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Cover Story:

New Care Delivery

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Editorial

New Care Delivery

[Prof. Christian Lovis](#)
Editor-in-Chief, IT
HealthManagement.org
Head – Division of Medical Information Sciences | University Hospitals of Geneva | Switzerland
Professor of Clinical Informatics | University of Geneva | Switzerland

The COVID-19 pandemic has been an accelerator for a profound paradigmatic shift that started several years ago, from a hospital-centred and centralised acute care system towards a patient-centred and distributed network of multiple actors playing new roles. Autonomy of patients is leveraged, telemedicine and telemonitoring is increasingly used by care professionals, assisting technologies and tech-driven improvements in infrastructure and logistics provide the capacity to deliver care both remotely and offsite. At the same time, radically new models of care are needed because of an ageing population, rising cost of healthcare and the financial challenges healthcare is facing globally. Healthcare systems and providers need not only technological, but also cultural and management changes.

In this issue, we talk about New Care Delivery in healthcare and the novel ways hospitals are exploring to optimise care delivery without compromising its quality or increasing the cost.

Astrid van der Velde and Ed de Kluiver focus on current organisational and technological barriers that prevent large-scale implementation of hospital admissions at home and share the outcomes of running a virtual heart centre. Prof. Laura Oleaga argues that all specialties, including radiology, need to implement new care-delivery models, which need to incorporate elements such as screening, preventive check-ups and follow-up of patients with chronic diseases.

Jorge Fernández García, who has been leading a new EIT Health initiative, the High Value Care Forum, talks about how high value care is achievable with small steps and how the Forum can help. Chris McCahan explores what novel ways of care delivery, such as digital solutions or home-based care, shape the 'new normal' in healthcare.

Rafael Vidal-Perez looks into how artificial intelligence is transforming the field of cardiology, specifically its potential in diagnostics and prediction of cardiac events such as atrial fibrillation. A team of experts led by Prof. Eugene Fidelis Soh presents the Central Health Model of Care designed to look beyond the hospital walls in the pursuit to achieve better population health in Singapore. Prof. Penny Gowland, Marco Belardinelli, Martyn Beckett and Aaron Montgomery talk about Open MRI and how it can enhance the value and output of MRI.

In our Winning Practices section, a team of radiologists from Moscow led by Prof. Sergey Morozov outlines the benefits of a systematic approach (CT as the modality of choice, contactless workflow, staff restructuring, etc.) applied to radiology departments in Moscow during the COVID-19 pandemic. Gilbert Bejjani highlights the added value of shifting traditional inpatient surgeries to outpatient ambulatory care centres in Belgium.

Dorota Napierska and Arianna Gamba discuss 'green hospitals' in our Management Matters section and describe the sustainability challenges in healthcare and effective strategies to respond to the impacts of climate change and pollution.

We hope you will enjoy this issue and will gain inspiration from it. As always, your feedback is welcome.

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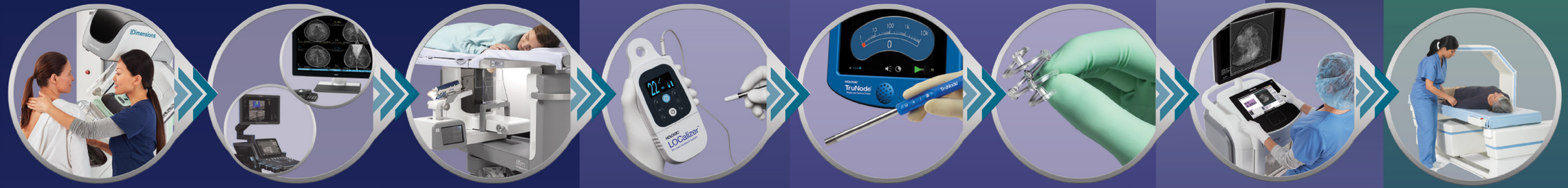

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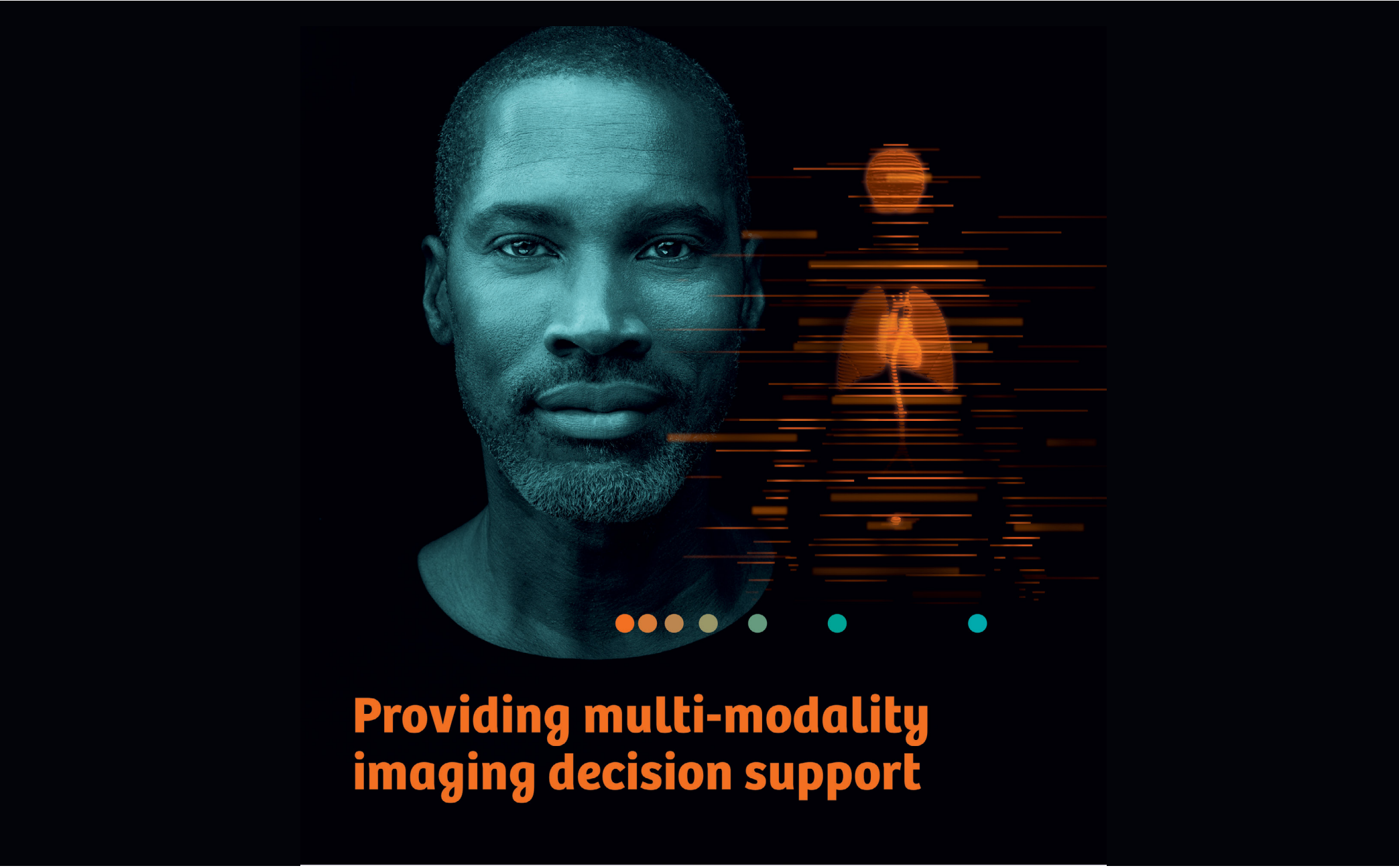

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Have your say. Engage!

The healthcare industry continues to face challenges. The COVID-19 pandemic, the consistent increase in chronic disease prevalence, an ageing population, lack of drug development, antibiotic resistance, obesity, shortage of healthcare personnel and other similar issues need to be addressed. Maybe it is time to look at new care delivery models and strategies. We explore this and much more in this issue.

To contribute, contact us on **Interested@HealthManagement.org**

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Contributors

Martyn Beckett
Martyn Beckett is an Operations & Service Director with extensive experience in the private sector and NHS in the management of safety critical services. He has excellent transferable general and senior management skills in business development and customer relations and project management.

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Marco Belardinelli, ASG Conductors
Marco is Business Unit Director of the MRI Division at ASG Conductors, with a special focus on the technology and market development of the MROpen Evo, the "best MRI experience" system based on unique superconducting technology and other innovative applications.

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Dr Gilbert Bejjani, Belgium
An accomplished hospital manager, Dr Bejjani is Medical Director and Executive Director at the Basilique Clinic-CHIREC hospital group. He is engaged in health issues, leadership, and innovation in the medical field in multiple Belgian institutions and organisations.

612 New Care Delivery Paradigms

Ed de Kluiver, the Netherlands
Ed de Kluiver is chairman of the Isala Heart Centre and a member of the board of the Dutch Cardiovascular Association. His ambition is to offer large-scale specialised cardiac care in the living environment of the patient expanding the current Isala virtual heart centre.

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Dr Jürgen Fortin, CNSystems
Jürgen Fortin is the founder and CEO of CNSystems. He is also a university lecturer and responsible for the company's intellectual property being the author of more than 80 patents and several publications on current and future noninvasive technologies. MyPa$$w0RT0oo7

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Arianna Gamba, Belgium
Arianna holds degrees in International Relations and in Health Economics and Management. She leads HCWH Europe Circular Healthcare work managing a portfolio of projects and overseeing implementation of advocacy strategies related to sustainable procurement and circular economy..

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Jorge Fernández García, Spain
With 20+ years of experience in healthcare and life sciences, Jorge has been with EIT Health for the last 3 years. Prior to this, he was overseeing E-Health at Hospital Sant Joan de Deu and leading the Moebio initiative, both in Barcelona. He regularly advises and mentors startups across Europe.

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Prof. Penny Gowland, UK
Penny Gowland is a Professor of Physics at the Sir Peter Mansfield Imaging Centre at the University of Nottingham. Her career goal has been to who develop quantitative methods in MRI. She has published very widely in the methods and applications of MRI and is the current Secretary of the ISMRM and a Fellow of the ISMRM.

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Jan Kips, Agfa HealthCare
Jan Kips is a Product Manager with Agfa HealthCare and is responsible for the advanced workflows domain within Enterprise Imaging. He has significant experience in the Belgian eHealth-sector. He has a PhD in biomedical engineering and a Masters degree in eletromechanical engineering.

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Deborah Xue Ling Lee, Singapore
Deborah Lee is a Management Executive at Tan Tock Seng Hospital in Singapore. She has a Bachelor of Science (Honours) in Life Sciences, specialisation in Biomedical Sciences and minor in Psychology from the National University of Singapore.

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Shu Ching Loh, Singapore
Loh Shu Ching is the Executive Director of the Division for Central Health at Tan Tock Seng Hospital in Singapore. She has a MA in Health Management and Policy from the University of Iowa and a BA (Honours) in History from the National University of Singapore.

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Prof. Christian Lovis, Switzerland
Prof. Lovis is a medical doctor and Professor of Clinical Informatics at the University of Geneva. He contributed to the Swiss Federal strategy for eHealth and law on shared patient records. He is the president of the EFMI and has participated in several start-ups.

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Chris McCahan, USA
As global sector lead for healthcare services at IFC (World Bank group), Chris has facilitated investment transactions around the world for almost 20 years. Prior to this, he led investments in other industries. He holds an MBA from SMU's Cox School of Business.

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Dr Aaron Montgomery, USA
Aaron Montgomery is board certified in diagnostic radiology through the American Board of Radiology, and is also board certified in vascular and interventional radiology. His interests include vascular interventions, and liver disease causing portal hypertension (TIPPS).

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Prof. Sergey Morozov, Russia
Prof. Morozov is a Professor of Radiology, expert in clinical imaging, healthcare management and informatics. He is also the Chief regional radiology and instrumental diagnostics officer, Ministry of Healthcare, Russia and the CEO of Diagnostics and Telemedicine Center, Moscow.

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Dr Dorota Napierska, Belgium
Dr Napierska holds PhD degrees in Biology (Biochemistry), the University of Gdansk, and Biomedical Sciences (Nanotoxicology), Katholieke Universiteit Leuven. She worked at the European Commission (DG Joint Research Center) and the Department of Public Health of KU Leuven (Belgium).

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Prof. Laura Oleaga, Spain
Prof. Oleaga is the Chair of the Radiology Department of the Hospital Clinic in Barcelona. She is an active member of many scientific societies and is the Scientific Director of the European Diploma in Radiology since 2018.

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Prof. Eugene Fidelis Soh, Singapore
Eugene Fidelis Soh is the CEO of Tan Tock Seng Hospital and Central Health in Singapore, serving a population of 1.4 million. He is Adjunct Professor at the Lee Kong Chian School of Medicine and Chairman of the Centre for Healthcare Innovation Co-Learning Network.

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Danny Steels, Agfa HealthCare
Danny Steels is a Product Manager with Agfa HealthCare, working in the healthcare sector for 15 years. He started in 2016 with the analysis of Agfa's Peer Learning solution and is responsible for its current design. Danny has a Masters degree in electronics engineering.

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Astrid van der Velde, the Netherlands
Astrid is manager of the Cardiology Group at Isala, and project leader of NWE-Chance. She is also member of several (inter-)national advisory boards of initiatives focussing on hospital care at home. Her ambition is to innovate healthcare for tomorrow.

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Dr Rafael Vidal-Perez, Spain
Dr Vidal-Perez is a Cardiac Imaging Consultant in the Cardiology Department of Hospital Clinico Universitario de A Coruña, fellow of the European Society of Cardiology and the American College of Cardiology. Spanish Society of Cardiology – Board Member (Treasurer). Association for Acute Cardiovascular Care -Board member.

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Contributing Authors: Anna Andreychenko, Victor Gombolevskiy, Ekaterina Kuz'mina, Nataliya Ledikhova, Mihail Lobanov, Olesya Mokienko, Elena Panina, Nikita Polyshuk, Evgeniy Popov, Serey Ryzhov, Christina Sergunova, Igor' Shul'kin, Irina Sokolina, Ilya Soldatov, Irina Trofimenko, Anton Vladzymyrskyy

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Hospitals Going Green & Healthy

Sustainability for healthcare and patients

Author: Dr Dorota Napierska | Chemicals Policy & Projects Officer | Health Care Without Harm (HCWH) Europe | Brussels | Belgium
Author: Arianna Gamba | Procurement Policy & Projects Officer | Health Care Without Harm (HCWH) Europe | Brussels | Belgium

Following their unique healing mission to 'first, do not harm,' hospitals and health professionals should lead the transition to carbon neutrality, reduce their environmental footprint, and adopt effective strategies to respond to the impacts of climate change and pollution without compromising the quality of care.

Key Points

- The healthcare sector consumes large amounts of single-use plastic and produces significant carbon and other toxic emissions through energy consumption and waste, undermining the health of the very population it seeks to heal.
- Plastics used in the healthcare sector regularly contain harmful chemicals that can put already vulnerable patients at risk and present a continued exposure for healthcare workers.
- Increased plastic consumption and waste during the COVID-19 pandemic is unsustainable and is contributing to continued environmental degradation and climate change – which are public health issues, not just environmental concerns.
- Continued environmental damage, including pollution, reduced air quality and climate change are testing the healthcare sector's resilience and ability to provide care and prevent harm.
- The sector must reduce its environmental footprint and collaborate with suppliers to innovate and overcome barriers to a low-carbon, low-impact, circular economy.

"Places of healing should be leading the way, not contributing to the burden of disease."
Tedros Adhanom Ghebreyesus, Director General of the World Health Organization

Healthcare Today – Carbon-Intense, Linear Economy

Discussions of sustainability in the healthcare sector often focus on drug shortages, demographic changes and shrinking public health budgets. Much less attention is paid to reducing the significant environmental footprint of the sector, while sustaining high-quality care.

The global healthcare sector accounts for 4.4% of total global carbon emissions, and the healthcare sector within the European Union is one of the highest polluting healthcare sectors after the US and China; evidence also shows that the supply chain drives 75% of emissions within EU healthcare (HCWH 2019a). Anaesthetic gases, though they make up a small percentage of the overall carbon emissions from healthcare facilities, are extremely potent greenhouse gases and persist in the atmosphere for a long time driving a warmer climate.

Climate change is increasingly being acknowledged as a public health issue, not just an environmental one – our health and our environment are intrinsically connected. A warming climate

increases extreme-weather events, not only risking and endangering human life but also testing the healthcare sector's resilience and ability to deliver care under pressure. As temperatures rise, we are also seeing an increased incidence of vector-borne diseases (Githeko et al. 2000), which is even linked to COVID-19. The World Health Organization (WHO) states that most emerging infectious diseases and recent pandemics originate in wildlife and evidence suggests that increasing human activity on the natural environment is driving the emergence of new diseases as wildlife and ecosystems are disturbed and displaced (WHO 2020).

How we currently produce, use and dispose of healthcare-related products is emblematic of our linear economy and also presents a significant source of environmental pollution. Hospitals worldwide generate millions of tons of waste each year, most of which is incinerated – non-medical products such as paper and plastic are not always segregated and recycled, or are wrongly handled as medical waste.

As harmful chemicals (Napierska n.d.) can be found in a wide range of healthcare-specific products, such as disinfectants, medical devices and textiles (HCWH 2019b), when they are used and disposed of, they pollute the environment and negatively affect human health. Toxic emissions from plastic incineration not only contribute to global warming but reduce air-quality and can trigger a number of health-related problems (Azoulay et al. 2019), particularly respiratory issues in vulnerable populations, which is also increasing vulnerability to COVID-19. Plastics disposed of via landfill have the potential to leach toxic chemicals into the soil, groundwater and other surrounding water sources (UN Environment Programme 2018).

The volume of healthcare-related products and consequently the volume of medical waste is rising steadily – not only due to a growing population and increase in patients, but crucially because the healthcare sector has become more and more reliant on single-use items (Terzon 2019) and products with a lot of packaging, representing a substantial part of today's problem. More recently, the COVID-19 pandemic has made us more aware about the level of waste being produced by personal protective equipment (PPE), now both within healthcare sector and outside.

With such a significant environmental footprint, the healthcare sector has not only an opportunity to lead us towards a low-impact, low-carbon, circular economy, but also the moral responsibility to acknowledge the health impacts of environmental damage and to demand immediate action.

The COVID-19 pandemic has made us more aware about the level of waste being produced by personal protective equipment

Plastics in Healthcare – Closer Look

For over 20 years, Health Care Without Harm's (HCWH) work has focussed on toxic chemicals generated throughout the lifecycle of plastics used in healthcare that can harm patients and workers' health, and pollute the environment. Some examples of such chemicals include phthalates and Bisphenol A, which are used to make many medical devices (HCWH 2019c), and dioxins generated during the production and disposal of plastics (polyvinyl chloride, PVC in particular [Schettler 2020]), which can damage human health.

Previously, metals, glass and ceramics were used for medical implants, devices and supports. In recent decades, plastic polymers have replaced those materials as they offer transparency, reduced weight, better biocompatibility and lower cost. With excellent barrier properties, plastic packaging also offers lightweight, low cost, durability and transparency, and is particularly suitable for medical applications.

The most widely used plastic material in medical applications is PVC followed by polyethylene (PE), polypropylene (PP), polystyrene (PS) and polyethylene terephthalate (PET). The industry points out that modern healthcare would be impossible without many plastic-based medical products.

Over the last 30 years, there has been a gradual transition from reusable non-plastic to disposable plastic products in healthcare. The most common arguments for this transition were an increased focus on infection prevention and control, and cost-effectiveness. Today, medical plastics are everywhere, from examination gloves to sterile syringes and IV tubes or heart valves. This increase in plastic consumption, however, represents not only more waste but also more supply chain emissions. Plastic packaging and single-use products made of different (often mixed) plastics and materials frequently contain hazardous chemicals (HCWH 2019c). Plastics used in healthcare can therefore pose a direct localised risk to patients and staff.

There is, unfortunately, a lack of precise data showing the extent of medical and non-medical plastics uses and volumes of waste. Where evidence has been gathered, the need for transformative action is clear. The UK's National Health Service, for example, recovers only 5% of plastic waste (Percival 2019) and pays to dispose of 133,000 tonnes of plastic each year, significantly contributing to its €766m (£700m) annual waste disposal bill (GPT Waste 2014). More and more initiatives are being undertaken to address plastic waste streams in European healthcare providers.

Plastic Pandemic

Whilst COVID-19 has spurred an unprecedented increase in the use of PPE everywhere, naturally the healthcare sector has particularly seen a huge spike in demand and use.

Much of the PPE being produced to fight the COVID-19 pandemic is made from plastics and therefore very likely to contain hazardous chemicals (Hervey 2020). Medical textiles, such as masks and gowns, are often treated with per- and polyfluoroalkyl substances (a chemical group known as PFAS) due to their excellent repellent properties. Unfortunately, these chemicals are also toxic and very persistent: they do not break down in the human body or the environment and can enter our water systems. Another concern is PVC, the cheapest option for manufacturing disposable gloves, which often contains harmful phthalates. Whilst financial considerations remain prominent in purchasing decisions, healthcare purchasers should consider these risks and exposures to not only their healthcare workers but importantly their patients, who are often already vulnerable.

The COVID-19 pandemic has also seen an increased offering of antimicrobial impregnated products (containing biocides, which are per definition harmful substances). Whilst the specific advantages of treating PPE with biocides is frequently questionable, another concern is that the indiscriminate use of biocides can contribute to the increasing development of antimicrobial resistance (AMR) (Stenuick 2019).

PPE is, of course, essential for the protection of health workers and patients, but there is increasing concern about the increase in waste from healthcare's response to this outbreak. Since 25 February, 3.1 billion items of PPE have been distributed for use by health and social care services in England alone – compared to 2.43 billion items used by all NHS trusts and social care organisations in 2019 (Department of Health and Social Care 2020). In Italy's northern Lombardy region, the amount of infectious medical waste in April this year has doubled or maybe even tripled since the start of the pandemic (TheLocal.it 2020).

Hospitals and waste processors often label all hospital waste as infectious, meaning that many products are being sent for incineration when they can in fact be safely recycled. No qualitative data is yet available on the environmental impacts of the increased plastic incineration during COVID-19; however, there is already sufficient evidence that incineration is harmful for the environment and therefore our health. Health Care Without Harm's experts have prepared a comprehensive document with the latest information and recommendations on how to address waste management during a pandemic (HCWH 2020). We need to ensure that sound medical waste management – proper segregation, collection and disposal of all COVID-19-related waste – is duly practiced.

The pandemic has also highlighted the sector's single-use problem. Challenges around decontamination and reuse of PPE still remain after many faced shortages early on in the pandemic, affecting the care of patients and safety of healthcare workers. There are growing calls to safely reuse equipment and recycle some non-infectious hospital waste, such as plastic packaging. It is vital that we rethink our dependency on single-use items and work towards more sustainable solutions to reduce environmental impacts from manufacturing and waste, as well as improved resilience to supply shortages.

COVID-19 is reshaping the world and has reoriented healthcare's priorities. This crisis is helping all of us realise that 'business as usual' is not an option anymore: we all need to work towards more sustainable and resilient health systems that effectively care for the planet, as well as for its people.

Healthcare of Tomorrow – Hospitals Go Green & Healthy

Established a decade ago, Global Green and Healthy Hospitals GGHH is a growing community of over 1,350 members who are using innovation, ingenuity and investment to transform the health sector. GGHH brings together hospitals, health systems and health organisations from around the world under the shared goal of reducing the environmental footprint of the health sector and contributing to improved public and environmental health.

In Europe, the European Green Deal initiative has a potential to impact the healthcare sector in many ways, and offers unprecedented opportunities for hospitals and health systems to achieve their sustainability goals (HCWH Europe 2020). The principle of 'do no harm,' which underpins the Deal, is closely aligned with HCWH Europe's vision that the sector should protect not only the communities it serves but also the environment – itself a critical component of human health. With over 15,000 hospitals in the EU, the healthcare sector accounts for approximately half of public spending in the EU and 14% of annual EU GDP in total (HCWH 2019a). European healthcare can therefore play a significant role in influencing market supply and demand to lead the transition towards safer, innovative, and more sustainable and circular products.

The new EU Circular Economy Action Plan lists textiles as the fourth highest-pressure category for the use of primary raw materials including water, and fifth for greenhouse gas (GHG) emissions. Boosting the EU market for sustainable textiles and tackling the presence of hazardous chemicals should not only address fast fashion, but also include an important category of technical textiles, such as medical textiles. The global medical textiles market is growing (Grand View Research 2019), but unfortunately medical textiles can contain harmful substances such as endocrine disrupting chemicals (EDCs), and

single-use items are significantly contributing to plastic pollution: polyester and other plastic polymers make up the majority of textiles today.

Increasing the use of reusable textiles represents a more sustainable alternative to single-use items in healthcare and provides benefits such as waste reduction and cost savings. The healthcare sector needs to innovate and collaborate with suppliers to overcome barriers to this transition, like the limited sterile service and laundry capacity of hospitals. More effort is needed to accelerate the transition to a circular economy where materials are reused and recycled and waste is prevented (European Environmental Bureau 2019); there is an urgent need to expand the circularity of products and materials used in the medical sector. Withdrawing or minimising legislative exemptions for harmful substances in medical products will also help promote the use of non-toxic, reusable and recyclable materials, and ensure higher safety and sustainability of those products.

In Europe, incinerating healthcare waste is still common practice, yet in the US, where more than 5,000 medical waste incinerators were in operation nearly 30 years ago, today fewer than 60 active medical waste incinerators remain (Wernick 2015). Given that alternatives to incineration are available, a phase-down of medical waste incineration in Europe is possible and appropriate. HCWH is collaborating globally with healthcare systems, NGOs, governments and international agencies such as WHO to research and promote environmentally sound and healthy alternatives to medical waste incineration.

By taking action to reduce its own environmental impact and its contribution to practices that damage health, the healthcare sector can truly embrace its healing mission, as well as reduce costs in pursuit of its sustainability goals. Healthcare spending represents a large part of total public procurement spending in Europe. By uniting purchasing power and aligning procurement criteria to demand for ethically produced, healthy and sustainable products and services, healthcare organisations could simultaneously gain more leverage and demand lower prices. With harmonised sustainable healthcare procurement across Europe, manufacturers will be more inclined to meet the demand for sustainable products.

Of course, the responsibility for creating a healthier environment does not solely lie with the healthcare sector. However, through its mission and its purchasing power, it has the opportunity to drive innovation and find new ways of delivering high-quality patient care and reduce environmental and human harm. Inspiring other sectors to follow and collaborating with private industry to reduce the environmental footprint of its activities, the healthcare sector has both the potential and the opportunity to make a huge impact in slowing and even reversing environmental degradation for the benefit of all.

Conflict of Interest

None.

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Innovating in Healthcare: Hospital Admissions at Home

Author: Astrid van der Velde | Manager Cardiology Group | Isala Heart Centre | Zwolle | the Netherlands | Project leader | NWE-Chance

Author: Ed de Kluiver | Chairman | Isala Heart Centre | Zwolle | the Netherlands | Board member | Dutch Cardiovascular Association

Today's hospitals are not yet the hospitals of the future. Emerging societal challenges are demanding a shift towards hospital care at home. Although telemedicine, like telemonitoring and telerehabilitation, has been getting more popular in recent years, hospital admissions at home are still in their infancy. Current organisational and technological barriers prevent large-scale implementation of hospitalisations at home. Once these challenges have been overcome, hospital admissions at home will help innovate healthcare and move it towards a more sustainable model. There are even possibilities for international expansion.

Key Points

- Hospitals today are not yet the hospitals of the future.
- Hospital admissions at home have many advantages.
- To implement hospital admissions at home on a large scale, current organisational and technological challenges have to be overcome.
- New developments – like digital therapeutics, artificial intelligence and nanotechnologies – provide opportunities to innovate in healthcare.
- Exploring hospital admissions at home together has international potential.

Time for Change

Increased pressures on healthcare budgets, the aging of the population, and reduced hospital capacity provide a clear need to modernise today's healthcare system.

It is a widespread misconception that a hospital is always the best place for patients. In fact, hospitals can be harmful environments for patients, especially for elderly people. Adverse events like delirium, hospital infections and trauma arising from falls are common among admitted elderly patients (Hsieh et al. 2015). These events lead to an increased risk of intensive care admissions and mortality.

The current COVID-19 pandemic emphasises significantly the need for hospital care at home. The good news is, therefore, that there is at least now a chance for change. There are many options for development. The technology sector is booming and can facilitate the introduction of digital health and therapeutics (EHTEL 2020). Artificial intelligence and nanotechnologies are taking off. Changing social values are creating pathways for integrated care, often supported by technologies, in the living environment of the patient.

Virtual Heart Centre

The virtual Isala Heart Centre was launched at the beginning of the 21st century. It is part of Isala Heart Centre, the largest non-academic heart centre in the Netherlands, which provides a virtually complete palette of cardiac care to patients in

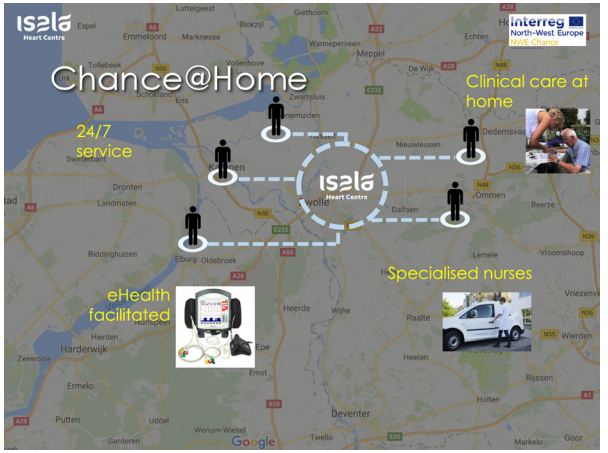

Figure 1. Chance@Home Service.

a large geographic region. Its headquarters are in Zwolle, the Netherlands.

A virtual heart centre – like Isala – is all about providing hospital care in the living environment of patients. It provides hospital care with healthcare professionals who are available at a distance, and it uses eHealth and mHealth, sensors in/on a patient, and point-of-care technologies. So, basically: this is hospital care without a 'brick' hospital. The services offered by the Isala virtual heart centre consist of telemonitoring, mHealth-guided cardiac rehabilitation, mLearning, a virtual cardiac emergency unit, and a service called Chance@Home.

Hospital Admissions at Home: Facts and Figures

In 2004, the Isala Heart Centre started a pilot for treating heart failure patients at home: Chance@Home (Figure 1). The pilot concluded that home-based
administration of intravenous medication by specialised nurses was a feasible, effective, safe and patient-friendly alternative for regular in-hospital care for known chronic heart failure patients who experience high-risk, acute increases in disease symptoms (Van de Wetering et al. 2004). After this successful pilot, Chance@Home was then offered as a regular service. It is a service that provides integrated care, which requires a strong collaboration between patient, nurses, medical specialists, general practitioners, the pharmacy, informal caregivers and home care.

Today, more than 6,000 Isala patients are treated at home. Chance@Home is used for both cardiac and pulmonary patients. Around 80% of them are heart failure patients. Patient and professional satisfaction is high. Preliminary results show that vulnerable patients benefit the most: the percentages of delirium, infections and falling trauma are low, and patients are more active.

A virtual heart centre is all about providing hospital care in the living environment of patients. This is hospital care without a 'brick' hospital

Hospital admission at home costs on average 40% less than a regular hospital admission. However, hospitals are often not reimbursed by health insurance companies for hospital admissions at home. By providing better outcomes against lower costs, Chance@Home could in reality be a paragon of value-based health care.

With the societal drive for innovative solutions to cope with a rapidly increasing number of chronic (heart failure) patients, there is a need to upscale and professionalise the Chance@Home initiative. Until recently, Chance@Home has been a local initiative; it has the ambition, however, to develop further into a fully mature service that can be replicated. Both organisational and technological innovation is needed for its scale up.

Scaling Up Chance@Home Way of Working

Scaling up requires a solid and professional organisation with a quality system, excellent logistics, and a help desk/call centre. Once out of the pilot phase, Chance@Home quality will need to be assessed on a structural basis, and randomised clinical trials will have to be performed.

Hospitalisations at home require excellent logistics. Healthcare professionals have to provide a 24/7 service to patients who are admitted at home. Cars must be equipped with all necessary medical technology (like a mobile ECG, medication, and laboratory supplies). Questions need to be answered quickly. Furthermore, scaling up requires an integrated technology with a platform for both healthcare professionals and patients, and the connectivity of technology in a multivendor environment.

Yet, some challenges remain. With the introduction of a variety of technologies to support hospital care at home, the provider doesn't want to bother the healthcare professionals with different kinds of output. The healthcare team should be provided with a single overview containing all relevant outcomes measured by the different technologies. Patients should have access to the most relevant information regarding their hospital admission at home, and should be supported in this process by an eCoach, for example.

International Potential

In recent years, hospitals have provided more ambulatory services at home. However, the delivery of hospital admissions at home is still in its infancy (Levine et al.

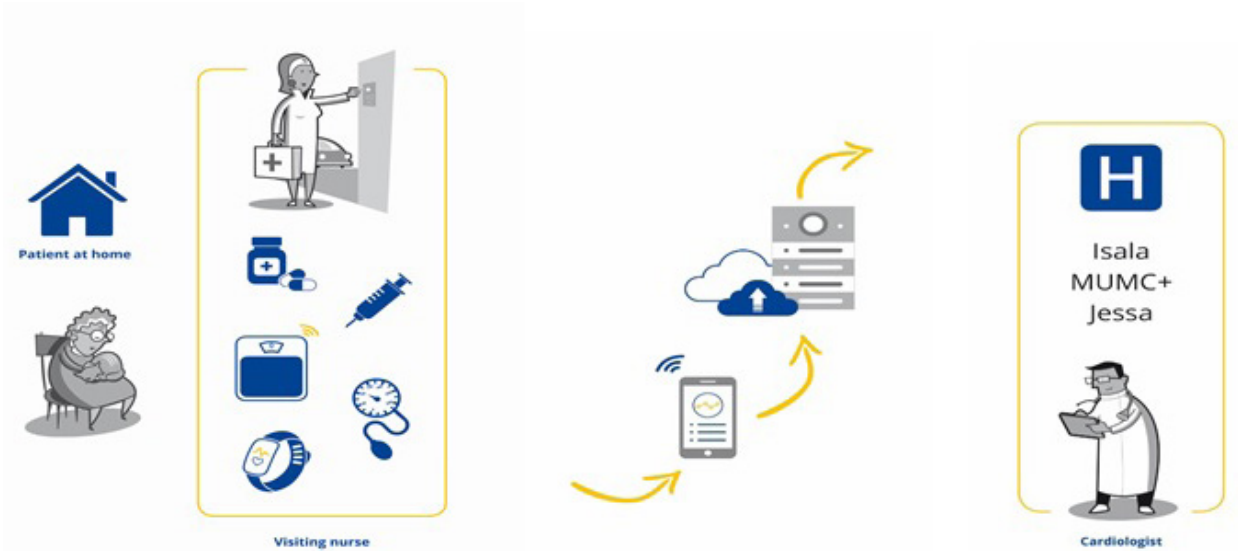

Figure 2. Hospital Admissions at Home, NWE-Chance.

2018). The organisational and technological innovation of hospital admissions at home – that is so desperately needed to make possible a world-wide transition in healthcare – is addressed by the NWE-Chance consortium. This
consortium consists of ten partners (medtech companies, hospitals, universities and network organisations) in three countries (the Netherlands, Belgium and the United Kingdom). NWE-Chance promises the development or optimisation of a number of integrated eHealth applications (blood pressure, weight and oxygen saturation measurements, a vital signs patch for heart rhythm, respiratory rate, posture and activity plus an eCoach): they will be used to admit heart failure patients at home. The feasibility of both technology and the supporting care process (Figure 2) will be tested by three hospitals (each hospital has a different state of organisational readiness with respect to hospital admissions at home). NWE-Chance will also launch an innovation hub to bring the stakeholders involved in this organisational shift together: they will share their knowledge with respect to home hospitalisations.

All these initiatives are made with the aim of enabling a profound, sustainable transition of the healthcare sector by implementing hospital admissions at home on a large scale. It is hoped that this shift can be expanded not only in Zwolle or the Netherlands, but in a collaborating country, Belgium, as well. Such innovations in healthcare may even be extended more widely internationally.

Acknowledgements

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Conflict of Interest

None. ■

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New Health Care Delivery

Author: Professor Laura Oleaga | Radiology Department | Hospital Clínic | Barcelona, Spain

New care-delivery models should include screening, preventive check-ups and follow-up of patients with chronic diseases. All specialties, including radiology, need to be involved. This will involve significant investment, practice reorganisation and systems that are high-value based and patient-centred. This will require coordination and organisation between primary care centres and referral hospitals.

Key Points

- As an integral component of healthcare, radiology is involved in the whole patient process, from prevention to diagnosis and treatment of diseases.
- New care-delivery models should involve all specialties, including radiology.
- Harmonisation between primary care centres and hospital care is essential for an optimal and consistent care delivery.
- Radiology departments, in coordination with primary care physicians, can contribute to the diffusing of information and to educating the population.

Introduction

Our health care system and its various models are being questioned, particularly now with the challenges and added pressure of the current pandemic.

As an integral component of healthcare, radiology is involved in the whole patient process, from prevention to diagnosis and treatment of diseases.

The application of new technologies and artificial intelligence has led to advances in the medical world in general, and radiology in particular has seen the benefit of these improvements.

But the ever-growing number of imaging studies is having a serious impact on health care spending (Hendee et al. 2010). Among the factors contributing to this growth, an ageing population, chronic diseases and lifestyle have been identified.

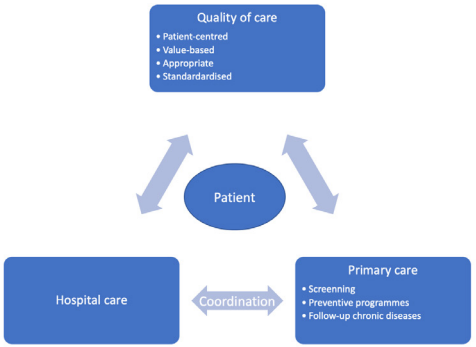
This constellation of factors leads us to reflect on how we can improve our health system and how to organise it from primary care to hospital care. Seamless coordination between these two health care areas is essential, so that they can function together as a well-harmonised and interlinked work chain. Currently they function as independent entities with very little interconnection. This has led to deficiencies in care provision, excessive growth in imaging utilisation, a saturation of the system and increase in care spending, as well as dissatisfaction of health personnel.

New care-delivery models should involve all specialties, including radiology. A patient-centred and high-value based system that includes screening, preventive check-ups and follow-up of patients with chronic diseases will require a significant investment and precise organisation at all levels.

However, these changes must be introduced without neglecting the quality of care that should be a priority in every health system.

Primary Care

The first line of approach in care delivery is primary care. Whilst in primary care most patients present with chronic ailments, there will be some acute conditions that demand a rapid response to imaging requests and immediate reports are necessary (Insights Imaging, 2010). Radiology departments must adapt their internal organisation to provide a fast-track, effective response. This requires a



standardisation of the protocols, in agreement with the reference hospital centre, and a rapid reporting response. A collaborative effort will be needed to develop evidence-based appropriateness criteria for imaging studies that include education of primary care physicians and patients where necessary.

Implementation of computer-based decision support systems aligned with general practitioners can be an effective instrument to guide and standardise the appropriate use of imaging studies (Qayyum et al. 2013).

Taking a standardised approach can help avoid unnecessary hospital admissions for imaging procedures and further improve patient experience by avoiding overutilisation and/or duplication of tests.

Artificial intelligence systems and structured reporting are valuable preparation tools that will help in the standardisation and rapid response of reports. They should be extended to the entire radiological community and become the standard of care in radiology.

Hospital Care

Harmonisation between primary care centres and hospital care is essential for an optimal and consistent care delivery. Radiology departments have a key role to play in this coordination (Figure 1).

Hospital specialists need to offer suitable support to primary care physicians and promote their training and participation in common organisational decisions that will favour the integration of the two areas of care (Sarwar et al. 2015).

Screening/Preventive Programmes

Ischaemic and hypertensive heart disease, strokes, pulmonary infections, cancer, and diabetes still remain the most relevant causes of death in middle-, upper- and high-income countries.

The screening and management of cardiovascular disease, together with smoking-related diseases, comprise a major element in the workload of primary care practitioners. There is convincing evidence that GP-based preventive programmes for cardiovascular and smoking-related diseases and intervention are both feasible and cost-effective. Imaging is an essential tool in the risk-stratification and screening of these patients. Radiology departments, in coordination with primary care physicians, can contribute to the diffusing of information and to educating the population.

The application of new technologies and artificial intelligence has led to advances in the medical world in general, and radiology in particular has seen the benefit of these improvements

Chronic Diseases

A growing number of chronic diseases, principally heart disease, stroke, cancer, diabetes, and obesity, require prevention and screening programmes.

Experts have estimated that by 2030, chronic diseases will account for more than 70% of the global disease burden and will be responsible for 80% of deaths across the world (Beaglehole et al. 2003).

Primary care centres, in coordination with hospitals, can be part of the monitoring process of chronic diseases. This will require a change of scope and vision in physicians, and greater collaboration and networking between professionals, including radiologists.

Conclusion

Radiology departments have their part to play as a vehicle of coordination between primary care and hospital care, participating in prevention and screening programmes as well as in the diagnosis, assessment and planning of treatments.

Conflict of Interest

None ■

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Continuous Improvement Through Peer Learning

Author: Jan Kips | Product Manager | Agfa HealthCare

Author: Danny Steels | Product Manager | Agfa HealthCare

Traditionally, the radiology community advocates peer review for quality assurance. The current trend is to focus more on peer learning, where learning from peers in a continuous improvement mode becomes more important than focusing on the (number of) diagnostic errors. Agfa HealthCare has developed a module that supports both peer review and peer learning in its Enterprise Imaging (EI) platform. HealthManagement.org spoke to Jan Kips and Danny Steels of Agfa HealthCare to learn more about this new module and how it can help facilitate learning in radiology.

Can you explain the peer learning feature and how it is relevant for the radiology environment?

Peer reviews are a fundamental part of the radiology workflow. They allow you to collect and evaluate data on reading errors and to meet your regulatory requirements. Diagnostic errors in radiology are - and have always been – a major concern. Research has indicated that every day, a radiologist commits 3 to 4 diagnostic errors (Bruno 2017) and diagnostic errors contribute to an alarming 10% of patient deaths in the U.S. (McMains 2016). This becomes even more important in the current trend of cross-site collaborations, where patient care more often depends on the performance of various radiology departments.

The traditional way to measure radiology performance has been through peer review, where radiologists evaluate and score their peer's reports. However, while peer review focuses on how many errors were made, peer learning wants to focus on 'how and why' an error was made (Haas et al. 2019; Larson et al. 2017).

The concept of peer learning is gaining traction. Various hospitals in the U.S. are already using it, either on top of the traditional peer review or as a replacement. Participating radiologists report that peer learning helps to improve patient care more than traditional peer review, encourages more people to participate in the feedback process, and facilitates learning for everyone involved.

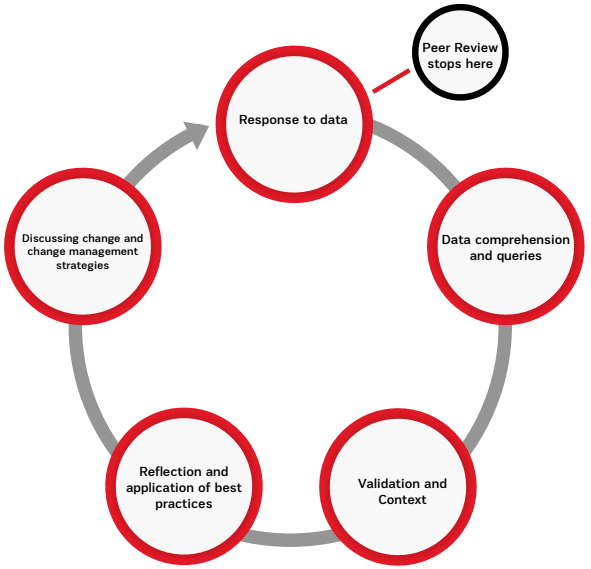
At Agfa HealthCare, we believe there is a clear value in having physicians trigger peer reviews themselves on studies that they come across as learning opportunities. A whole range of use cases/situations in which one could see a learning opportunity would simply be missed with traditional peer review. Listing a few:

- Users detect a learning opportunity while reading a study.
- Additional input from a clinician, multidisciplinary conference, laboratory or pathology result that alters the report conclusion and offers a learning opportunity.
- Peer learning case started as a result of a risk management meeting

Apart from focusing on the errors and negative feedback, there is now consensus that giving positive feedback is equally important. 'Good calls' provide important learning opportunities too. Both are being proposed by the regulatory bodies in the ACR and RCR.

The current peer review used in radiology departments has drawbacks. You say that Agfa has developed a "true peer learning" workflow. Why do you think your tool is better than other available options?

Although initiated with the best intentions, there are a number of drawbacks related to the traditional peer review. Randomly selecting studies for peer review leads to less learning opportunities. Generally, 20% of the



studies present 80% of the learning opportunity. So by randomly creating cases, a lot of learning opportunity is missed. That is why many radiologists consider peer review a time-consuming activity that must be done for compliance reasons only. Also, the focus on the number of discrepant findings may lead to a blame culture, with typically little feedback to the report author.

Agfa's peer learning module allows to address these shortcomings by:

- Offering the possibility to both automatically and manually trigger peer reviews.
- Fully embedding the peer review workflow in the radiology workflow in Enterprise Imaging.
- Anonymised, built-in feedback loops that allow authors to learn from the advice of colleagues.
- Dedicated conference functionality to discuss the case and ability to follow-up on recommendations or process changes.
- A highly configurable workflow, allowing customers to tailor their workflow from traditional peer review to a peer learning workflow with conferences and anything in between.

How does Agfa's peer learning feature minimise the element of shame when identifying errors and/or mistakes? How does it offer a more positive approach?

It's worth noting that changing the culture is primordial and perceived way more important and difficult than the right software implementation. That being said, there are a few particular features of Agfa's peer learning module that can support this culture:

Anonymisation Mode

Both the patient and the original report author can be anonymised during the peer learning workflow. Privileged users can break the glass and overrule this anonymisation, e.g. in case there are serious consequences for the patient, and they need to be identified.

Note that in a true peer learning mindset, anonymisation is not required as there is no stigma on making errors. It's all about learning from one's mistakes and sharing these learning points. However, even in organisations where the peer learning mindset is present, there may be occasions in which anonymisation is desired. Think of a teaching session with students or a meeting with external participants. That's why Agfa's EI peer learning module also allows – in addition to the system-level anonymisation – to anonymise per meeting (conference).

Asking for Additional Information

Imagine you're performing a peer review and lack some information in order to make a thorough assessment, such as the patient's clinical history, which is not mentioned in the current nor prior reports. Through a dedicated 'request feedback' task, the reviewer can request this additional information, even without knowing who he is asking the question to (in case the workflow is anonymised).

Importance of Feedback

Feedback is very important for building an open culture and allowing original report authors to actually learn from the peer review. This feedback can be both positive (good calls) and negative (ideally with follow-up actions or constructive feedback).

Peer Learning Administrator Role

The peer learning model allows the possibility to include a peer learning administrator. The key functions of a peer learning administrator include:

- First reviewer of the cases reported
- Reject cases when non-relevant
- Add missing/additional case data like patient history
- Review cases and rewrite the original feedback if needed to ensure that it is phrased in a constructive way
- Put cases on the agenda of conferences when needed, for example, a Quality Committee can discuss cases upfront before discussing them in a group
- Follow-up on actions to be taken or reopen cases when needed

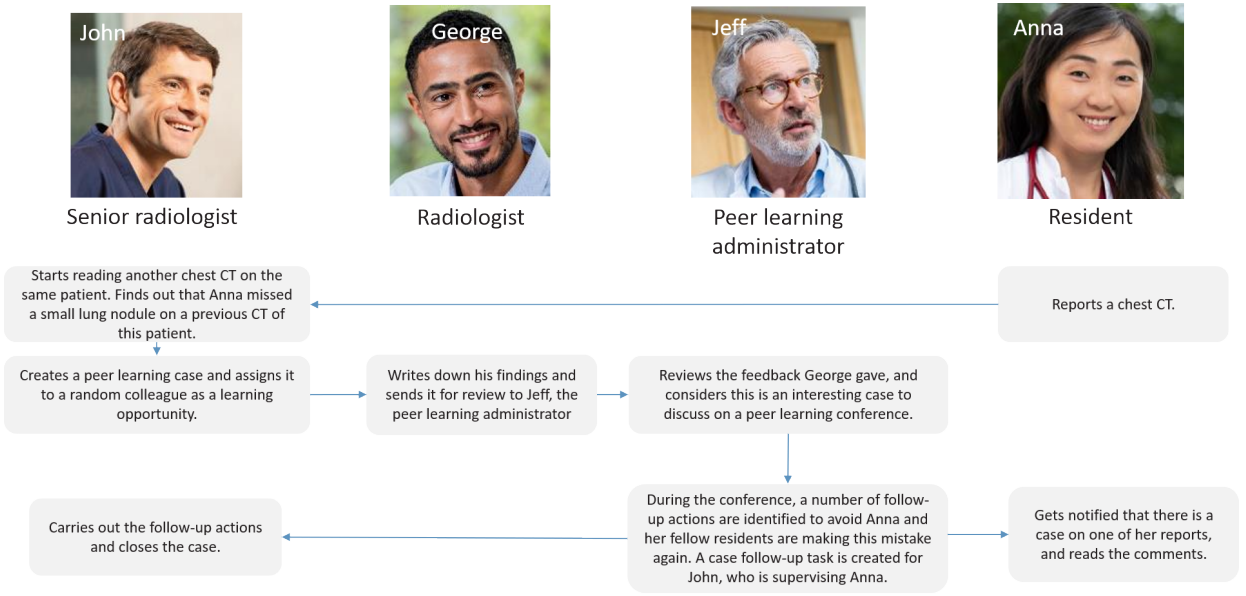
Is the peer learning model easy to implement?

The workflow is very configurable, so an important part of the implementation is the workflow analysis. Similar as for many other workflows, we recommend to think big, but start small: the entire scope/vision of the department on peer learning should be known upfront, but implementation should be done stepwise to fine-tune where needed.

Is the peer learning module implementable for all types of facilities or only for larger hospitals or departments?

One of the key properties of the peer learning module is its configurability which makes it relevant for all types of facilities and departments. Workflows can easily be tuned from very simple (one reviewer, always triggered manually) to very

Example of a complex peer learning workflow



complex (multiple review boards, manual & automatic creation of cases).

The software can also perfectly cater to the more traditional peer review workflows with only a random selection of cases and registering scores as the Radpeer score, or a combination of both.

The peer learning workflow is completely **embedded in a radiologist's routine workflow.** Enterprise Imaging is a task-based system. The peer learning related tasks are just 'one of them,' and appear in the activities overviews. Depending on the user's preference, there can be separate activities overviews and/or task lists for peer learning activities, or they can be merged with existing ones.

When a hospital or department implements this feature, do the radiologists lead it, or is there another committee or team that manages it?

That's completely up to the hospital/department. Some organisations choose to appoint a peer learning administrator, who decides which cases get discussed in meetings or reviews the wording before the original report author gets his feedback. All data is available in the reporting module as well, allowing PACS admins to extract the reports needed for hospital management or accreditation and certification bodies.

The peer learning module can also be used for a second opinion workflow. Can you explain it a bit more?

Indeed, if you want a second opinion without having the second radiologist's name on the report, you can trigger a peer learning case on your own report. That's just one example on how this module can cover other use cases that are not strictly peer learning.

In summary, Agfa HealthCare's peer learning system is designed to improve collaboration and foster a culture of teamwork and feedback which promotes actionable learning and would enable radiology departments to create a continuous improvement cycle. It's learning at its best. That is our ultimate goal. ■

Ready to turn your radiology department into a continuous learning environment? Download the leaflet and start here.

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New Era in High Value Care in Europe

Interviewee: Jorge Fernández García | Director of Innovation | EIT Health | Barcelona | Spain

High value care has been on the healthcare agenda for some time now, but for many, it is still a concept rather than a reality. As research from EIT Health shows, healthcare providers often lack the tools necessary for the successful transition. To address this gap, the organisation has launched a new initiative, the High Value Care Forum, that aims to facilitate the shift towards patient-oriented outcomes through education, training and best practice sharing. An expert who has been leading this initiative, talks about how high value care is achievable with small steps and in what ways the Forum can help.

The EIT Health High Value Care Forum was launched in September. Please tell us about this new project.

The High Value Care (HVC) Forum is our new strategic initiative to move the needle with regard to HVC in Europe. It will support healthcare providers and professionals to drive transformation in healthcare systems towards outcomes that have the highest impact and are of most importance to patients. This is, in fact, what a lot of national and regional health systems and healthcare providers are moving towards, but how to do it is not always clear. We hope to provide value within this domain of 'how'.

What are the specific formats the Forum includes?

We see three lines of activity. The first one is what we call the 'case study library' meant to showcase examples of successful implementation of HVC, enable sharing the lessons learnt, and inform future activity. It is not about how good a hospital is, but how it has succeeded on its HVC path: what it did, which barriers it had to overcome, the issues it faced and how they were solved, and so on. Even though we call it a 'library', our goal here is less academic and more on the practical side – to make sure that people have tools to make the HVC implementation successful.

The second area is education and training. This is something urgently required by our community, which includes top institutions and companies working in the field of healthcare and life sciences, in other words, the people who are aware of the HVC's potential. Such people are still a minority, and it takes them a lot of time and effort to explain the HVC ideas to others – what it is, how to do it, what does it mean. We have talked to more than 50 stakeholders in our community, experts who have been leading these efforts in their respective organisations, and all of them said they needed to train people both within and outside their organisations. Here, it is not enough to simply define the terms. There is, of course, the system proposed by the value-based healthcare (VBHC) pioneers, Professor Michael Porter and Professor Elizabeth Tiesberg, but as I said, our endeavour is not academic. We are more interested in how to make the actual transition successful.

The third format focusses on best practice sharing through workshops and conferences. This is how the initiative started in the first place. We attended many events, and the people we met there kept talking about the need for a place where we could meet continually – a place where we could talk to each other, test approaches, report achievements. The important aspect here is that if people share their knowledge and experience, all of them can be winners. In this field, there is no competition.

Why is it 'high value' care and not the more common 'value-based' care?

There are two reasons for that. HVC is the term used for the restructuring of healthcare delivery towards measurable outcomes that have high impact and matter most to patients. In other words, HVC is about outcomes, while VBHC is about the process. We want to concentrate on the outcomes. The second reason is how Europe sometimes holds this attitude of 'nonacceptance' towards things that originate in the US, as VBHC does. Also, there are several countries where VBHC got some bad publicity. This was because the implementation

was wrong, not because the ideas were wrong. This created a situation where people supported the idea of working towards outcomes that mattered to patients and not only to clinicians or regulators or policymakers, but they felt very uncomfortable using the term VBHC. In any case, HVC is a widely used term. It is not our invention, and I think here in Europe, it will become common.

Considering the COVID-19 developments, why has EIT Health decided to launch the initiative now?

It does look like it is 'just in time'. However, we have been working on HVC programmes with our innovators and entrepreneurs since February 2018. Therefore, creating a platform for healthcare institutions was a natural step for us. At our annual event, the EIT Health Summit last year, the keynote speech (by Prof. Teisberg) and many topics were around outcomes that matter to patients. Furthermore, we spent eight months studying successful and unsuccessful implementations of HVC across Europe and produced a comprehensive report, "A handbook for pioneers," which hopefully will be useful to the community moving forward.

In other words, the current launch of the Forum has nothing to do with COVID-19; it hasn't happened because of COVID-19. It is common knowledge that many healthcare resources are wasted on avoidable complications, unnecessary treatments or administrative inefficiencies. Costs are increasing, and in some countries such as the US or Switzerland, people have to pay a lot of money to get the outcomes they want. What HVC does is facilitate the shift towards patients paying for important services. Let me give you an example. What is important for an oncology patient is the number of days that they spend at home, but they pay for the number of days they spend at the hospital. There is a clear misalignment here, and the one who is usually penalised in the end is the patient, not the hospital or healthcare system. This is the current situation, and we as an organisation have this mandate to try and change it.

The pandemic has somewhat delayed our plans. We had everything ready back in March, but then the attention shifted to COVID-19. However, the pandemic has highlighted the value of having a holistic view of how we provide care. For example, it has never been clearer that prevention is key; the importance of diagnostics has been brought back, as it helps to avoid wrong treatments, which are both costly and harmful. Nevertheless, despite all these changes, the goals of the Forum are the same as they were before the pandemic.

> One of the things you learn working in a hospital system is that there is no 'on/off switch' for any transition

Is there a possibility that healthcare providers may now be too preoccupied with the pandemic-related challenges and not have enough capacity for HVC projects?

First of all, it depends on the specific situation in each particular hospital. For example, I live in Barcelona, and when I talk to people in Madrid, the US, or Israel, hospitals there are indeed really busy. One of the things you learn working in a hospital system is that there is no 'on/off switch' for any transition. You start small and proceed bit by bit. You showcase some of your achievements, other people copy them, and in the end, this becomes their standard of care. This is how you transform reality, and we want to play a role here, to move that needle towards the transformation of the healthcare systems. Even if a hospital is really busy, it only means that we are delaying the change, not refusing it altogether. The goal is still worthy. This is especially important here in Europe, with our public health systems, for which we can no longer pay. This is where innovation enters the equation, because we, as a European society, want to preserve our healthcare systems, so we need to optimise the way they operate.

Fortunately, many are willing to start with small steps and eventually reach a bigger goal. Michael Porter is an academic, and he considers you as being 'HVC/VBHC' if you meet the six criteria he has defined. At our end, we don't do this. We talk to people, and if someone has done something that has a real impact on patient outcomes, we study their experience. According to our research, we can say that there are different bases for success, and it should not necessarily mean ticking all the boxes on Michael Porter's list. We want to see more patients being treated in different ways. We want to see that patient-reported outcomes and patient-reported experiences are being asked from patients, evaluated and then taken into account by the hospital management and national healthcare systems. You focus on something, measure it, and try to improve it – and then you start the cycle all over again.

In the report, EIT Health outlines a concept of the 'Implementation Matrix'. How does it fit into the HVC paradigm?

This is part of what we call the 'tools'. People do understand what HVC is, they just don't have the tools to implement it, they don't have a 'process' of what comes first, what follows, what are the barriers, what are the levers, how to multiply the impact, and

Pandemic Accelerating Uptake of New Care Models

Author: Chris McCahan | Sector Lead for Health and Education Services | IFC | Washington (DC) | USA

Since the start of the COVID-19 pandemic, novel ways of care delivery, such as digital solutions or home-based care, have been shaping the 'new normal' in healthcare. An investor reflects on their potential benefits and risks, and explores the elements necessary for their smooth adoption.

Key Points

- The COVID-19 pandemic is boosting the adoption of new care delivery modes, which hold great promise and present new challenges.
- Technology enabled tools, however useful, carry some inherent risks and require solid infrastructure in place.
- During the pandemic, home-based care has proven to be a safer alternative to a hospital setting, but strict safety protocols must be in place.
- Digitalisation of healthcare services leads to more organised data flow facilitating population health management and the transition to more efficient health care delivery.
- Governments must provide appropriate regulatory frameworks for these new developments.

Background

The COVID-19 pandemic is accelerating the evolution of health care delivery models, which holds enormous promise for expanding access, bringing down costs and improving the quality of care. Some of the change, such as the surge in telehealth and telemedicine and the deployment of home-based care solutions, is quite visible to patients. Other changes are more behind the scenes, such as health providers' adoption of technologies that improve operational efficiencies and their use of artificial intelligence to fine-tune treatment approaches. While tech-enabled solutions have allowed continuity of care, the pandemic is also shedding light on the challenges these solutions pose.

In primary care, the near wholesale flip from in-person to virtual consultations during the lockdowns has given insight into the strengths and limitations of telemedicine. We have seen that many services can be delivered remotely effectively, saving time, cutting costs, and potentially improving patient and doctor safety. But these benefits depend on there being affordable access to reliable broadband internet and this is still lacking in many places, especially in developing countries. In addition, remote diagnosis has some drawbacks compared with an in-person consultation, which allows a doctor to pick up on certain symptoms or signals (for example, body language cues) that video and phone consultations may not. Doctor training will need to be recalibrated to compensate for this.

While virtual consultations can save patients time and energy by cutting out trips to and from the clinic, they can add to the doctor's work burden given the time and effort it takes to set up and interact using digital platforms, all the while troubleshooting connectivity issues. Not all digital tools improve productivity and IT-driven doctor burnout is a well-documented phenomenon (Gawande 2018). In addition, this shift in care delivery calls for greater attention to be paid to data protection implications – safeguarding, for instance, that the online communication channel chosen is not vulnerable to hackers or other malicious actors.

In specialty care, digital technology is increasingly being harnessed to improve the quality of treatment. For example, an International Finance Corporation (IFC)

so on. The Implementation Matrix is one of those tools. We are also working on what we call a Step-by-Step Guide to explain the steps – a hospital team might need these to start their HVC transformation journey. In the end, it is all about giving people the tools to achieve their goals. This is not the job of EIT Health, national/regional health authorities, or consultants – it must be hospitals that initiate the change from within. For this, they need tools, which are simple to understand and use so that people can communicate in the same language and understand each other. There have been some very successful experiences with our startups using certain tools. Everything goes faster because they understand each other faster and identify the problems and the ways to solve them faster. The advantage of having these tools is that they can be adjusted to include any new aspect that might surface along the way. For us, the tools are a means and not the end.

The healthcare landscape across Europe varies greatly. How do you ensure the smooth application of the tools in such diverse settings?

Our tools are universally applicable. You can use them in any country and from any stakeholder's perspective. What is totally different is the reality of the places. For example, the way pregnant women are monitored and treated in Spain is not the same as in the UK. I am not talking about the quality, but about the number of visits, the specific responsibilities, etc. These are very local. But we are not aiming to have uniformity in Europe. We are interested in having better health outcomes for patients, and that's it. This goal can be reached with different approaches. If we take startups, their main goal is scalability – they do something once and then copy-paste it everywhere. In the case of HVC, the aim is not scalability, it's replicability. If something has worked in Germany, it can be implemented elsewhere, not by copy-pasting it, but by adjusting it to a particular system. On the other hand, something might have worked in Germany because of a very specific feature present there but not in another system. This helps to see that a certain approach might not be replicable, and you need to look for other ways.

During your extensive research, were there any common 'success factors' with regard to HVC implementation?

Indeed, there are several. The first one is to have support at the executive level. Why is that? Because transitioning to HVC is mostly a management challenge, not a technological one. Whenever things start to get complicated, you need to be backed up by the leadership. This is very important, especially when introducing something new. The organisation would resist because you are asking to move away from the traditional ways of working and do something different, so you need support at the highest level.

The second factor, which is also very important, is the alignment with the payment models. As I said before, if you want to have A but you're paying for B, it will never work. The hospital can do everything perfectly, but unless you support your aspirations with a proper payment model, there will be no meaningful outcome. Let me give you an example. For close to ten years, I was Director of E-Health at Sant Joan de Deu (SJD) Hospital, a major paediatric hospital here in Spain. We had what we called the 'Liquid Hospital', an initiative to radically transform the provision of care through intensive use of technologies oriented towards the patient. One of the key 'Liquid Hospital' projects related to diabetes. From the methodological point of view, diabetes is quite simple because it has a metric of the blood sugar level, so it is easy to agree on the reimbursement with the regional payors, as we did. As a rule, there are four visits to the hospital for diabetic patients each year, regardless of whether the patient is compliant with the treatment or not. On the other hand, the technology that we used allowed us to remotely monitor patient compliance, which meant that we didn't really need to see them in person four times a year. The regional system, however, only paid us for in-person visits, not for digital visits. Although we were pushing to show that the 'Liquid Hospital' strategy was efficient, our financial team disagreed. Therefore, unless this change transforms the payment part, it's very difficult to implement, especially in public systems, as was in the case of SJD. Therefore, at EIT Health, when our partners form consortiums, we always ask them to include a provider and a payor from the same region taking care of the same patients. In this case, everybody's perspectives can be aligned to ensure the desired transformation.

The third success factor is about the knowledge that is out there but is not codified. We are putting a lot of effort into codifying this knowledge, as we did with our report. Back when I worked at SJD Hospital, I brought the Stanford Biodesign Innovation Fellowship to Barcelona. It is a great programme where interdisciplinary teams experience a full cycle of innovation to create innovations coming from hospitals. Anything you might have wanted to know about biodesign, you could find in a 1,000-page programme book. However, a participant once mentioned something that wasn't in that book, but what they learnt from a Stanford professor who supported their team. It shows that sometimes the

only way to learn something is for somebody to tell you about it. No book, no guide, no article can do that. There is the knowledge that is still in people's heads, so we need to extract and codify it – to then initiate a discussion among the stakeholders on the processes, problems, solutions, etc. This is exactly what we hope to achieve.

The Forum has now been successfully launched. What are the next steps?

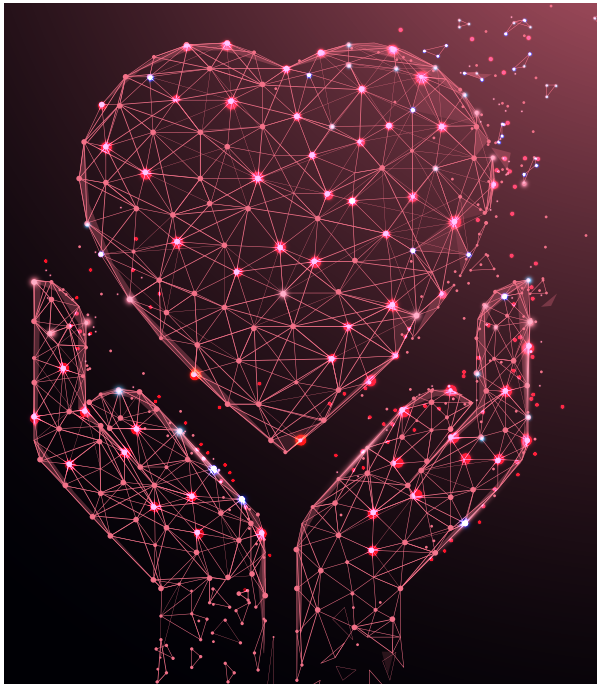
First of all, we focus on education and training. There are meetings to be arranged. For this, EIT Health is engaging with people and institutions who will be the 'transformers'. Currently, we are in talks with several cross-border institutions looking to join forces and support this initiative. COVID-19 is, of course, an obstacle here, but we will create small groups, and that will be the start. Also, we will release some of the content that we already have, to be discussed at those meetings.

Hopefully, we will get through to the desired way of operation, which is to offer training opportunities. We plan to publish several case studies per year with 'lessons learnt' and best practice documents that people can build upon. There will be several workshops on specific topics, such as data, payments, procurement, outcomes, etc.

To follow up on our progress, we will be building a portfolio of those cases that have 'matured' through the participation in the Forum, i.e. the workshops, training and conferences. The workshops are starting this year, and in 2021 we hope to also deliver the online training programme. Then, as soon as the situation allows – hopefully in 2022 – we're aiming for a large conference. The HVC initiative plan has been in place since March, so now we are ready to engage with the community for the benefit of everyone involved.

Conflict of Interest

None. ■



client runs a network of diabetes clinics in Mexico, where 14 million people suffer from diabetes. A chronic illness that leads to myriad health complications, diabetes can also be a contributing factor in COVID-19 illnesses and deaths. After analysing its electronic medical records, the network noticed that patients with similar disease and demographic profiles often responded differently to the same recommendation, depending on personality type. This inspired it to create a research platform that uses behavioural analytics to tailor treatment strategies to personality types. It also deploys a mobile app to send gentle reminders to patients.

With people reluctant to visit clinics and hospitals in person during the pandemic, home-based care has become more popular. This can be a more cost-effective and safer way to deliver care compared to a hospital setting. It can be especially useful for patients recovering or rehabilitating from surgery and patients with chronic conditions like diabetes that can be monitored remotely. Providers need to strictly follow infection prevention and control protocols given that health workers in this space operate outside of a clinical setting and may be providing care in multiple homes in a single workday.

Healthcare providers' adoption of digital operating processes holds enormous promise for more efficient delivery of service and, when combined with data analytics, more sophisticated business models. For example, another IFC client has managed to become India's largest integrated online healthcare platform by offering a range of digitally delivered and enabled services including lab tests, e-prescriptions and teleconsultations. When India went into a 21-day COVID-19 lockdown in March, the company had the digital infrastructure to handle a deluge of online orders for essential COVID-19-related supplies like masks and hand sanitisers, as well as a 440% jump in flu and fever teleconsultations.

Digital technologies can also be harnessed to better connect the data dots in the health system, creating a more seamless flow of information between providers and payors and between public and private entities. This can produce better quality data on life-cycle health treatment costs by demographic, which can promote a transition from costly fee-per-service models to models that understand and apportion risks more appropriately. Such tools are helpful to governments in managing population health as they implement their collective commitment, made at the 2019 UN General Assembly, to achieve Universal Health Coverage by 2030.

Just as health providers are adapting on the fly to an unprecedented set of circumstances, governments must adapt on the regulatory side. The pandemic pushed many to relax regulatory restrictions that impeded non-traditional modes of care delivery – for example, telehealth consultations and e-prescriptions. Health-related regulations may need to be revisited to ensure the sustainability of these modes of care by addressing the challenges and new risks they pose. Strong, practical, clear regulation that enables market innovation while protecting patients, consumers and data is the key to delivering better, safer healthcare for all.

Conflict of Interest

This article references two health care companies both of whom the International Finance Corporation (IFC) has invested in. Clinicas del Azucar is a network of speciality diabetes clinics in Mexico. In 2018 IFC approved a $4 million equity investment in Clinicas. 1mg Technologies is an integrated online healthcare platform in India. In 2019 IFC approved a $10.2 million equity investment in 1mg. IFC's total healthcare investment portfolio, as of September 2020, amounted to $2.3 billion, spanning the health services, life sciences, and medical equipment and technology subsectors. IFC, a member of the World Bank Group, is the largest global development institution focused on the private sector in emerging markets. ■

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Workflow Optimization in Radiology: How AI is Helping Clear Waiting Rooms

Hospitals and Medical Practices Benefit from Custom Software Solutions

An overview of the implementation of a GE Healthcare analytics platform at a radiology practice in the German RheinMain region and the Institute for Radiology, Kantonsspital Aarau, Switzerland.

Business Intelligence (BI) and Artificial Intelligence (AI) allow medical practices and hospitals to achieve significant increases in efficiency. Implementation of a GE Healthcare analytics platform at a radiology practice in the German RheinMain region and the Institute for Radiology at the Swiss Kantonsspital Aarau have demonstrated how this software can improve appointment scheduling and workflows in everyday practice and clinical life while also reducing waiting times and the number of patient no-shows. This delivers considerable service improvement for patients and also reduces costs.

Long waiting times not only cause frustration among patients and referring doctors, but they also pose the risk of delayed diagnosis, meaning that by the time the appointment actually happens, it may be too late to administer the optimum treatment for the illness. “If my next available MRT appointment is not until the next five weeks, for example, I run the risk of losing that patient,” explains Dr. Christopher Ahlers, Radiology Consultant and Executive Director of radiomed, a practice cooperative for radiology and nuclear medicine in Germany’s RheinMain region. Like many other registered radiologists, Dr. Ahlers is facing many challenges in his daily work. “We need to treat more and more patients in less and

Figure 1: MR Excellence Program

less time," explains Dr. Ahlers. The radiologist sees himself as both a doctor and a businessman. "Of course, patient wellbeing is my primary concern, but I also have to pay attention to the efficiency and economic viability of the practice."

Efficient Processes in Medical Practices are Essential

In his quest to remain competitive and to identify improvement potential in everyday practice, Dr. Ahlers looked to GE Healthcare for support. "One stand-out fact was that on some devices, our practice staff were utilized to full capacity with around two patients per hour." From Dr. Ahler's perspective, it, therefore, made sense to address the specific issues with an analytical approach. First, he and his colleagues used a spreadsheet to document all the steps where they were losing time. All unused resources, inefficient scan protocols, downtimes and waiting times cost the practice time and money.

Individual Analysis with GE Healthcare

To ensure the data obtained was of high quality, they embarked on an optimization project together with GE Healthcare. The following questions were defined: Where are we losing time? Does it take too long to reach the point where a patient is actually lying in the scanner? Why are our staff already utilized to capacity with just 1.5 patients per hour? Would it help to employ more staff? Are there idle times?

"No doctor wants unhappy patients," agrees Jan Beger, Director Digital Application Services EMEA at GE Healthcare. This is why GE not only offers continually improving software for imaging equipment but also supplies applications for workflow optimization. "Although this offering is initially pretty invisible compared to an MRT or CT scanner, you suddenly begin to notice improvements in the workflow." Everyone involved wants the process to run smoothly, from registration to examination and then to treatment. "In an ideal scenario, we benefit patients with shorter waiting times, staff with less overtime, and doctors by giving them more time for their patients," is how Beger describes the objectives of the custom AI service supplied for workflow optimization in radiology. To this end, GE has developed an Applied

Figure 2,3: 16% time savings with MR 1.5T HWS protocol

Intelligence platform called Imaging Insights. A set of dynamic dashboards delivers comprehensive analyses from imaging techniques including MR, CT, x-ray and ultrasound. As a cross-provider solution, Imaging Insights combines device data with workflow data from radiology information systems (RIS) to measure key performance indicators (KPIs) in radiology.

Business Intelligence for MR Technology Delivered by MR Excellence

GE´s MR Excellence program, part of Imaging Insights, enables radiology teams to combine the collected data more effectively and to optimize their workflow, increase performance and make informed decisions. The solution uses LEAN and Change Acceleration process tools to assist radiology employees in better understanding their data and making the right decisions. “MR Excellence has finally enabled us to identify the idle capacity times of our MR technology and, therefore, to increase our cost efficiency, while maintaining consistent imaging quality,” explains Dr. Ahlers. Through a thorough analytical investigation of all processes in our clinical practice, MR Excellence has facilitated the optimization and standardization of suboptimal appointment scheduling and resource utilization, as well as scan protocols. Patient waiting times for appointments have fallen from six to eight weeks previously to between one and two weeks, depending on the device. MR Excellence not only optimizes workflows but also applies AI that helps doctors consolidate relevant data.

Dr. Christopher Ahlers is convinced that AI offers benefits for the future of medical care: “Within ten years at most, radiologists will only be viewing images that have previously passed through an algorithm.” Rather than replacing doctors, this will provide them with valuable insights that they previously wouldn’t have been able to obtain, or at least not so quickly.

Thanks to the use of BI, radiomed has been able to increase productivity by up to 30 percent. Depending on the system, they have been able to increase the number of MR scans from 120 to around 170 a week.

Solutions are Equally Applicable in Individual Practices and Hospital Environments

As the number of patients treated per day increases, the economic benefit becomes more significant. GE Healthcare has solutions that could help achieve this. One example is the Institute for Radiology at the Kantonsspital Aarau, Switzerland: “Here we suggested deploying AI to improve the efficiency of appointment scheduling,” explains Beger. So far, initial test runs have shown very positive results. The Institute for Radiology in Aarau employs some 140 employees - of whom 39 are doctors for almost 30,000 inpatients and around 60,000 outpatients every year. In 2018, it performed approximately 120,000 examinations. “Our workflows in the Institute need to be fine-tuned and run like clockwork,” reports Prof. Dr. Sebastian Schindera, Chief Physician at the Institute for Radiology, Kantonsspital Aarau, Switzerland. However, the potential for improvement often lies in detail. In 2.5 years, he and his team have documented 2514 no-shows - patients who simply don’t turn up for their agreed appointment. The target set by Prof. Schindera, in cooperation with GE Healthcare, is to reduce the number of no-shows. “Ultimately, the increasing numbers of no-shows can endanger other patients who have to wait a long time to be examined.”

No Shows are Irritating and Expensive

Whether patients forget, no longer need their appointments, are running late or have to cancel at the last minute, missed appointments mean more than simply lost revenue. In the worst-case scenario, it also means that booked rooms and devices can’t be made available for other patients at short notice. “Since it’s not so easy to quickly find another patient for an empty MRT scanner, this results in enormous costs of having equipment standing idle,” explains Prof. Schindera. Data published in the USA in 2018 reports a no-show rate of up to 15% in every 200,000 outpatient appointments. According to the study, this can lead to business losses of approximately USD 700,000. Prof. Schindera comments: “I’m not aware of any similar statistics in Europe, but if I project the data from the USA on to our examinations here in Aarau, this will represent losses of up to CHF 150,000 per year.”.

Combining AI and Text Message Reminders Minimizes No-Shows

The first step in preventing no-shows is to make a precise record to capture the current situation. A range of strategies can then contribute to decreasing this rate in the hospital. Combining the most effective measures can result in significant

improvements. The first solution that was tested in Aarau was sending a text message reminder 24 hours before the appointment. This text message contains key information so that patients remember their appointment or have the opportunity to cancel. If cancelled, the appointment can then be reassigned. In Aarau, this approach reduced the number of missed appointments by 30 to 50%. Although this was certainly an initial success, there was still potential for improvement.

The Aarau hospital, therefore, tried a second strategy, using AI from GE Healthcare, to predict a high no-show probability of patients for a particular appointment. The algorithm is trained using past data and incorporating predictive factors such as day of the week, time of day, weather forecast, demographic patient data and previous history. This algorithm can use patient profiles to generate recommendations, such as "avoid scheduling appointments for patients aged between 20 and 30 early in the morning" or "patients who live more than 20 km away should not be scheduled during rush hour traffic." This AI tool can also provide staff with a list of patients with a "high risk of no-show" for the next five days, so staff can then contact these patients again to confirm the appointment.

Dr. Alexander Cornelius, the Deputy Director of the Institute for Radiology, Kantonsspital Aarau, Switzerland, is delighted with the results of the initial test runs and has a positive view of the complete implementation in just a few weeks: "I'm impressed at the results of the Edison applications from GE Healthcare. The solution has enabled us to estimate the anticipated no-show rates for expensive MRT examinations much more effectively. Using the algorithm should enable us to reduce the number of no-shows and, therefore, fully guarantee high capacity utilization of our equipment infrastructure."

For Beger, this demonstrates the "sheer inexhaustible potential" of AI, which extends far beyond simple appointment scheduling. "It is becoming increasingly rare for diagnosis and treatment to be defined by a single physical location. Nowadays, we can interpret clinical data quickly and accurately and deliver findings directly at the point of treatment." In addition to supporting appointment scheduling, the functionality of "Edison Analytics" also includes more efficient modeling of radiologists' daily workflow. The software provides a general overview of important information such as productivity and throughput times, trend analyses and cost comparisons for reporting findings through to the capacity of individual report writers. "Nowadays, the possibilities of AI mean we can very quickly analyze large datasets from devices and diagnostic imaging processes, in order to obtain answers to decisive questions," is how Beger describes the advantages of the AI and BI solutions from GE Healthcare. This means that clinical and central administrative functions can also be analyzed and optimized across disciplines.

GE is already planning to implement further dashboards offering a variety of additional applications for its Swiss customers. For example, it is currently designing a dashboard that intelligently and independently assigns patients to the appropriate protocol and best possible appointment based on criteria such as referring doctor or specific diagnosis.

GE Healthcare: Data Protection by Design

GE Healthcare is aware that patient data is extremely sensitive: "It goes without saying that our AI solutions are always analyzed in respect of data protection regulations and ethical considerations and are developed accordingly," stresses Beger. "For example, all data used for training AI is anonymized." AI is intended as a support feature to assist medical personnel.

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Artificial Intelligence and Cardiology: Reaching New Frontiers

Author: Dr. Rafael Vidal-Perez | Cardiac Imaging Consultant | Cardiology Department | Hospital Clinico Universitario de A Coruña | A Coruña, Spain

Part of the new care delivery in cardiology is the use of artificial intelligence tools that are proving their utility in this evolving field. Electrocardiography has been considered an important diagnostic tool but also could have a role in the prediction of events. One important event to predict is atrial fibrillation due to its causal relationship with stroke, something that could be prevented in many cases with the start of anticoagulation. Artificial intelligence has shown potential value in predicting atrial fibrillation using simple tools as 12-lead electrocardiography. These strategies, based on electrocardiography, could have a role in other scenarios. External validation of this algorithm will be the key to AI success in daily clinical practice.

Key Points

- Decision-making process in medicine is a complex task.
- Incorporation of artificial intelligence tools in the field of cardiology into daily decision-making will improve care.
- Artificial intelligence has a potential value in predicting atrial fibrillation using simple tools as 12-lead electrocardiography.
- ECG patterns evaluated by artificial intelligence could help in the diagnosis of important diseases with an important impact on prognosis

Decision-Making in Cardiology

Nowadays, the decision-making process in cardiology, as a part of medicine, is a complex task that, in an ideal world, is based on the availability of reliable and objective evidence, fast access to knowledge, as well as the proper interpretation of available facts with the incorporation of patient benefit-risk ratios into every step; however, the experience of the practice of cardiology in the real world has taught us that this evidence is not always available, assimilation of knowledge takes time and decisions regarding each individual case may not always be objective (Bonderman 2017).

It is known that the most errors in decision-making have been attributed mainly to two elements, one of them is bias, such as for example, categorising minorities (social bias), and the other one is noise, which means that decisions are prejudiced by irrelevant factors, such as current mood, time since the last drink or even the current weather, as highlighted by Kahneman (2016). If you take all this information together, there is clear room for improvement with respect to generating evidence, structuring knowledge and translating it into clinical decisions

Probably the incorporation of artificial intelligence (AI) tools in the field of cardiology into daily decision-making will improve care delivery. But it is necessary that cardiologists retain the last step in the control of the system, keep an eye on the decisions and have the authority to change algorithms in cases that go wrong.

In this evolving field, AI is showing that simple tools like electrocardiography (ECG) could bring us a lot of potential information converting the ECG into a powerful instrument for prediction.

Electrocardiography as a Predictor of Events

One of the best telemedicine tools is ECG, and it is well known from the beginning of the twentieth century. It is also one of the first examples of telemedicine. In the early 1900s, Einthoven transmitted heart tracing via telephone lines from the local hospital to the laboratory where his string galvanometer was located (Einthoven 1906). ECG plays a fundamental role in diagnosis but could predict future events

On this topic, one of the focus is atrial fibrillation (AF) prediction, as AF is an important cause of stroke, a real public health problem due to the mortality and disability situations after one episode (Alkhouli 2019). A widely available, low-cost, and non-invasive test that facilitates the identification of patients who are likely to have AF would have important diagnostic and therapeutic implications and the ECG could fit in this definition.

For instance, up to a third of strokes have no known cause - so-called embolic stroke of undetermined source (ESUS) (Hart 2014). Many of these strokes are related to AF, which can be under-detected due to its paroxysmal and often asymptomatic nature (Martin 2015). Patients with ESUS are at high risk of a recurrent stroke, and when atrial fibrillation is documented, anticoagulation might reduce mortality and reduce the risk of recurrent stroke (Lip 2018). However, empirical use of anticoagulants following a ESUS event, whether with warfarin or a direct oral anticoagulant, has not been shown to be beneficial and increases risk of bleeding (Hart 2018; Mohr 2001). Therefore, determination of whether AF is present is crucial to guide therapy.

Recent advancements in high-quality signal acquisition and the availability of automated hardware ECG setups have facilitated the use of ECG in mass examinations, and many ECG-derived markers have been confirmed as risk factors for incident AF. Both the atrium-related and ventricle-related ECG variables were risk factors for incident AF, with significant hazard risks even after multivariate adjustments. The risk factors included P-wave indices (maximum P-wave duration, its dispersion or variation and P-wave morphology) and premature atrial contractions or runs. In addition, left ventricular hypertrophy, ST-T abnormalities, intraventricular conduction delay, QTc interval and premature ventricular contractions or runs were a risk of incident AF (Aizawa 2017). But this approach has limited efficacy and new tools need to be created, and AI has been the solution.

A widely available, low-cost, and non-invasive test that facilitates the identification of patients who are likely to have AF could have important diagnostic and therapeutic implications

Artificial Intelligence and Atrial Fibrillation Prediction

Significant elements were developed in the last years to show the value of AI for AF prediction, and recently Paul A Friedman and his group at Mayo Clinic published important results about this topic (Attia 2019a). They showed that ECG in sinus rhythm could predict the AF in the follow-up. They developed an AI-enabled ECG using a convolutional neural network (CNN) to detect the electrocardiographic signature of atrial fibrillation present during normal sinus rhythm using standard 10-second, 12-lead ECGs.

They collected for that standard 10-second, 12-lead ECG acquired in the supine position at the Mayo Clinic ECG laboratory between Dec 31, 1993, and July 21, 2017, with rhythm labels validated by trained personnel under cardiologist supervision. They included 180922 patients with 649931 normal sinus rhythm ECGs for analysis: 454 789 ECGs recorded from 126526 patients in the training dataset, 64340 ECGs from 18116 patients in the internal validation dataset, and 130802 ECGs from 36280 patients in the testing dataset. 3051 (8.4%) patients in the testing dataset had verified atrial fibrillation before the normal sinus rhythm ECG tested by the model. A single AI-enabled ECG identified AF with an Area Under the Curve (AUC) of 0.87 (95% Confidence Interval 0.86–0.88), sensitivity of 79.0% (77.5–80.4), specificity of 79.5% (79.0–79.9), which could be interpreted as a good result.

This AI model tries to find signals in the ECG that might be invisible to the human eye but contain important information about the presence of AF. This AI model was trained using the standard 10-second, 12-lead ECG alone and did not require any other inputs for AF risk assessment. One important thing is that the detection of the AF signal in the ECG relies on this easily obtained 10-second recording as opposed to the more invasive loop recording or cumbersome Holter ECG monitoring (that means 24-48h wearing a device). Also, the addition of multiple ECGs within an individual patient improved the model accuracy and suggested repeated measures might yield even better performance.

The explanation of how ECG in sinus rhythm could predict AF is complex. The authors suggest that the structural changes that precede AF, which

might include myocyte hypertrophy, fibrosis, and chamber enlargement, are likely to lead to subtle ECG changes, allowing for the prediction of underlying AF.

The implications of this study are really important as it supports the hypothesis that subtle patterns on the normal sinus rhythm ECG can suggest the presence of AF. The ability to identify patients with potentially undetected atrial fibrillation using an inexpensive, non-invasive, widely available point-of-care test has important practical implications for atrial fibrillation screening and potentially for the management of patients with prior stroke of unknown cause.

Artificial Intelligence and Electrocardiography Reaching New Frontiers

But there many other things that ECG could show us with the help of the different approaches of AI.

One example is determining serum potassium. Extreme potassium concentration perturbations have well-described ECG manifestations, but more subtle potassium changes may be detectable by Deep Learning of the ECG, and a CNN identified hyperkalaemia with an AUC of 0.85-0.88. This approach may have implications for outpatient titration of medications that disrupt potassium homeostasis or renal function, or for altering dialysis schedules. This approach could give us serum electrolyte concentrations without any blood drawing (Galloway 2019).

Another development, although myocardial diseases causing poor ventricular function are often detectable on the ECG, the ECG itself is not the better screening test for asymptomatic left ventricular dysfunction - a condition that could affect up to 2-5% of the adult population. However, a CNN trained using ECG and echocardiography pairs could reliably detect left ventricular dysfunction (AUC 0.93) (Attia 2019b). This network has performed well in a subsequent validation study at the same institution (Attia 2019c) and is currently being tested in a prospective, cluster-randomised clinical trial called ECG AI-Guided Screening for Low Ejection Fraction, named the EAGLE trial (Yao 2020).

Also, AI has been used for the detection of hypertrophic cardiomyopathy (HCM) based on 12-lead ECG through a CNN, showing an AUC was 0.96 (95% Confidence interval: 0.95 to 0.96) with sensitivity 87% and specificity 90%, which means high diagnostic performance, particularly in younger patients, but this model requires further refinement and external validation (Ko 2020).

Conclusion

Artificial intelligence tools are promising, and they will change the way cardiology is practiced, but physicians need to be prepared for the upcoming AI era. We also need clear results of the utility of AI in daily practice. Many applications are discovered in a short time period, but they need to be replicated in different populations. External validation will thus be the key to AI success.

AI use in ECG interpretation could have important implications for atrial fibrillation screening and for the management of patients with unexplained stroke, but this approach needs further prospective calibration before widespread application for screening a broader, ostensibly healthy population.

Conflict of Interest

None ■

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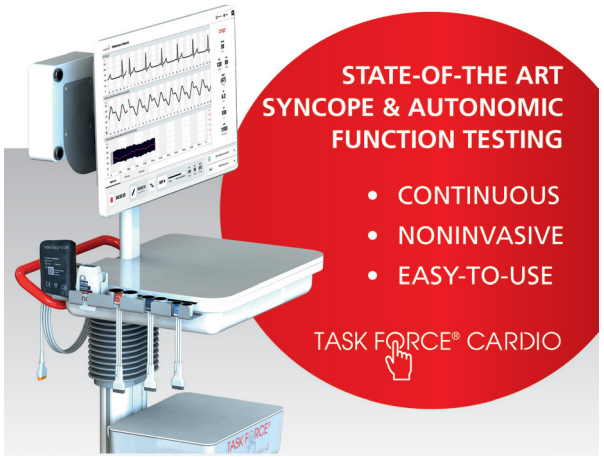
Setting New Standards in Syncope Management

Author: Dr. Jürgen Fortin | CEO & Chief Scientific Officer | CNSystems | Austria

Syncope is a heterogeneous syndrome with complex underlying mechanisms. The spectrum of patients presenting with syncope is broad, which requires appropriate, often individualized diagnosis paths.



"Patients presenting with syncope, a sudden transient loss of consciousness, require appropriate, often individualized diagnosis and treatment"[1]

Syncope is a heterogeneous syndrome with complex underlying mechanisms which have been described in numerous studies during the last decades with diverse approaches. The spectrum of patients presenting with syncope is broad, which requires appropriate, often individualized diagnosis paths.

In order to support the clinicians, medical societies regularly release Syncope Guidelines summarizing best clinical practices.

In the latest guideline update of the European Society of Cardiology, tilt testing and autonomic function tests are recommended as common diagnostic tools. Noninvasive continuous blood pressure (finger) and 12-channel ECG are listed as part of the essential equipment of a syncope unit, as fast changes in blood pressure and heart rate are used as primary parameters for diagnosis.[1]

The latest Heart Rhythm Society guidelines also emphasize the use of 12-channel ECG for the initial examination of syncope patients whereas for advanced diagnostics tilt testing and orthostatic tests are endorsed. The awareness regarding proper assessment of syncope seems to have increased and cardiovascular testing is reported to be a critical element in the evaluation and management of selected patients with syncope.[2]

Common practices of syncope management was recently investigated in a survey among specialists and showed that ECG assessment and orthostatic testing were classified to be necessary in the initial phase, whereas tilt testing and autonomic testing are recommended later in the pathway and in selected cases.[3]

Surprisingly, advanced hemodynamics also play an important role in better understanding the physiological interactions during the different phases of syncope. In a recent meta analysis, Buzko et al. (2019) compared different hemodynamic parameters during tilt test and mentioned Stroke Volume (SV) as being a significant marker in tilt position.[4]

Since the 1950s, cardiac output measurements have been considered relevant for syncope testing in addition to continuous blood pressure, but easy-to-use assessment tools were lacking. With the introduction of continuous noninvasive methods in the 1980s, rapid changes in blood pressure and later on cardiac output and vascular resistance could be assessed during tilt testing for diagnosing vasovagal syncope.[5]

Today, systems providing a full hemodynamic parameter set and synchronized patient signals for ECG and blood pressure are available allowing for an efficient syncope diagnosis and meeting the latest recommendations of the guidelines.

CNSystems is a market leader for state-of-the art syncope management and now introduces its new generation of hemodynamic assessment - the Task Force® CARDIO. The unique platform makes hemodynamic measurement even easier compared with its forerunner, the Task Force® Monitor, and relies on CNSystems' proven and validated CNAP® finger blood pressure technology with more than 20 years of experience and over 1,000 peer reviewed publications.

Are you ready for more details on an easy solution for efficient syncope management? Just visit www.cnsystems.com. ■

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Building A Hospital Without Walls

Author: Prof. Eugene Fidelis Soh | **CEO | Tan Tock Seng Hospital (TTSH) & Central Health | Singapore | Adjunct Professor | LKC Medicine (NTU – Imperial College London)** | Singapore

Author: Shu Ching Loh | **Executive Director, Division for Central Health | TTSH & Central Health** | Singapore

Author: Deborah Xue Ling Lee | **Management Executive, Population Health Office | TTSH & Central Health** | Singapore

Author: Dawn Yi Cheng | **Manager, Population Health Office | TTSH & Central Health** | Singapore

Author: Pei Xuan Chua | **Assistant Manager, Population Health Office | TTSH & Central Health** | Singapore

In the pursuit to achieve better population health, the Central Health Model of Care is designed to look beyond the hospital walls, and achieve the Five Population Health aims of Better Health and Better Value with Better People delivering Better Care to build a Better Community.

Key Points

- A contextualised population health model is necessary to address the issues of Singapore's changing healthcare needs.
- Four Principles guide the Central Health Model of Care by outlining the fundamental shifts required from the current healthcare delivery system to achieve its Five Population Health Aims.
- Six Strategies detail the approach taken by Central Health towards actualising Population Health Management for 1.4 million residents.

Singapore has a resident population of 5.7 million. It has experienced rapid economic development over recent decades and built a fairly well-regarded healthcare system (Lim 2017; Miller and Lu 2018). The country has one of the lowest infant mortality rates at 1.7 per 1,000 live births (Singapore Department of Statistics 2020) and life expectancy at birth has risen from 83.2 years in 2010 to 84.8 years in 2017 (Ministry of Health 2019).

However, her health system now faces significant challenges. Singaporeans live about ten years of their lives in ill health, and with an ageing population, frailty, dementia, isolation and disabilities would be key social drivers of health (Gan 2019). These social drivers cannot be managed with a medical model alone. There is a need to integrate health and social care in the community and to support ageing in place.

Where Healthy Life is Central

In 2017, Singapore's public healthcare system was reorganised into three integrated clusters; each responsible to provide comprehensive care across the care continuum for the population in their respective region. The National Healthcare Group (NHG) integrated cluster, of which Tan Tock Seng Hospital (TTSH) is part, serves the central-northern region of Singapore. The region is divided into three population zones to better cater to the local needs of each

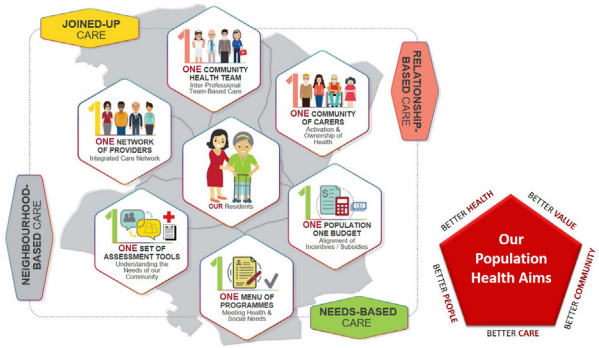

Figure 1. The Central Health Model of Care (4 Principles, 6 Strategies and 5 Population Health Aims).

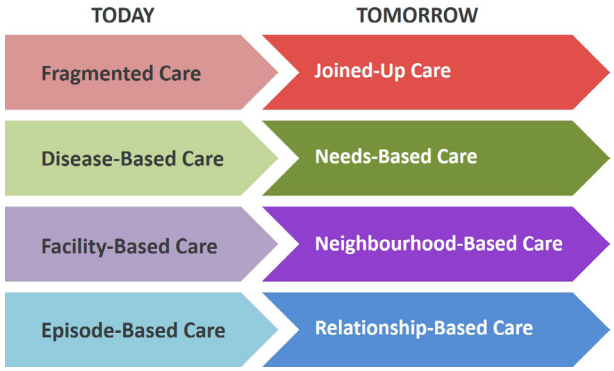

Figure 2. The Care Principles of Today Versus Tomorrow.

zone. TTSH has been tasked to go beyond its walls to look after the 1.4 million residents living in the central population zone of the cluster.

Residents in Singapore's central zone are comparatively older than elsewhere in the country; 17% are aged over 65 years compared to the national average of 14% (Singapore Department of Statistics 2019). About one-fifth of the elderly population there live with mild to severe frailty, and the needs for fall prevention, dementia care and palliative care are growing.

In 2017, TTSH started to redesign care and expand its mission towards population health. It rallied its primary and community care partners around Central Health, a new integrated care model to bring care beyond the hospital into the community. In 2019, this network of 75 partners committed to the shared mission of building health together for the residents in Central Singapore. Central Health as an integrated care network for the central population zone was launched.

Central Health Model of Care

The Central Health Model of Care uses a value-based population health approach that recognises the importance of health determinants, focusses on health outcomes, and is driven by evidence and data. It adopts Kindig and Stoddart's (2003) population health definition of "the health outcomes of a group of individuals, including the distribution of such outcomes within the group".

The Central Health model describes 'Four Principles' (4P) and 'Six Strategies' (6S) to achieve its Five Population Health Aims of Better People, Better Care, Better Community, Better Health and Better Value. The Five Population Health Aims extend from the Institute for Healthcare Improvement (IHI)'s Triple Aim. Better Care aims to improve patients' experience through the pursuit of care excellence and integration; Better Health seeks to improve the health of the population and staff through the promotion of healthy living and health ownership; and Better Value aims to control healthcare costs and to optimise value-driven care. Associated with IHI's latest quadruple aim, Joy in Work, is Better People where workforce growth and transformation are the focus. The final Better, Better Community, envisions a conducive environment with strong community-embedded relationships to support the delivery of quality care.

The 4P outlines the fundamental shifts required from the current healthcare delivery system to achieve population health while the 6S describes the approach towards actualising population health in the community (see Figure 1). At the centre of the model are the residents, who have the potential to be activated for self-care and are the focus of the network's care efforts.

The model creates an ecosystem, which focusses on health, not disease, and on serving residents, not patients. It supports residents by building a body of lay carers in the community, such as family members, friends and volunteers, who assist and care for those who live around them. Formal service providers, such as community health teams and health and social care providers, complement these lay carers in the provision of relationship-based and joined-up care. The care in the ecosystem is enabled through the application of assessment tools to determine the population needs, which will be met by a menu of health and social interventions available in the central population zone. Lastly, as a lever to drive integrated needs-based care, the healthcare financing model is evolving to facilitate the alignment of incentives across payers, providers and patients to ensure delivery of value-based care.

Four Principles – 'How' Singapore's healthcare delivery system should evolve

The Four Principles (4P) in the Central Health Model of Care represent fundamental mindset shifts from those that underpin the traditional model of care (see Figure 2).

These are:

i) Joined-up care

A network of providers that work together to coordinate care efforts such that residents receive seamless care across the care continuum over time. Each provider contributes interventions that join up with other providers to make progress in residents' health goals.

Figure 3. Community Health Posts Across Central Zone's Seven Subzones.

ii) Needs-based care

Understanding and characterising the needs of residents to design and deliver care that is matched to their needs. These needs may be health status or determinants of health. Recognising the multidimensional nature of health and its determinants, the aim is to achieve health-social integration in care delivery.

iii) Neighbourhood-based care

The care is anchored in local communities, which makes it more accessible for residents. Neighbourhood-based care allows care to be customised to local needs and preferences. It reflects the centrality of the community in the care model and the potential for local communities to be empowered to take charge of their health

iv) Relationship-based care

Shifting from an episodic transactional provider-patient exchange to a care partnership with residents built on understanding and trust, relationship-based care is continuous and longitudinal. Over time, it empowers residents to achieve greater levels of self-care.

Six Strategies (6S) – 'What' the enablers necessary to achieve population health are

Central Health aims to build healthier, happier communities where residents are activated and cared for by one community of carers, supported by one community health team and one network of providers. This integrated care network of providers uses the enablers of one set of assessment tools to identify needs, which are met by one menu of programmes. To ensure alignment of payers, providers and patients, transformation of the financing system is required to care for one population with one budget. The strategies, collectively known as the 'Six Strategies' (6S), are described below.

Strategy 1: One Community of Carers

Residents desire and have the capacity to care for themselves, their families and others who live around them. This is observed even in elderly residents and those living with serious chronic diseases. In Singapore, many residents live with their extended families and it is common to see three generations of the same family live together.

The role of a carer is mostly informal and can be taken on by anyone – volunteers, peer group leaders, caregivers and residents themselves. This strategy of building 'One Community of Carers' aims to activate individuals and promote a relationship-based care by equipping individuals with the necessary skills, knowledge and confidence to assume critical roles in managing health and social well-being in the community.

The Centre for Health Activation (CHA) was launched with a focus on Activation, Research and Training, also known as the 'ART of CHA' to empower residents to make effective decisions about their own health and well-being, as well as the opportunity to become healthcare volunteers. They are the bridge for other residents transiting from the hospital into the community. Some activated residents also assume the role of Peer Support Leaders and lead their fellow residents in community-based activities such as exercise and healthy eating, allowing neighbourhood-based care to flourish.

To date, CHA has over 500 active volunteers that support the growing suite of 33 programmes to meet the evolving health and social care needs of the population. CHA also works closely with community partners to develop and conduct programmes like Charge Up! Learning Programme that has so far equipped more than 115 carers with paraclinical skills and knowledge, such as managing chronic diseases and doing gait assessment.

Strategy 2: One Community Health Team

Complementing the community-based lay carers to better address the residents' unique needs, the central zone is geographically divided into seven subzones, where 'One Community Health Team' is assigned to each subzone. The goals of the community health teams (CHTs) are to build relationships with residents and work closely with local partners across health and social care to enable health engagement, care coordination and ageing in place. To this end, CHTs are co-located with partners in the community and currently operate 91 community health posts at partners' sites (see Figure 3). CHTs remain as the main physical presence and visibility in the community, and each team member is a local ambassador. They have intimate knowledge of ground needs and circumstances, and the information is incorporated into population health planning and interventions co-developed with the Central Health partners.

CHTs are multidisciplinary teams from TTSH. Each team is anchored by community nurses and health coaches, and supported by doctors, allied health professionals, pharmacists and administrators. The team delivers care in three main areas: wellness, preventive care and transitional care. In the latter, they support and empower residents with skills and knowledge for self-management of health issues and delay frailty progression. Additionally, team-based convergence of skill sets and competencies can be achieved through cross-trainings. In the long term, the CHTs contribute to building a Hospital Without Walls by delivering care for residents in the community. CHTs will work alongside the Community of Carers to ensure strong care support in the neighbourhoods. (See appendix for stories from the CHTs on patient care beyond the hospital.)

Strategy 3: One Network of Providers

In 'One Network of Providers,' the co-creation of a common vision and shared goals guide the collaborations amongst partners with an aim to evolve the relationships into long-standing partnerships characterised by multilateral collaborations. An integrated care network delivers seamless care for residents in a holistic and concerted manner, where the convention of facility and episodic-based care is broken down and residents' needs are considered in totality, shifting towards relationship and neighbourhood-based care.

To date, Central Health has built a network of strategic partners who work in the central population zone. They include 'vanguard partners' for overall care integration, institutions which manage residents who are transiting from hospital to community care, and expert partners in specialised care areas such as End-Of-Life (EOL) services. The network also admits primary care providers and community partners, which are major touchpoints in the central zone. Collectively, an integrated care network is envisioned to better integrate care delivery across the care continuum and simultaneously foster alignment across health and social care providers.

Strategy 4: One Set of Assessment Tools

With greater collaboration with partners in care delivery, there is an impetus to establish a common language amongst partners. To enable this, the 'One Set of Assessment Tools' strategy allows insights into the population's needs, for planning and implementation of interventions, and evaluation on the effectiveness of interventions.

> **The community health teams remain as the main physical presence and visibility in the community, and each team member is a local ambassador**

The tools are broadly categorised in two areas:

1. Population-level assessment tools: The applications enable segmentation of population for analysis at the macro (i.e. country), meso (i.e. specific subpopulation such as residents grouped by chronic conditions) and micro levels (i.e. high-risk population of certain outcomes like readmission) (Vuik et al. 2016). Stratification of population is necessary for population health management to design the right interventions for the right population. It also identifies unmanaged needs by comparing care interventions that should be delivered against care that has been delivered for the same population segment. In Central Health, a two-pronged approach is explored, where first, a global risk stratification tool is used to categorise residents based on their health status and other factors. Based on the categorisation, a needs-based segmentation tool would then be applied to match appropriate interventions.

2. Individual-level assessment tools: These applications are further subdivided into clinical and social assessment tools. Despite Singapore's small geographical area, there is currently little harmonisation of tools across institutions and in different care settings. A shared set of clinical assessment tools creates a common language for providers to join up care and enables collaboration.

Strategy 5: One Menu of Programmes

In 'One Menu of Programmes,' the strategy aims to consolidate all interventions available across the care continuum into a common directory of health and social care programmes. This comprehensive list of programmes is derived on two levels. Firstly, it leverages the existing services offered by health and social care providers, and secondly, it identifies gaps in addressing the population's needs. This gap identification creates opportunities for Central Health partners to collectively co-create new programmes to ensure that the population has the access to resources that would benefit their health.

TTSH has developed six care workstreams to provide direct care services that complement and bridge gaps in 'One Menu of Programmes.' These workstreams target different segments of the care continuum, ranging from Preventive Care to Long-Term and EOL Care. All workstreams are co-developed and implemented with the Central Health community partners, and are joined up to ensure care integration. Preventive Care optimises the bio-psycho-social well-being through outreach, screening and health coaching. The Primary Care workstream right-sites appropriate services to reduce unnecessary demand for specialist services. Frailty-Ready Hospital Care provides evidence-based care to support the older and frail population. To ensure seamless care post-hospitalisation, Intermediate

Care and Transitional and Community Care workstreams establish downstream rehabilitation and transitional care. The Long-Term Care and EOL workstream assists residents to maintain quality of life and dignity in their final days.

Building on 'One Community of Carers,' the assessment and list of programmes (recommended based on needs) would be made public to encourage self-servicing amongst activated residents. Residents who require more assistance are not left out, as they can turn to the CHTs for identification of suitable programmes, based on needs and geographical proximity. This blends with social empowerment, where social interventions are recommended to residents. This is a shift towards person-centred care where social and environmental determinants of health are incorporated.

Strategy 6: One Population, One Budget

In the last strategy, 'One Population, One Budget,' a new financing model is required to align the incentives of the payers, providers and patients. The alignment seeks to focus on health outcomes and sustainability of the health system. The current pay-for-service model at the point of care drives volume and does not give attention to outcomes. It increases overall system cost and is unlikely to be sustainable. Central Health aims to establish a population-based financing model that aggregates, aligns and anchors on the health ecosystem and what the population values.

So far, incremental steps have been taken to transform the current financing model. Central Health is a collaborator in pilot financing projects that enable value-based care and right-siting. An example is the bundled payments of Diagnosis-Related Groups (DRGs) in tertiary and intermediate care facilities. The bundled payment methodology prescribes the shared amount that care providers from different settings can receive based on a DRG code. It incentivises care providers to work together to optimise care for the residents such that any savings could be shared amongst the providers.

Hospital Without Walls Through Digitalisation

Digitalisation will be a key enabler to building a Hospital Without Walls. It enables care to be delivered beyond the hospital anytime and anywhere. Today, patients come to the hospital to receive care. Tomorrow, care follows the patient. The hospital's digitalisation effort comprises a matrix of Strategic Innovation Programmes (SIP) and Digital Innovation Technologies (DIT). SIPs serve to integrate multiple innovation projects into a coherent development roadmap towards a strategic goal. SIPs adopt the hospital's innovation cycle, which is an iterative process to redesign care, stack up technologies and redesign jobs. This process ensures that technologies support new care models and empowers a digitally-ready workforce. DITs, on the other hand, are technology-driven workgroups that focus on a technology (e.g. Artificial Intelligence & Analytics, Telehealth, Digital Applications, Medical Technology and Operations Technology). DITs support pilots to address relevant use cases and operations. It develops the technological platform and middleware to integrate the use of these technologies. Successful technology pilots can be incorporated into the innovation roadmap for an SIP.

The first two SIPs have been initiated – Wards Without Walls (WoW) and Clinics Without Walls (CoW). WoW focusses on the use of technologies and robotics in enabling inpatient care transition from hospital to home. CoW leverages telehealth and digital applications to build a care relationship that transcends episodic clinic visits and activates patients to own and manage their health. Another five SIPs are in the works, and each programme extends the hospital beyond its walls into the community.

Just the Beginning Amidst Challenging Times

TTSH marked its 176 years of care in 2020 amidst the COVID-19 pandemic. COVID-19 has illustrated that an integrated care model can help in the hospital's business continuity to shift care into the community to free up bed capacity for the hospital's outbreak response. The model also enabled closer collaboration with primary and community care partners to fight the outbreak in the community. TTSH repurposed its CHTs as community swab teams for testing of COVID-19, conducting staff training and reviewing infection control practices at residential and convalescent facilities belonging to our community partners. In the new normal ahead for Central Health, TTSH will work closely with partners to plan and prepare the community for the next outbreak response.

In taking on the expanded mission, TTSH is establishing itself as a Hospital Without Walls where its patients can continue to be cared for beyond the hospital; where the residents in the community can stay safe and healthy and age well in place; and where care is focussed on supporting the people to lead healthier and more meaningful lives. The next chapter of the hospital will be written together with its partners as Central Health, and it promises to be one of greater resilience, reinvention and renewal.

Conflict of Interest

None. ■

Contributors

• Adj A/Prof Ian Leong, Assistant Chairman Medical Board, Community Care Integration, TTSH & Central Health, Singapore
• Jennifer Yap, Chief Communications Officer, TTSH & Central Health, Singapore
• Dr Wong Chia Siong, Director, Population Health Office, TTSH & Central Health, Singapore
• Celine Ong Wei Hui, Director, Activation, TTSH & Central Health, Singapore

Appendix

Stories from the Community Health Teams (CHT)	
First home visit condition  Photo credit: TTSH	CHTs collaborate closely with community partners for home visitations and co-management of care. An example is Mr K., 60-year-old Chinese gentleman who lives alone in a one-room rental flat. Mr K. has been known for frequent admissions due to falls that result in multiple injuries on the cheeks, elbows, knees, back and hip. At his last admission, Mr K. was referred to the CHT to assess his ability to cope at home and review his wounds. A joint home visit assessment was arranged with a social worker from a nearby Senior Activity Centre due to suspicions of elder abuse based on the wounds that were sustained. During the first home visit assessment, the CHT noticed that the home was not 'fall-safe' as it was cluttered with items stacked almost up to the ceiling, slight flooding observed from the kitchen sink to the bathroom and the sink and drain had been clogged for at least two weeks. Mr K. also had not changed his wound dressing since discharge, with a layer of slough and pus observed to have leaked from the dressing. Together with home services, the CHT worked closely to manage the wound dressing of Mr K. Arrangements were made with social workers to de-clutter his home, coordinate services for meal delivery and provide home personal care. With close monitoring and follow-up by the CHT and partners, Mr K. was well enough to return to work as a cleaner after two months. To ensure continuity of care for Mr K., the case was handed over to a social service care provider for follow-up.
 Photo credit: TTSH	Another example is Mrs Z., who has mild Alzheimer's disease and often forgets to take her medications. She was referred to a CHT to review her medication compliance and coping abilities at home due to fall risks in view of her bilateral knee weakness. During home visitations, the CHT nurse would carry out physical check-ups and provide medication education to Mrs Z., while the occupational therapist did home environment assessments, reviewed her function and recommended appropriate walking aids to assist with her mobility. Based on the condition of Mrs Z., onsite referral was done for Mrs Z. to a Senior Activity Centre near her home. Home nursing services was also brought on board to assist with medication packing to help Mrs Z. with medication compliance. Mrs Z. also brought up the mental health issues that her son was facing. The team was able to help Mrs Z. to make the appropriate referral for her son to the relevant support services. Mrs Z. is now able to walk for short distances with the help of a walking frame to meet her friends in the neighbourhood, and her son assists her with the use of a wheelchair to attend her medical appointments at the polyclinic.

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It's Time for Open MRI

Author: Prof. Penny Gowland | Professor of Physics Faculty of Science | University of Nottingham | UK

Author: Dr. Aaron B. Montgomery | Innovative Open MRI of Pensacola | USA

Author: Martyn Beckett | COO | InHealth | UK

Author: Marco Belardinelli | Business Unit Director | ASG - Paramed

Magnetic Resonance Imaging (MRI) is a powerful diagnostic tool in clinical medicine. However, MRI technology is evolving continuously. In a recent webinar organised by HealthManagement.org, Prof. Penny Gowland, Dr. Aaron Montgomery, Martyn Beckett and Marco Belardinelli looked into the strategies that could be used to maximise the value and the output of MRI by utilising advancing technology. They specifically discussed open MRI and how it can enhance both value and output of MRI.

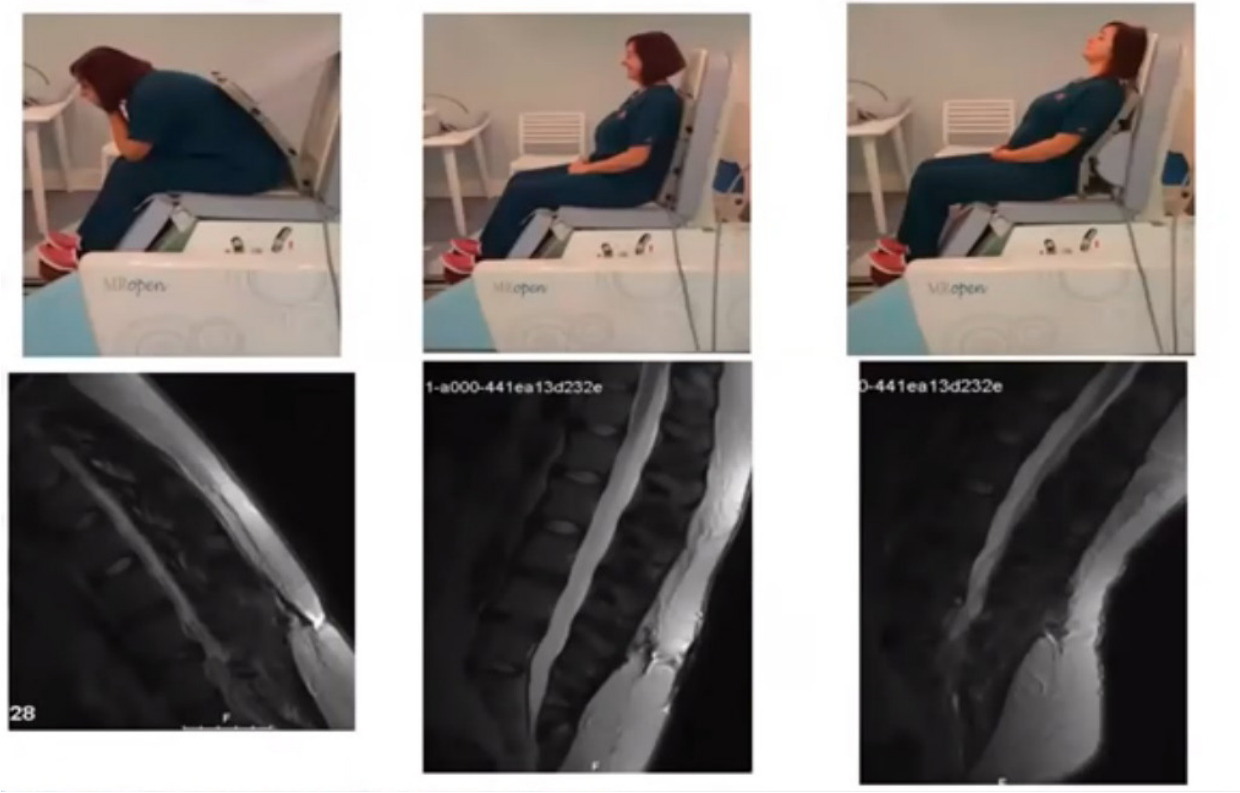
Key Points

- An open MRI is an MRI scanner that is configured to enhance patient comfort.
- An Open MRI offers high-quality imaging, a wide-open design, and a comfortable scanning environment.
- Some of the key benefits of an Open MRI include kinder and quicker clinical care, less claustrophobic environment, rapid positioning, and ability to study the effects of position and gravity and human dynamics.

An open MRI is an MRI scanner that is configured to enhance patient comfort. Traditional MRI scanners consist of a hollow, cylindrical structure. Patients are slowly sent through this structure during an MRI exam. However, being in a narrow and confined space can be challenging for some patients, especially those who suffer from claustrophobia. Traditional MRIs are also not suitable for patients who have difficulty laying down or those with wide shoulders or excess weight. An open MRI is shaped more like a doughnut, with magnets above and below the patient and open sides.

An Open-MRI opens up the possibility of providing new clinical information. Specifically, it provides a whole new dimension in MRI and offers the ability to look at the effects of position and gravity on the human body. One of the things that you could do in an Open MRI scanner that you couldn't possibly do in a standard MRI scanner is to look at the effects of normal positioning, normal gravity on joints and standard movements in joints, and the effects of repositioning on the way the body is functioning. Another area of interest in clinical research is the use of Open MRI in respiratory medicine. Patients with respiratory disease find it very hard to lie supine. An Open MRI can help look at the shape of the diaphragm in COPD and several other conditions to identify changes in the way the diaphragm functions in disease. This would be clearly impossible with any other modality - not only MRI, but there are no other imaging modalities that would provide this resolution when a patient is upright.

Another area of application for Open MRI is in experimental medicine. You can look at the dynamics of the human body, joints in large angles and also the movements of the joints. Gastrointestinal function can also



be more effectively studied with this advanced tool. Hence, an Open MRI has the potential to simplify clinical imaging, enable new clinical studies and provide a unique tool to study human dynamics in vivo.

An Open MRI offers multiple options for patient positioning. Standard MRI can only be performed with the patient lying flat, but with an Open MRI, the patient can be seated, standing or lying down, thus providing optimal patient positioning.

A major problem that many patients face with standard MRI is claustrophobia. This is not just a problem in terms of patients feeling confined, but it can also complicate the diagnostic exam. Findings from a study from the University of Wisconsin-Madison show that approximately 5 to 7% of the world's population suffers from severe claustrophobia. MRI has been shown to trigger claustrophobia. Another study shows that nearly 13% of patients experience a panic attack during an MRI. It is estimated that nearly 20% of patients have difficulty completing an MRI or refuse to go through with an MRI. An Open MRI is a more comfortable alternative for such patients.

Open MRI is also very useful in patients who suffer from certain medical conditions that make it difficult for them to lay down flat. These include Congestive Heart Failure (CHF) and COPD. Cancer patients also have a higher incidence of difficulty in laying flat. Similarly, patients with back pain would prefer to do an MRI in a different position.

Traditional enclosed MRI scanners require the patient to enter a narrow tunnel, but an Open MRI allows the patient to sit, stand or lay down. Also, in an Open MRI scanner, there is nothing immediately in front of or above the patient. There is thus no barrier between the patient and their surrounding environment. They can see what's around them at all times and can even watch TV while sitting in the scanner during the MRI procedure. This is not something that is possible with a traditional MRI scanner.

Overall, the unique design of an open MRI offers several benefits:

- Patients can walk in and be scanned in a variety of positions. This is called positional or weight-bearing MRI.
- Patients can be scanned in the exact position they experience pain, or for the spine and joints to be imaged under the effects of gravity. The spine can be scanned in multiple positions (for example, flexion and extension).
- An Open MRI may be the last chance for imaging to support diagnoses of conditions for patients while avoiding the need for general anaesthesia.
- An Open MRI can offer patients an improved MRI experience and provide the opportunity for a more accurate diagnosis when upright and/or weight-bearing examinations are necessary.

For more information and details on Open MRI, please listen to the complete webinar: https://iii.hm/asgdigiconfjournal

Moscow Radiology: COVID-19 Preparedness and Action

Author: Professor Sergey Morozov | Chief Regional Radiology and Instrumental Diagnostics Officer | Ministry of Healthcare, Russia
CEO of Diagnostics and Telemedicine Center | Moscow, Russian Federation

Contributing Authors: Anna Andreychenko, Victor Gombolevskiy, Ekaterina Kuz'mina, Nataliya Ledikhova, Mihail Lobanov, Olesya Mokienko, Elena Panina, Nikita Polyshuk, Evgenij Popov, Serey Ryzhov, Christina Sergunova, Igor' Shul'kin, Irina Sokolina, Ilya Soldatov, Irina Trofimenko, Anton Vladzymyrskyy

A systematic approach (CT as modality of choice, contactless workflow, staff restructuring, intensive learning, information and methodological support, a concept of clinically confirmed COVID-19 cases with classification according to severity, network of outpatient CT centres with the head reference centre, quality assurance) allowed maximum availability, safety, quality, and standardisation of radiological diagnosis of COVID-19 in the Moscow megalopolis.

Key Points

- Moscow has implemented a systematic approach for treatment and management of COVID-19.
- A network of outpatient CT centres (functioning 24/7, workload 94 studies per 1 scanner) allows to control 'stay-at-home' patients, to provide timely detection of deterioration signs, and indications for hospitalisation.
- Clinically confirmed case of COVID-19 (regardless of the result of a single laboratory test for the presence of SARS-CoV-2 RNA by PCR and the epidemiological history) based on clinical manifestations of the acute respiratory symptoms and typical features for COVID-19 on the chest CT scan.
- Municipal radiology reference center assumed the tasks related to the interpretation of radiologic exams conducted in municipal outpatient facilities: uninterrupted remote radiology reporting, mandatory double review of all cases of viral pneumonia, quality control (peer-review).
- Strategy for applying diagnostic imaging services during the COVID-19 pandemic: 1) no radiology exam in case of absent of symptoms and clinical signs; 2) the primary diagnostic method for coronavirus disease is high-resolution chest computed tomography; 3) portable X-ray or ultrasound is used to assess the dynamics of clinical symptoms in patients in ICU.

The COVID-19 pandemic has forced all countries of the world to take extraordinary measures to overcome the disease, curb its spread, as well as confront the growing economic crisis. The challenges to national healthcare systems are enormous, requiring mobilisation of all resources, intensive involvement of the new opportunities, special protection of medical personnel, real-time solutions, practical actions in a rapidly changing environment and under high stress (Guan et al. 2020; Liang and Zhejiang 2020). It should be noted, that radiology is at the forefront of COVID-19 struggle. In Moscow, the first case of COVID-19 was detected on March 2, 2020. At the time of writing, 62,658 confirmed cases are reported in Moscow, of which 6,374 patients recovered, and 695 died. Only 15% of patients were over 65 years

old. The Government of the Russian Federation and the Moscow Mayor's Office have taken unprecedented measures to provide support and curb the spread of coronavirus infection. In this article, we share information on activities of the diagnostic radiology services in the capital of our country, and our experience of managerial, logistical, educational, and methodological measures, as well as application of digital technologies.

In total, Moscow has more than 150 state medical facilities, national medical research centres (funded by the federal budget), and a well-developed private sector. The number of hospital beds per 10,000 population is 62.1. Primary care medical facilities (city clinics) can provide about 309 appointments per shift per 10,000 population. There are a number of medical personnel per 10,000 population: doctors - 58.3, nurses - 82.8. As of January 1, 2020, the population of Moscow was 12,692,500 people.

The municipal radiology diagnostic services integrate diagnostic departments of city outpatient and inpatient facilities (CT, MRI, x-ray, mammography, nuclear medicine). Medical facilities are well-equipped for the provision of interventional radiology and radiation therapy. All diagnostic equipment is connected to the Unified Radiological Information Service (URIS). URIS provides:

- operational management through the dashboard to monitor the usage, workload, and operability of equipment (pilot studies on dose control monitoring are in progress);
- standardisation of study protocols and reports;
- citywide quality control system (peer-review);
- centralisation of radiology report writing and telemedicine consultations;
- training and research (including artificial intelligence).

During the COVID-19 pandemic, the main tasks of the Moscow diagnostic radiology services became the following:

1) ensuring readiness for high-intensity work under conditions of increasing workload on top of losses among medical staff;
2) reducing mortality and improving outcomes through the high-quality, timely and uninterrupted diagnostics and follow-up;
3) the early diagnosis of pneumonia caused by COVID-19 before the development of conditions requiring mechanical ventilation.

Preventing the Spread of Infection

Multiple managerial, methodological, and administrative measures have been taken to implement these tasks. Moscow Healthcare Department provided regulations and methodological recommendations, the Chief Officer of Regional Radiology and Instrumental Diagnostics issued informational letters. Moscow Research and Practical Clinical Center of Diagnostics and Telemedicine Technologies (also known as 'Moscow Radiology') is the main organisation which provides strategy, methodology, management, quality control, digital technologies introduction, teleradiology and learning for the municipal radiology diagnostic services.

Organisational Decisions

Management. In the radiology department, we have created an operational management group under the department head leadership. The group's responsibilities include coordinating measures within the framework of infection control, interacting with medical facility administration, collecting and disseminating current information on infection control among employees (including messaging services), preparing the emergency strategy, planning, and implementing measures to ensure seamless operation. We developed a checklist for self-assessment of the department readiness to operate during the COVID-19 pandemic (medradiology.moscow/f/chek-list_po_gotovnosti_k_covid.pdf).

Separation. Mandatory measures: separation of patient flows, separation of personnel shifts, and zoning of radiology departments, creating contactless workflows. A radiology department should be divided into the following zones:

- "red"
- conditionally clean (in hospital settings),
- buffer
- "green."

Staff restructuring. The following actions were performed in municipal hospitals:

- nurses from other departments were transferred to radiology departments to assist x-ray technicians;
- screening programmes were discontinued, and x-ray technicians from those programmes were transferred to CT-scan rooms;
- with additional staff, operation in CT-scan rooms is organised in a new way. Three employees work there: a doctor – remotely, an x-ray technician – in the control room, an assistant (a nurse or released x-ray technician from another modality) – in the treatment room. The assistant also positions a patient on the table and communicates with patients directly.

Active visits management. A number of planned radiology exams are reduced. At the same time, the availability and timeliness of radiological studies in emergencies are rigorously kept. Diagnostics in oncology and life-threatening conditions, interventional radiology, radiation therapy, and others are fully operational.

Infection control. Disinfection, sanitation, and infection control measures are carried out under the current legislation of the Russian Federation. Additionally, international best practices are considered.

Outpatient CT Centers (OCTC). In Moscow, patients with mild COVID-19 are treated at home. Medical observation is carried out remotely by the staff of a specialised telemedicine centre. Medications are provided to municipal clinics' patients free of charge. A network of outpatient CT centers (OCTC) has been developed in Moscow to improve monitoring of these patient cohorts, provide timely detection of signs of deterioration, and indications for hospitalisation. Centres were opened on the base of municipal city clinics. OCTC is examining patients with COVID-19 who are assigned to this clinic. Studies are free of charge for patients and funded by

the Federal Funds for Mandatory Medical Insurance.

The operation of the OCTC is regulated and standardised by a special decree. In particular, the following rules are established:

- working hours, time periods of patient examinations and disinfection (studies are carried out 24 hours daily, seven days a week);
- dividing departments into zones;
- structure and number of healthcare teams;
- rules for routing and ensuring continuity of medical care;
- infection control measures, personnel protection measures, disinfection.

At the stage of the OCTC creation, specialised training for doctors and x-ray technicians was conducted, methodological support was provided to heads of departments and leaders of medical facilities. General practitioners who work in municipal outpatient facilities joined the team of OCTCs. They refer patients with severe respiratory symptoms (to >38,5℃, cough, shortness of breath or difficulty breathing) to the CT scan. If negative dynamics are detected on CT images, the patient goes back to the physician who determines the necessity of hospitalisation. It is how the concept of "clinically confirmed case of COVID-19" is implemented.

All OCTCs have special support from Moscow Radiology Reference Center. At the time of writing, 48 OCTCs are functioning in Moscow 24/7, about 5,000 chest CT scans are performed daily for patients with COVID-19 before transferring them to a hospital or to home care. The average load is 94 studies per a CT scanner (workload is 108%). The highest record was 163 studies in a day. It is absolutely incredible work of Moscow doctors and technicians. During the first two weeks of operating, OCTCs performed 45,444 chest CT scans, radiologists identified 23,021 patients with CT-signs of COVID-19. We cannot fail to mention the numerous volunteers from small and medium-sized businesses (restaurants, cafes) who provide hot meals to the personnel of OCTCs.

Guidelines

Under the auspices of 'Moscow Radiology,' a working group of experts was formed (representatives of 10 clinics in Russia). International and domestic experience has been systematised, and the group developed the guidelines "Radiology and Coronavirus Disease (COVID-19): Organisation, Methodology, Interpretation" (medradiology.moscow/f/ luchevaya_diagnostika_koronavirusnoj_infekcii_covid-19_ v2_17042020-4.pdf).

Strategy for Applying Diagnostic Imaging Services During the COVID-19 Pandemic.

The purpose of diagnostic radiology is primary diagnostics, differential diagnostics, patient routing, follow-up, determination of indications for transferring patients to the intensive care unit, or for discharging from the hospital for outpatient treatment. Considering the resources and capabilities, our own and international medical experience, we proposed the following principles of choosing a modality of diagnostic imaging services:

1. If symptoms and clinical signs of acute respiratory infection (ARI) are absent (regardless of the epidemiological history), the use of radiology studies is not recommended.
2. The primary method for the diagnostics, confirmation, and follow-up of COVID-19 (taking into account clinical and laboratory data) is high-resolution computed tomography of the chest (in outpatient and inpatient settings).
3. For critically ill patients (including those who are in intensive care and resuscitation units (ICU), if they cannot be transported, or if computed tomography is not available), x-ray (a portable x-ray machine) or ultrasound is used to assess the dynamics.

As per regulations of the Russian Federation and international recommendations, polymerase chain reaction (PCR) is used for the final diagnosis (verification) of COVID-19. However, our own experience in fighting the pandemic in Moscow and international publications indicate several PCR problems (Ai et al. 2020; Dai et al. 2020; Pan et al. 2020):

- low sensitivity;
- long waiting time for results (at least one day), leading to the delay in beginning a specific therapy;
- high proportion of false-negative results.

This situation has forced us to review approaches for classifying the cases of coronavirus infection. As a result, the Moscow healthcare system has adopted the concept of clinically confirmed case of COVID-19.

Clinically Confirmed Case of COVID-19

Clinical manifestations of the acute respiratory infection (in the absence of other known causes explaining clinical symptoms, regardless of the epidemiological history):

1. Body temperature above 37.5 °C
2. One or more of the following symptoms:

- cough – dry or with scanty sputum
- shortness of breath, feeling of congestion in the chest
- blood oxygen saturation according to pulse oximetry (SpO2) ≤ 95%
- sore throat, runny nose, and other catarrhal symptoms
- weakness, headache
- anosmia
- diarrhoea.

Typical chest CT features of COVID-19:

- ground-glass opacities
- consolidation zones
- thickening of interlobular septa interstitium ("crazy paving")
- hydrothorax
- bilateral, mainly lower lobar, peripheral, perivascular distribution.

This approach allowed to route patients more efficiently and begin a specific therapy earlier. PCR continues to be performed according to the standard protocol, but the negative result of the method are almost entirely levelled. In the pandemic, the main method for diagnosis of COVID-19 in Moscow has been

computed tomography because of the limitations of PCR test. In municipal outpatient facilities, a CT scan is used for sorting patients with signs of ARI and follow-up patients with a mild form of COVID-19. In hospitals, a CT scan is used for follow-up, disease progression prediction, determining criteria for a patient's discharge from the hospital for outpatient treatment (Ai et al. 2020; Dai et al. 2020; Pan et al. 2020).

We realise, that CT scan can identify a difference between viral and bacterial pneumonia in patients with ARI symptoms from the third to fifth day of illness. Unfortunately, signs of COVID-19 are not recognised on CT images during the first 3-4 days of illness and in mild cases. Computed tomography is included in all clinical protocols and guidelines for the city medical facilities. Methodological support has been provided:

- standardised operating procedures have been developed (primarily for x-ray technicians on how to perform studies and disinfect equipment)
- doctor's training, informational support for department heads at the regular remote seminars (meetups)
- remote quality control (peer-review), individual quality improvement measures (educational, organisational, technical, others) based on the results
- telemedicine consulting by experts for city doctors.

To standardise the doctor's performance, we developed a unique classification and a short format of the CT-scan report. We recommended solutions for patient routing, criteria for hospitalisation in the intensive care unit, or a patient's discharge from the hospital based on the clinical manifestation and the degree of pulmonary tissue involvement (Table 1). Classification allows to standardise patient routing and treatment.

The implementation of these approaches ensured a systematisation of operation of Moscow diagnostic radiology services, its effective interaction with clinical divisions, outpatient and inpatient medical facilities. Proposed classifications and criteria allowed to speed up doctors' productivity, make it standardised, transparent, easily manageable and adaptable to rapidly changing environment. By introducing the concept of "clinically confirmed case of COVID-19," we could reduce the time from the disease onset to the beginning of the specific therapy.

Digital Infrastructure

Moscow Radiology Diagnostic Services is a shared digital space. It is based on the Unified Radiological Information Service (URIS). URIS is an information system with its own data centre, to which all digital diagnostic equipment of municipal outpatient facilities and partially city hospitals are connected (complete connection of hospitals is planned from 2019 to 2021). The main functions of URIS include:

The Moscow healthcare system has adopted the concept of clinically confirmed case of COVID-19

- centralised archive of radiology studies' results;
- monitoring of equipment operation, accessibility to radiological services for patients;
- supporting managerial decision making;
- providing remote communication for writing radiology reports and expert consulting;
- remote quality control;
- providing medical data for training, research, development of artificial intelligence.

To expand the functionality of the radiological information system, we supplemented it with a dashboard, speech recognition, and intellectual (AI-based) report templates (as part of a scientific experiment). URIS is also integrated with the Uniform Medical Information and Analytical System of Moscow (UMIAS), that ensures continuity of city medical facilities' work and minimises study duplication. Also, thanks to this integration, the studies' results are available to city residents in their account on the portal "Moscow State Services." Taking into account the pandemic experience, we can already say that URIS, as the basis of the unified digital space, requires the prompt integration of hospitals, modules for monitoring radiation dose, and rapid increase in computing resources.

Teleradiology

The COVID-19 pandemic has led to a real telemedicine boom. On one hand, the demand for direct-to-consumer telemedicine and telehealth has dramatically increased. On the other hand, telemedicine and digital technologies have become non-alternative basis for organising healthcare in the "doctor-to-doctor" segment. The potential of telemedicine as the tool for healthcare management in a pandemic are enormous:

1) fast arrangement of consultations, decision making support, including patient logistics;
2) effective reallocation of human resources, including covering the increasing losses among medical personnel;
3) uninterrupted use of expertise of self-isolated doctors;
4) decrease of face-to-face social and professional contacts among healthcare workers.

In diagnostic radiology, telemedicine allows remote reporting, expert consulting on complicated cases, remote quality control (peer-review). Thanks to teleradiology, a face-to-face contact of radiologists and radiation oncologists with patients can be minimised. Almost all doctors can be removed from the "red" zone. The exception is doctors who are involved in conducting studies with contrast enhancement (according to the current regulation, a radiologist must be present at the procedure room).

Severity	CT	Clinical Data	Decision
Zero	CT-0 Not consistent with pneumonia (including COVID-19).	–	Inform a primary care physician. Refer to a specialist.
Mild	CT-1 Ground glass opacities. Pulmonary parenchymal involvement =<25% OR absence. CT sigs on top of typical clinical manifestations and relevant epidemiological history.	A. t^0 <38.00°C B. RR <20/min C. SpO_2 >95%	Follow-up at home using tele- medicine technologies (mandatory telemonitoring).
Moderate	CT-2 Ground glass opacities. Pulmonary parenchymal involvement 25-50%.	A. t^0 >38.50°C B. RR 20-30/min C. SpO_2 95%	Follow-up at home by a primary care physician
Severe	CT-3 Ground glass opacities. Pulmonary consolidation. Pulmonary parenchymal involvement 50-75%. Lung involvement increased in 24–48 hours by 50% of respiratory impairment per follow-up studies.	One or more signs on top of fever: A. t^0 >38,50°C B. RR ≥30/min C. SpO_2 ≤95% D. Partial pressure of oxygen (PaO_2)/ Fraction of inspired oxygen (FiO_2) ≤300 mmHg (1 mmHg=0,133 kPa)	Immediate admission to a COVID-specialised hospital. In a hospital setting: immediate transfer to ICU. Emergency computed tomography (if it is not done before).
Critical	CT-4 Diffuse ground glass opacities with consolidations and reticular changes. Hydrothorax (bilateral, more on the left). Pulmonary parenchymal involvement >=75%.	Signs of shock, multiple organ failure, respiratory failure.	Emergency medical care. Immediate admission to a specialised hospital for patients diagnosed with COVID-19. In a hospital setting: immediate transfer to ICU. Emergency computed tomography (if it is not done before and a patient's condition allows for it).
Recovery	Criteria for regression of pathological changes: – reduction of ground glass opacities, appearance of new ground glass opacity zones is permissible no more than 25% of the transverse size of one side of the thorax; – reduction of previously visible consolidation zones; – residual opacities in pulmonary parenchyma of various lengths and distribution; – absence of pleural effusion associated with COVID-19.	A. Normal body temperature (less than 37.0°C) B. No signs of increased respiratory failure with oxygen saturation exceeds 96% C. C-reactive protein level decreased to less than double of normal range, white blood cells count is above 3.0x109/L	Discharge from the hospital for outpatient treatment, dynamic monitoring at home using telemedicine technologies if required (telemonitoring).

Table 1: Classification of the severity of lung tissue abnormalities in patients with COVID-19 and routing rules

Methodological Assistance

Recommendations for radiology departments:
• move doctor's offices to the "green" zone, isolate them as much as possible, and provide the necessary number of workstations and auxiliary computer equipment;
• issue radiology reports using hospital (radiological) information system (in Moscow - URIS);
• switch most radiologists to remote operation mode;
• distribute workstations to doctors (at least professional monitors), provide remote connection to hospital (radiological) information system (in Moscow - URIS);
• implement time-limits for x-ray technicians in the conditions of the remote doctor's work, as well as for remote radiology reporting and study consultation.

Moscow Radiology Reference Center

In April 2020, Moscow Radiology Reference Center (MRRC) was launched. MRRC is designed for the most effective use of the primary healthcare personnel, simplifying management of medical staff and ensuring its interchangeability (including prevention of workflow interruptions in radiology departments due to the staff shortage). MRRC operates 24/7/365 providing radiology reports and quality control (peer-review) of diagnostic studies.

The planned number of doctors in MRRC is 500. All radiologists of outpatient radiology services are concentrated in the reference centre. Of course, in the pandemic, we are talking about operating remotely or at the facilities divided into zones. In any case, most of radiologists are removed from the healthcare settings, which reduces the risk of infection and their absence at work. MRRC assumed the tasks related to the interpretation of radiologic exams conducted in municipal outpatient facilities:
• uninterrupted remote reporting of radiologic exams
• mandatory double review of all cases of viral pneumonia
• quality control (peer-review).

Additionally, at the level of the Russian Federation, MRRC provides:
• organisational and methodological support of the diagnostic radiology services of the country
• expert remote consulting
• support of educational events
• participation in scientific research.

Moscow Radiology Reference Center provides constant support of OCTCs (see above). Doctors on-call conduct round-the-clock remote quality control (peer-review) of studies and provide expert telemedicine consulting, if necessary (approximately 20-25% of cases). During the first two weeks of OCTC operating, Moscow Radiology Reference Center made 10,391 peer-reviews and consultations.

Expert Telemedicine Consulting

Earlier, remote discussions of complicated clinical cases were carried out by consultants of the 'Moscow Radiology' centre regularly. Consultants of the centre conducted decision-making support for doctors of Moscow municipal outpatient facilities for particularly complicated, atypical, rare cases. Note, that such consultations were provided in different modalities. Annually 'Moscow Radiology' carried out around 3,000-3,500 expert teleconsultations.

With the pandemic progression, a demand for expert telemedicine consultations on the differential diagnosis of viral pneumonia has increased, and not only from Moscow municipal clinics but also from medical facilities of other regions of the Russian Federation. It required to design special mechanisms for handling such requests. 'Moscow Radiology' has developed a radiological information system (RIS). It allows doctors from different regions of the Russian Federation to upload anonymised studies in the DICOM standard, and for consultants to conduct remote interpretations. A two-stage approach was methodically applied:
• stage I – upload an anonymised video to 'Moscow Radiology' chat for triage, a consultant on duty determines the need for a complete consultation;
• stage II – if the need is confirmed, a full study is downloaded in the DICOM standard into a special RIS, and the consultant doctor provides a complete teleconsultation.

At the triage stage, cases which were not consistent with viral pneumonia were eliminated, for example, bacterial pneumonia, oncology. Such a process reduced the burden on the consultant radiologists of 'Moscow Radiology,' allowing them to work only with targeted cases. Moreover, this accelerated process of making diagnostic decisions at the local medical facilities, reduced, among other things, medical staff concerns and patients' anxiety.

Social Media and Web

E-mail, internet messengers, telephone, social networks, video conferencing are actively used for communication on organisational, logistical, and methodological issues. In particular, the number of Moscow Radiology' Telegram® channel (t.me/MoscowRadiology) users has increased by five times in three weeks. There are 2,738 participants now (radiologists, x-ray technicians, department heads). It became the platform for a rapid exchange of information about the current situation and problems, discussion of organisational issues, sharing experience, informing about a release of guidelines, regulatory documents, educational events, as well as for triage consultations. Also, 'Moscow Radiology' set up chats for:
• heads of radiology departments
• x-ray technicians
• consultant doctors involved in methodological work
• AI integration and accuracy evaluation.

Such channels and chats existed before, voluntarily uniting specialists. During the pandemic and quarantine measures, they have become a critical tool for real-time communication. The number of users in each chat increased by several times. 95-100% of each target audience is united in thematic groups. Health workers

are promptly and effectively informed based on their target profiles.

During the first days of the pandemic, 'Moscow Radiology' set up a website Radiologists vs COVID-19 to accumulate the most relevant information, guidelines, regulations, webinars, etc. The website allows to quickly and conveniently inform medical community.

Artificial Intelligence

In the conditions of staff shortage (including personnel absence due to sickness) and sharp increase in workload, the use of computer vision technologies and artificial intelligence for automated analysis of diagnostic images has become especially relevant. The main potential scenarios for such tools are the following:

- triage (sorting) of CT scans performed in the primary care settings
- assessment chest-CT abnormalities in patients with COVID-19 in dynamics.

In this case, AI can help save doctors' time and reallocate their attention to challenging cases. Since January 2020, a large-scale scientific experiment has been launched in Moscow to assess the capabilities of computer vision technologies in radiology. The project is being implemented by the Moscow Government and provides grants to companies that develop services based on artificial intelligence (mosmed.ai). Currently, 12 companies have already participated in the experiment, and the selection of new participants continues. The uniqueness of the project is that companies can integrate their software into URIS, and prospectively analyse tens and hundreds of thousands of studies. We intend to assess diagnostic accuracy, commitment, and satisfaction of doctors, as well as level of technological defects. Initially, the experiment was conducted on three types of studies: chest CT for detecting lung cancer, mammography for detecting breast cancer, chest x-ray for detecting several pathologies (tuberculosis, cancer, pneumonia). However, the pandemic has made adjustments – now services can participate in the experiment for detecting signs of viral pneumonia (including COVID-19) on CT scans and chest x-rays.

At the time of this writing, the first developer of such an algorithm has successfully integrated into URIS. Calibration and a preliminary assessment of the algorithm accuracy are underway.

Training

Due to the rapid evolution of the pandemic, we have faced an acute need to inform and train our medical staff:

1) Information vacuum: most medical professionals lack evidence-based information about the diagnosis, treatment, prevention of COVID-19, as well as the management of radiology services during a pandemic;
2) Rapid changes in the medical and tactical situation, the accumulation of knowledge in real-time, need to provide up-to-date but verified information to many medical professionals almost daily;
3) At the same time, minimisation of personal social contacts and excessive workload, the highest stress level made traditional forms of information exchange (conferences, masterclasses, classroom training courses) completely ineffective.

To solve these problems, 'Moscow Radiology' has developed and implemented "Training and Informing System for Radiologists in the COVID-19 Pandemic."

Target audience:

- heads of radiology and ultrasound departments,
- radiologists and specialists in ultrasound diagnostics,
- x-ray technicians.

The system includes a combination of modern pedagogical and information technologies.

1. Pedagogical technologies:
- interactive training
- training in small groups (cooperation technologies)
- mutual learning
- problem-based learning.

2. Information technologies:
- full transition to the remote operation mode (webinar platforms)
- expanding the arsenal of software products and web applications, increasing the interactivity of e-learning (spaces for group work, online voting, joint 'whiteboard', etc.)
- expanding the number of applied mobile applications
- emphasis on chats in social networks and internet messengers (for informing, analysing clinical cases, training).

As a result, we conducted a combination of asynchronous distance learning courses and interactive online training in the group work format.

Learning Strategies

a) Standard advanced training courses on general topics.
Goal: fully maintain the processes of routine postgraduate education.
Mechanism: full transition to e-learning mode, measures to ensure access to educational materials from workplaces.
b) Targeted doctors and x-ray technicians training on COVID-19 issues.
Goal: prepare medical personnel for the pandemic.
Mechanism:
i) training – short-term online courses;
ii) constant information on current issues – webinars (with access to the recordings), special channels in social networks.
As an example, the 18-hours distance course on ultrasound and imaging diagnostics of COVID-19 (sdo.npcmr.ru/basic-kt-module-2).
c) Courses for radiologists who have not been trained before on chest computed tomography (CT).
Goal: provide a reserve of specialists for timely CT reporting.
Mechanism: short-term distance courses on conducting chest CT scan and reporting.

d) Training heads of diagnostic departments on COVID-19 issues.
Goal: to provide strategic professional development training for leadership of medical facilities on issues of organisation and management, infection control, changes in regulations. Mechanism:
i) training – regular (weekly) meetups with presentations of relevant materials, practical experience from various medical institutions and territories, discussions;
ii) constant information on current issues – webinars (with access to their recordings), special channels in social networks (medradiology.moscow/vebinary-v-2020)
e) Training physicians on specific issues of diagnostic radiology of COVID-19.
Goal: reduce the time from patient admission to diagnosis and beginning a specific therapy.
Mechanism: short-term distance courses and webinars for physicians, anesthesiologists on the basics of chest CT scan and x-ray with emphasis on the diagnosis of viral pneumonia.

Recommendations Based on Results of the System Performance:

1) Maximise the use of digital technologies and social media for continuous education and information of healthcare workers about COVID-19 issues;
2) Increase the social responsibility of business structures – to provide free access for educational institutions and medical professionals to software and web services for implementing distance learning during a pandemic;
3) Training courses for X-ray technicians, radiologists, physicians, healthcare administrators (leadership of medical facilities and heads of radiology and ultrasound departments) should be separated and have a specific approach;
4) Combine different training formats – short-term distance courses, constant information through enclosed channels in social networks, expert telemedicine consultations for the analysis of clinical cases.

Conclusion

Moscow has implemented a systematic approach – "imaging modality of choice – regulatory requirements – methodological support – quality assurance." It allowed maximum availability, safety, quality, and standardisation of radiology diagnostics of COVID-19 in a few days in the Moscow megalopolis.

Our main goal is to save people's lives. The role of diagnostic radiology during the COVID-19 pandemic has become crucial. Radiologists' significance and their level of responsibility have been fundamentally transformed. Previously, we were talking about the qualitative interpretation of diagnostic images and effective communication with clinicians. Now the situation has changed. During the COVID-19 pandemic, radiologists provide triage "en masse" and routing of patients between outpatient and inpatient medical facilities.

Moscow Healthcare Department has identified a pandemic response strategy. Within its framework, the parent organisation ('Moscow Radiology') established the goal setting for the radiology diagnostic services, provided a set of methodological, educational, scientific, organisational support, and implemented a quality control system. The role of the professional community is immeasurable! The dedicated work of medical staff, at the same time, active communication, feedback, selfless and friendly sharing of their experience and knowledge with colleagues, mutual support, giving advice are crucial in a pandemic. In truth: Aliis inservi-endo consumor!

Conflicts of Interest:

None. ■

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New Care Delivery Paradigms

The added value of shifting traditional inpatient surgeries to outpatient ambulatory care centres

Author: Dr Gilbert Bejjani | Anaesthesiologist – Head of Service, CMO, Executive Director | Basilique Clinic, CHIREC | Brussels | Belgium

In 2014-2015, under increasing financial pressure, the inpatient hospital beds at 'Clinique de la Basilique' (Basilique Clinic) were converted and adapted for outpatient care. Despite challenges, the clinic succeeded in creating a self-sustained, free-standing, outpatient ambulatory surgical centre. Employment was saved, and a lot of value was brought to patient care. This important and innovative change allowed the clinic to continue its mission in a healthcare environment favouring integrated and networked facilities.

Key Points

- In a value-based healthcare model where value is expressed as quality (i.e. health outcomes) over cost (V=Q/C), it remains difficult to deliver better quality and control costs without rethinking the current prevailing organisational models. Value can be achieved not only by reducing complications but also by impacting cost of care delivery, creating efficiencies in workflow and reducing carbon footprint.
- As such, creating hospital networks with specific goals for individual institutions is an essential step. This is achieved through resizing clinics and hospitals and reallocating resources to meet the goals of each institution within the network.
- Growth is not the sole metric by which success is measured. Financial margins, EBITDA or cash flow can be improved even in the absence of significant increase in caseload. This is achieved through innovation and cost reduction.

Value-based healthcare centres around the delivery of the best possible quality at the lowest possible cost. Reconciling the two sides of this equation remains challenging but is, in our experience, achievable. Processes aimed at reducing complications and medical errors, combined with improved efficiency in workflow and access to care are key.

On close examination, one would be surprised by the number of bottlenecks in our workflow in the inpatient setting. Eliminating redundancy in some processes while promoting it in others can lead to improved process performance, reduced medical errors and enhanced employee and patient satisfaction. The ensuing cost savings, when layered on top of the negotiating power of a hospital network, relating to medical supplies can tilt the equation towards value without any compromise on quality of care.

On a large scale, it is now clear that all institutions are not equal in their ability to deliver the same level of care with the same efficiency. Moreover, the ageing of the population and the increasing complexity of the cases are placing significant financial pressure on hospitals. This is further complicated by the skyrocketing cost of new medical and infrastructural technologies. As a result, resizing facilities within a network and reallocating the work to bring specific cases to the best-suited facility can have a significant positive impact. The 'good place to do the good work' easily becomes the 'best place

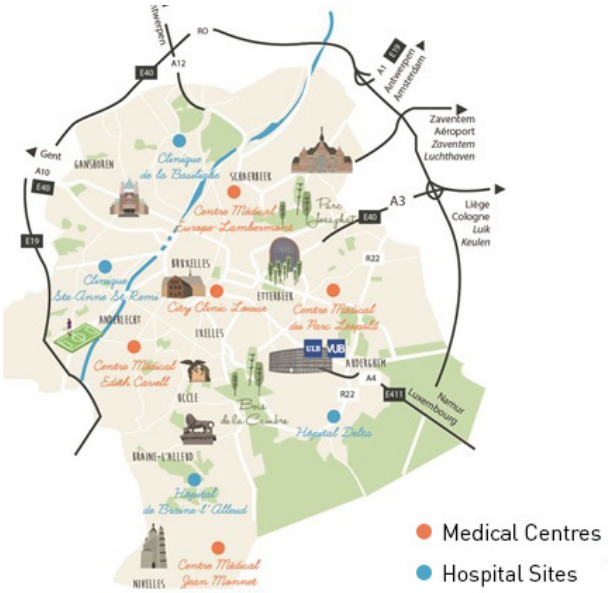

Figure 1. CHIREC hospital group: hospital sites and medical centres

to do the best work'. Providing some level of institutional specialisation allows implementation of consistent processes and avoidance of redundancy in equipment and other costly infrastructure requirements for care delivery.

Whereas labour and supply cost reductions are typically obvious areas of intervention, rightsizing excess bed capacity and designating speciality centres can be more impactful. We should not fear these changes because at the end of the day they help define the role '(there is something) for every site' in a larger network.

Our experience within our hospital network confirms the above views. On a larger scale, we moved and converted beds between different clinics in our hospital group. On a smaller scale, within each hospital we improved the specific mission it was tasked with.

Background

'Clinique de la Basilique' (Basilique Clinic) in the Northwest of Brussels is a smaller facility in the CHIREC hospital group. CHIREC totals more than 300 workers and 1,000 physicians on three hospital sites. One site is in Walloon Brabant (287 beds) and two sites are in Brussels: St-Anne St-Remi in Anderlecht (327 beds) and the brand-new Delta Hospital (438 beds), which opened in December 2017 (Figure 1).

One would be surprised by the number of bottlenecks in our workflow in the inpatient setting

Built in 1976, Basilique Clinic was a pioneering institution. It became the first one-day surgery centre in Belgium in 1986. The Belgian Association of Ambulatory Surgery (BAAS) was born in its walls in 1992, as was the International Association for Ambulatory Surgery (IAAS) in 1995. The clinic then evolved to become a 76-bed hospital. In 2015, a new state-of-the-art hospital was being built to combine two other hospitals in the CHIREC group monopolising most of the available resources. As a result of financial pressure, Basilique Clinic was slated for closure with the intent of moving the hospital beds to a bigger facility.

As value-based care was making inroads into Belgium, Basilique Clinic became an attractive site for a new business model, one that would take it back to its roots as an ambulatory surgical centre. The greatest challenges were saving employment, delivering quality care and achieving long-term financial stability. The clinic was left with a few physicians, less than 50 nurses and limited ancillary and administrative staff.

Innovation is Key

With an uncertain future, we engaged the team members by bringing flexibility and innovation to every step in their workflow. The dual goal was to motivate and support the team in delivering good care to patients, and to promote well-being at work.

Overall, the key innovation was the redesigned physician and patient flow. Physicians could access the operating room availabilities on a web-based platform, allowing real-time, streamlined scheduling. We improved patients' experience without conceding on safety by assigning one 'email' Single Point of Contact (SPOC) for physicians and another 'phone or email' SPOC for operated patients. A double-check was organised for every step to reduce errors. Every admission was planned only one or two hours before the operation to diminish the 7 a.m. rush and bottleneck for front office employees. Administrative verifications were made on admission, while medical record entries were completed and checked by nurses according to the anaesthesiologists' preop exam. Checklists were made available at levels to avoid omissions. A follow-up phone call was made to patients post-discharge. Importantly, we encouraged all stakeholders to challenge processes by providing better alternatives.

Critical decisions were made in consultation between the surgeon, a nurse (chief if needed) and an anaesthesiologist (chief if needed) in order to avoid miscommunication and errors. Task leaders were provided with a dedicated phone number available over the '12-hour'

Figure 2. Retrofitted Facility.

shift. Connection via WhatsApp services, as well as the creation of new documentation and smarter signage were implemented.

The other innovation was our approach to human resources management. We encouraged leadership that inspires positive actions, promotes an exchange of ideas and champions lean processes and innovative workflows. Good communication skills within and outside the clinic were also prized.

As the clinic is open only 12 hours per day, the typical 8-hour shifts were ill-suited for the job. Smaller teams working shorter shifts merged into 8-10-people groups. This allowed better management of the workload while providing adequate coverage including on holidays. Personal workload preferences were met through allocation to different tasks around the facility.

At Basilique Clinic, we have 75 FTE. These include less than 100 staff and over 120 physicians. Half of the medical workforce joined after 2015. We have 5,000 sq. m in two separate buildings, which house 8 interventional rooms, 50 beds and a CT scanner. The total income is around €18 million.

Micro-Hospital Development

Retrofitting the existing facility was challenging and required capital expenditure. Communicating the need clearly was key. From 76 inpatient beds we moved to 50 outpatient beds. It is what we called 'hospital without beds', when in effect we ended up with more beds then we needed to perform our ambulatory procedures. Along the way, some adaptations were made that resulted in better patient comfort. Shared rooms became individual rooms. Lighting was improved, as was the availability of air conditioning. Larger shared space was created for the staff.

In an effort to rebrand the clinic, the local press was regularly solicited. Collaboration with surrounding general physicians, as well as regular communication through scientific or professional meetings was pursued. In just a few years, the community was referring to the clinic in a more positive way.

Value and Sustainability

The rethinking of the clinic was meant to bring excellence in ambulatory surgery and the motto was 'do better with less'. Less money, less people, less time, less waste, less harm, and so on.

The clinic experienced large growth performing almost 8,000 interventions and more than 6,500 surgeries in 2019 (5,500 interventions and 4,000 surgeries in 2015). Readmission rates and cancellations for unexpected reasons were below 0.1%.

After double-digit growth in activity and financial results, we observed a slowdown in 2018 and even a regression in 2019. But EBITDA and cash flow continued to improve, even this last year! We had no doubt that our efforts would make the clinic's financial results sustainable, and the stress test results of 2019 confirmed the validity and sustainability of the business model. Although there are many reasons that account for the decrease in growth, this indicator was not our main focus. Our focus on cost reduction including through staff attrition, as well as some well-placed investments allowed for a healthy balance sheet. In fact, we understood from the onset that value-based care was not driven primarily by volume growth.

As we continue to improve our workflow, we remain laser-focussed on improving care, patient satisfaction and staff well-being. Overall, we have achieved our goal of elevating our small clinic into a well-deserved position in our hospital group.

Conflict of Interest

None. ■

Upcoming Issue

Cover Story: Patient Transformers

Today's patient is armed, informed and fully engaged in their care delivery. How does this abundance of knowledge change hospital systems and care delivery? How much is the patient already a care consumer with choices - and is there such a thing as too much choice? What innovative ideas is the market offering to face these challenges? This and much more is explored in our upcoming issue.

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