patients!

So far, we have discussed the need for metacognition in decision-making regarding patient outcomes. But another aspect is even more critical and underrecognized: the relationship between metacognition and a clinician's well-being. Over a decade of working professionally with the mental well-being of surgeons and other specialists, I have seen severe consequences of poor metacognitive skills on a doctor's health. Patients have lost their lives because of suboptimal metacognition, and doctors have also lost their own lives. These occurrences are rare, but the stress around making decisions is undoubtedly commonplace, the stress of dealing with the consequences of decisions. The increased professional stress and burnout among doctors can be partly attributed to difficulties in decision-making and suboptimal metacognitive skills. It is not all a dark picture, of course. The satisfaction, relief, and pride, one experiences after making a challenging but successful decision, is a joy that is difficult to describe, and one can only understand by experiencing it.

IAgain, metacognition plays a role in both negative and positive situations.

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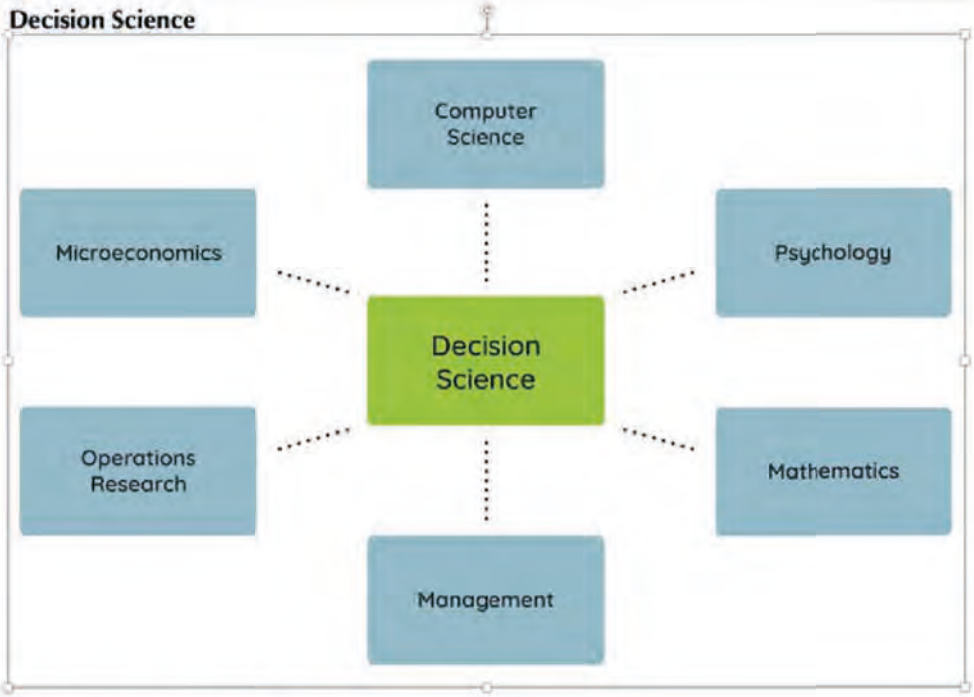

Fig 3-Contributing faculties of decision science.

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Understanding Polycystic Ovary Syndrome

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Abstract

Polycystic ovary syndrome (PCOS) is the commonest metabolic and endocrine disorder that affects women of reproductive age. It is characterised by irregular menstruation, hyperandrogenism and polycystic ovarian morphology.

While significant progress has been made in understanding PCOS, several research questions remain. For instance, there is a need for further investigation into the aetiology of PCOS, including the role of genetic and environmental factors, to aid in earlier diagnosis and treatment. Additionally, while some therapies have been effective in managing the symptoms of PCOS, their long-term efficacy and safety still need to be determined. There is a need to understand better the long-term health consequences of PCOS, particularly cardiovascular disease and cancer risk.

Early diagnosis, lifestyle modifications, and appropriate medical interventions can help to reduce the risk of complications and improve the overall health outcomes of women with PCOS. Looking forward, there is a need for a multidisciplinary approach to studying PCOS, including collaborations between researchers, healthcare providers, and patient advocacy groups. This may involve developing new tools and technologies for diagnosis and treatment and exploring novel interventions and therapies.

There is a growing recognition of the importance of PCOS as a significant health issue affecting millions of women worldwide, and continued research efforts will be critical for improving diagnosis, treatment, and long-term outcomes for those affected by the condition.

Introduction

Polycystic ovary syndrome (PCOS) is a common metabolic and endocrine disorder that affects women of reproductive age. It is characterised by irregular menstruation, hyperandrogenism and polycystic ovarian morphology1. PCOS is prevalent, affecting approximately 5-20% of women, depending on the definition used2. It is the most common endocrine disorder in females of reproductive age.

The syndrome is a significant cause of menstrual abnormalities, hirsutism, and female anovulatory infertility3. In addition, PCOS is associated with various health conditions, including insulin resistance, metabolic syndrome, increased risk of cardiovascular disease, pregnancy-related complications, and psychological problems4. Although PCOS has no cure, management typically involves lifestyle changes, medications, and on occasion, surgical interventions tailored to an individual's symptoms, age and fertility goals to reduce symptom burden and risk factors.

Despite ongoing research, there remain significant challenges in diagnosing and managing PCOS. The pathophysiology of PCOS is complex and needs to be fully understood, leading to more consensus and awareness regarding diagnosis and treatment5. Women with PCOS often report delays in diagnosis6 and dissatisfaction with treatment options7. This paper presents a comprehensive overview of the current state of progress in PCOS, highlighting the challenges faced in its diagnosis and management and identifying potential future directions for research.

Diagnostic criteria

The diagnostic criteria for PCOS have long been controversial and discussed. Currently, there is no single diagnostic test available for PCOS. Instead, the diagnosis is based on the presence of three main characteristics: irregular menstruation (oligomenorrhoea), hyperandrogenism (either clinical or biochemical), and polycystic ovarian morphology (PCOM) observed on ultrasound8. These three factors are collectively referred to as the Rotterdam criteria, and the presence of two out of three is required to diagnose PCOS, excluding other diseases such as thyroid disease, Cushing's syndrome and androgen-secreting tumours 9. PCOS is classified into four subtypes based on the presence or absence of the three critical diagnostic criteria, and different subtypes may have an increased risk of specific complications, such as metabolic dysfunction8,10. Biochemical hyperandrogenism is characterised by increased serum total and free testosterone and androstenedione and increased free androgen index (FAI).

Rotterdam Criteria for diagnosis of PCOS

- irregular menstruation (oligomenorrhoea),
- hyperandrogenism (either clinical or biochemical), and
- polycystic ovarian morphology (PCOM) observed on ultrasound

Variations in diagnostic features based on age and ethnicity present further challenges for diagnosis. Normal physiological changes during puberty, such as irregular menstrual cycles and multi-follicular ovaries, can mimic PCOS symptoms, leading to an increased risk of both underdiagnosis and overdiagnosis of the syndrome6,8. Hyperandrogenism can be defined either biochemically or clinically. However, when evaluating the clinical features of androgen excess, such as hirsutism, acne, or alopecia, significant variations may arise depending on the patient's ethnicity, and examination may be limited by self-treatment of hirsutism. Ultrasound morphology also poses a challenge for diagnosing PCOS due to variations in follicle count cut-offs and advancements and availability of technology8.

Aetiology

The pathophysiology and aetiology of PCOS involve a complex interplay of genetic and environmental factors that disrupt the functioning of the hypothalamus-pituitary-ovarian axis, leading to hyperandrogenism. Insulin resistance is another major component, caused in part by the accumulation of adipose tissue resulting from hyperandrogenism and oxidative stress11. The multifactorial nature of PCOS results in a constellation of effects that include metabolic, reproductive, and psychological impairments8. In addition, there is a correlation between increased body mass index (BMI) and the prevalence of PCOS. A study conducted by Teede et al. in 2013 showed that the prevalence of PCOS in women with BMI <25 kg/m2 was 4.3%, compared to 14% in women with BMI >30 kg/m212.

Recent research has identified several genes implicated in the aetiology of PCOS, making it a polygenic and multifactorial syndrome. Genome-wide association studies have identified 19 risk gene loci for PCOS located in the neuroendocrine, metabolic, and reproductive pathways13.

The pathophysiology of PCOS involves multiple genetic pathways, making it currently unfeasible to develop a single genetic diagnostic test. While the exact mechanisms by which variants in the genes confer risk to PCOS remain to be determined, uncovering candidate genes and cellular pathways involved in PCOS will increase understanding of the pathophysiology of PCOS and hopefully lead to more targeted management options14.

Risks associated with PCOS

PCOS is associated with various complications and health risks. For instance, it is linked to a higher risk of cardiovascular disease (CVD), type 2 diabetes mellitus (T2DM), pregnancy-related complications, psychological disorders, and endometrial cancer1. PCOS is considered a metabolic syndrome, and many of these associations are thought to be related to PCOS-induced insulin resistance.

Cardiovascular disease risk

The increased risk of CVD is thought to be due to the metabolic abnormalities associated with PCOS, such as insulin resistance, impaired glucose tolerance, obesity, and dyslipidaemia1. These metabolic abnormalities also increase the risk of developing T2DM and hypertension, risk factors for CVD. A meta-analysis conducted in 2012 showed that the risk of obesity was four times higher in women with PCOS compared to controls15. Additionally, the pattern of obesity in women with PCOS tends to fit the hyperandrogenic phenotype, with preferential abdominal fat deposition, further increasing the risk of CVD16.

Reproductive and obstetric risks

PCOS is linked to various reproductive and obstetric risks, ranging from fertility impairment to pregnancy-related complications17. The latter includes an increased risk of pre-eclampsia, gestational diabetes mellitus, pregnancy-induced hypertension, and miscarriage18. Although the mechanisms underlying these risks are not entirely understood, the increased risks are thought to be related to endocrine and metabolic dysregulation in women with PCOS, such as hyperandrogenism and elevated BMI17. Given these risks, it is essential to provide prenatal counselling for women with PCOS and enhanced antenatal care, such as regular monitoring for pregnancy-related hypertension and gestational diabetes mellitus.

Risk of malignancy

PCOS is associated with an increased risk of endometrial cancer, which may be further exacerbated by comorbidities such as obesity, infertility, and type 2 diabetes mellitus19. Perimenopausal women with PCOS have approximately four times increased risk of endometrial cancer20. However, the absolute risk of endometrial cancer remains relatively low4. The exact pathophysiology of this association is not fully understood. Still, it is thought to be related to the anovulatory cycles in women with PCOS, leading to continuous exposure of the endometrial lining to oestrogen17. Healthcare professionals must be aware of this increased risk and adopt a low threshold for investigating endometrial cancer in women with PCOS who present with risk factors such as prolonged amenorrhoea, abnormal vaginal bleeding or increased BMI. Investigations in such women include transvaginal ultrasound plus or minus endometrial biopsy. However, routine ultrasound screening for endometrial thickness in women with PCOS is not recommended4.

Psychological impact

The psychological effects of PCOS represent an important yet under-researched aspect of this condition. Living with PCOS has been shown to significantly impact mood and psychological well-being, potentially due to factors such as body image and the long-term health implications of the condition21. Evidence suggests that women with PCOS are at a higher risk of depression, anxiety, negative body image, and psychosexual dysfunction21. It is crucial to consider how these negative psychological factors may affect the patient's ability to maintain the lifestyle changes essential to managing PCOS.

Management of PCOS

Given the multifaceted nature of the syndrome, it is understandable that there is no one-size-fits-all solution. Generally, management approaches involve lifestyle modifications, medications, and in some cases, surgical interventions. Furthermore, treating co-morbidities related to PCOS, such as obesity, T2DM, and metabolic syndrome, should be managed as per recommended guidelines regardless of PCOS diagnosis8. Women with PCOS have a two-threefold higher risk of related co-morbidities than women without PCOS, with the onset occurring years earlier than other women. Thus, when investigating for co-morbidities, it is essential to consider the increased risk associated with PCOS8.

Management can focus on alleviating symptoms such as hirsutism or addressing associated risk factors such as cardiovascular disease. Management principles may also differ based on a woman's desire to conceive, as specific hormonal options may not be available due to their contraceptive nature. The most recent evidence-based international PCOS guideline, updated in 2018, sets out a range of recommendations for treating PCOS-related symptoms that are core to diagnosis, namely, irregular cycles and hirsutism4.

Lifestyle measures

Conservative management strategies for PCOS primarily involve lifestyle modifications such as diet, exercise and behavioural interventions to achieve and maintain a healthy weight. This is important, given that obesity leads to a worsening of symptom profiles for women with PCOS4. These measures can improve insulin resistance, reduce symptom burden, and improve the overall quality of life, given that hyperinsulinaemia promotes hyperandrogensim4. Physicians should recommend healthy eating and regular exercise to all patients with PCOS. A meta-analysis carried out in 2019 showed that lifestyle interventions in women with PCOS lead to an improvement in weight, free androgen index and BMI22. However, there was no specific impact on rates of live births or menstrual regularity, which are vital considerations for PCOS management.

Patient education and signposting are essential in managing PCOS, as it can help patients understand their condition and make informed decisions about their treatment options. Information should be culturally appropriate, evidence-based, and tailored to individual patients. Although lifestyle interventions are essential for managing PCOS, adherence to these measures can be challenging. Compliance with lifestyle modifications is crucial to achieving goals such as weight loss, and the effectiveness of these interventions may decrease over time if adherence is not maintained23. Given the adverse psychological effects associated with PCOS, physicians should consider the need for psychological support, such as support groups or talking therapies, such as cognitive behavioural therapy, which may be effective in women with PCOS24. A randomised trial conducted in 2015 showed that a three-pronged treatment strategy, including diet modifications, exercise and CBT improved depression and self-esteem in obese women with PCOS25.

Medications

Pharmacological management is often used as a second-line treatment for PCOS after lifestyle interventions. The medication chosen depends on various factors, including the patient's fertility goals, primary concerns, and comorbidities such as T2DM. Medical options may include oral contraceptives, insulin sensitisers, and anti-androgen medications. Combined oral contraceptives (COCs) have proven effective in treating menstrual irregularities and are superior to progestin-only preparations in managing hirsutism and acne8. However, patients must be counselled on the potential side effects and risks, such as mood disturbances and increased risk of thromboembolism.

Metformin is another medical option that improves menstrual regularity, increases insulin sensitivity, and reduces hyperandrogenism, mainly when combined with lifestyle modifications, even in women without T2DM26.

However, patients should know the potential gastrointestinal side effects impacting compliance. Modified-release preparations of metformin may help alleviate these symptoms4.

Anti-androgen medications such as spironolactone are also an option. Spironolactone is an aldosterone antagonist that primarily acts as a diuretic but can also lower androgen levels and improve PCOS symptom profile. The medication's anti-androgenic effects come from the blockade of androgenic receptors, which partly obstructs adrenal steroidogenesis and blocks the enzyme 5α reductase, thereby increasing the level of sex hormone–binding globulin protein in the bloodstream, which binds to androgens27. However, spironolactone is not recommended during pregnancy or for those trying to conceive, as it is associated with the feminisation of the male fetus in animal studies27,28. Hence, it is recommended to be taken with an oral contraceptive.

Surgical interventions

Surgical management options for PCOS are not commonly recommended and are generally considered after conservative and medical methods have been exhausted. These options include ovarian drilling, laparoscopic ovarian surgery, and bariatric surgery for those with severe obesity4. Ovarian drilling is a procedure that uses a laser beam or a surgical needle, administered laparoscopically, to destroy small areas of ovarian tissue. This can reduce androgen production and restore ovulation in some patients who have not responded to medical methods of ovulation induction, such as clomiphene citrate8. However, the evidence for the effectiveness of ovarian drilling is limited, as a Cochrane Review in 2020 found that it may decrease the live birth rate in women with anovulatory PCOS and clomiphene citrate resistance compared with medical ovulation induction alone29. Additionally, patients undergoing ovarian drilling are exposed to the risks associated with surgery, such as infection, abdominal adhesions, and thrombosis.

In cases of severe obesity, bariatric surgery may be considered for patients with a BMI over 40 or over 35 with comorbidities. This surgery can lead to weight loss, improve insulin resistance and ovulation, and reduce symptoms of PCOS30. However, bariatric surgery has risks, and patients should be carefully selected and assessed. Potential risks include surgical complications, nutritional deficiencies, and the need for long-term follow-up care4.

Conclusion

While significant progress has been made in understanding PCOS, several research questions remain. For instance, there is a need for further investigation into the aetiology of PCOS, including the role of genetic and environmental factors, to aid in earlier diagnosis and treatment. Additionally, while some therapies have been effective in managing the symptoms of PCOS, their long-term efficacy and safety still need to be determined. There is a need to understand better the long-term health consequences of PCOS, particularly cardiovascular disease and cancer risk.

Early diagnosis, lifestyle modifications, and appropriate medical interventions can help to reduce the risk of complications and improve the overall health outcomes of women with PCOS. Looking forwards, there is a need for a multidisciplinary approach to studying PCOS, including collaborations between researchers, healthcare providers, and patient advocacy groups. This may involve developing new tools and technologies for diagnosis and treatment and exploring novel interventions and therapies. There is a growing recognition of the importance of PCOS as a significant health issue affecting millions of women worldwide, and continued research efforts will be critical for improving diagnosis, treatment, and long-term outcomes for those affected by the condition.

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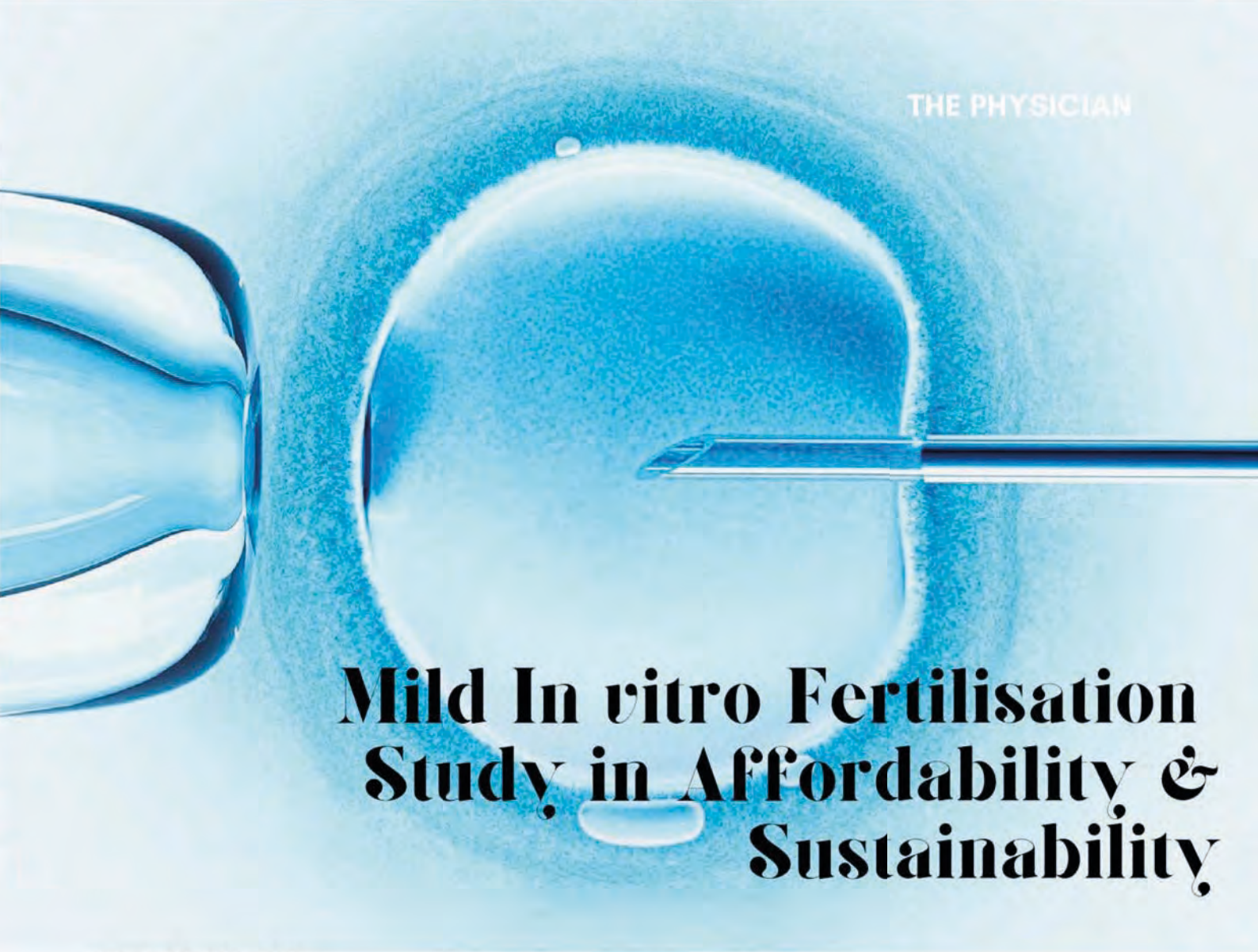

Mild In vitro Fertilisation Study in Affordability & Sustainability

Create Fertility, UK

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The case for making healthcare more sustainable is becoming increasingly urgent. Medical professionals understand the need to reduce costs and environmental impact. Innovation and creativity in developing novel treatment pathways jointly with patients are crucial in efficiently utilising scarce resources and delivering sustainable patient benefits. Approaches that aim to provide 'health prevention' and keep medical intervention as minimally invasive[1] as possible are often more desirable to patients and the environment. For instance, the benefits of minimally invasive surgery to patients include less postoperative pain, fewer operative and post-operative major complications, shortened hospital stay, faster recovery times, less scarring, less stress on the immune system, smaller incision, and for some procedures, reduced operating time and reduced costs.[2] The combined use of such minimally invasive technologies shortened operative times, diminished personnel use, and was associated with no additional risk.[3]

Infertility has a variety of aetiologies, and many therapeutic options are available. Before the advent of in vitro fertilisation (IVF), surgery was the primary treatment offered to patients with infertility. However, evolution in the practice of reproductive surgery and the advancement of IVF has changed the role of minimally invasive surgery in managing infertility. Ongoing developments in non-invasive fertility care have increased the importance of identifying the most appropriate indications for minimally invasive reproductive surgery for patients with infertility.4 These concepts are particularly pertinent in reproductive and women's health, and this case study explores the model at CREATE Fertility® and abc ivf®.

A friendly & safe approach

The CREATE Fertility® concept was driven by the desire to offer women bespoke choices in fertility treatment. Modified natural cycle IVF (mnc-IVF) or mild IVF (m-IVF) treatment delivered with lower doses of drugs have been shown to achieve pregnancy rates per embryo transfer that are acceptable for these treatment modalities, the cost for medication is low, risks for complications are dramatically reduced, and the treatments may be more psychologically acceptable to the patients. 5 Using such techniques, CREATE aimed to provide women with treatment that reduces risks, side effects and the burden of IVF while supporting healthier outcomes for mother and baby while maintaining outcomes. The team of Nargund and Campbell adopted pioneering approaches, including the use of advanced ultrasound in investigating infertile couples.6 Success in novel and mild IVF approaches also depends on maintaining and encouraging solid links to academic and medical communities, including notably to ISMAAR, the International Society for Mild Approaches in Assisted Reproduction, a UK charity set up to promote education and research.7

Access to IVF

The philosophy of putting patients first and finding a more efficient way to work is at the heart of the mild IVF approach. In the UK and worldwide, access to fertility treatment is not fair or equal. For many women and couples, the cost is a significant barrier that can stop them from building the family they want. The median projected price per IVF cycle in 2001 in the United States was estimated to be US$9226 and US$3531 in 25 other countries. Based on previously published estimates, the cost per delivery arising from IVF cycles in 2001 in the United States would average US$56,419 and US$20,522 in eight other countries. Multiple gestation births significantly increase the cost of IVF treatment, and this therapy does not meet the cost-effectiveness thresholds.8 The IVF treatment cost was £4202 to £5135 in the UK. When assessed in association with outcomes, the average cost per ongoing pregnancy was £8992-9472. 9 Furthermore, over the years, more sophisticated technologies and expensive medications have been introduced, making IVF increasingly inaccessible despite the increasing need. Globally, the option to undergo IVF is only available to a privileged few. In recent years, there has been growing interest in exploring strategies to reduce the cost of IVF treatment, which would allow the service to be provided in low-resource settings.10

The availability and treatment protocols via the national health service (NHS) vary nationwide in the UK.11 The CREATE team set out to find a way to offer women denied NHS treatment and priced out of private treatment another choice. Through the abc IVF ® agency in 2017, they were utilising mild IVF techniques, which offered substantial cost-reduction from standard therapies. This model also offered IVF in a streamlined, efficient patient journey, removing unnecessary add-ons.

CREATE™ Fertility

Next Steps

Since its inception, the CREATE team have supported nearly 19,000 women in their journey to parenthood. CREATE now has a network of 32 clinics in the UK, plus Vitanova in Copenhagen, which specialises in fertility treatment for women and same-sex couples who cannot access care in their own country. CREATE Fertility has become part of IVIRMA,12 the world's largest IVF company, and an NHS-approved provider of IVF treatment in many regions across England.

- The team continue to strive to address gender inequalities in healthcare, changing the paradigm of the 'male as default' in research studies.
- The team have invested in improving awareness and knowledge about women's health issues among the public and the medical profession through the CREATE Health Foundation charity, runs education modules in London secondary schools on fertility, and has partnered with the University of Bolton to provide post-graduate training in assisted reproduction, natural and mild IVF, and advanced ultrasound technology. 13
- The CREATE team has worked with the NHS to communicate the impact of lifestyle factors on fertility and endeavoured to create a better understanding of fertility issues among employers through its research white paper.
- CREATE Fertility is committed to helping to work towards the UN's sustainable development goals three (health and wellbeing), five (gender inequality), ten (reduced inequality) and thirteen (climate action) with her career-defining push to provide affordable, accessible, effective and safe fertility treatment, delivered sustainably.

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