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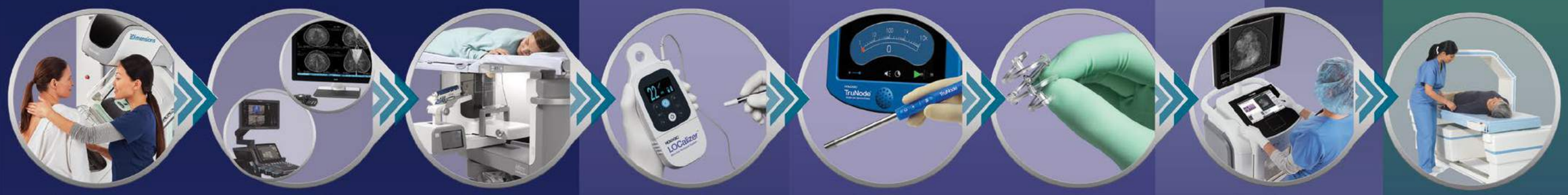

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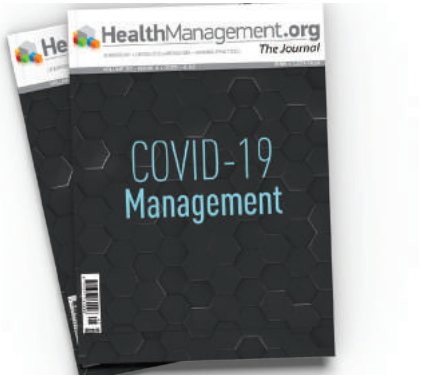

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Contributors

Valérie Bokobza
Valérie Bokobza joined NOVAIR in 2012 at the position of Marketing & CRM Director. She holds a Master Degree in Business from Neoma Business School, France.

260 Oxygen – A Vital Need for the Fight Against COVID-19

Miguel Cabrer
Miguel Cabrer is a Digital Health Entrepreneur with a special interest in transforming healthcare though real patient engagement. He is participating in initiatives for image exchange, patient portability and AI & Chatbots to facilitate patient engagement.

262 Virtual Consultations: Now or Never

Rachel Coleman
Rachel Coleman is the Programme Support Manager for the Yorkshire Imaging Collaborative, a network of nine acute hospital trusts working together to improve radiology services. She manages the administration and communications for the Programme and has supported the YIC team for the past year and a half, working before that as the Programme Support Officer for the WYAAT Programme.

231 New Image Sharing Technology Transforms Radiology Services Across Yorkshire

Nerea Elosua
Nerea Elousa is a biomedical engineer who strives to help physicians and engineers to understand each others' needs in the context of developing new medical devices, and improving clinical practice.

262 Virtual Consultations: Now or Never

Arnau Valls Esteve
As R&D Engineer at the SJD Hospital, Arnau is involved in various healthcare technology projects. He is a lecturer at d-Health Barcelona and a researcher in innovation and entrepreneurship in healthcare, digital transformation, big data and 3D printing for health.

270 Going 'Liquid'. Digital Transformation and Big Data Strategy in SJD Children's Hospital

Jürgen Fortin
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 80 patents and several publications on current and future noninvasive technologies.

239 Call to Action for the Cardiovascular Segment of COVID-19

Giuseppe Galati
Guiseppe Galati is a consultant cardiologist at San Raffaele Hospital in Milan, Italy. His specialties include chronic heart failure, cardiac magnetic resonance, echocardiography, myocardial disease, public health and health economics.

212 Management of COVID-19 in Italy

Rafael J. Grossman
Rafael Grossman is a practicing surgeon in the USA as well as a global speaker, healthcare and education technologist and futurist. His view is technology is a complement to the most important qualities of a medical provider: compassion and empathy.

248 Telemedicine Post COVID-19

Prof. David Koff
Professor of Radiology at McMaster University, David Koff is founder and director of MIIRCAM at McMaster, leading numerous research projects. He is Chair of Canada Safe Imaging and has been organising MIIT conference in Canada for the past 15 years.

252 Conducting Research in the COVID-19 Era

Alexandre Lourenço
Hospital Administrator at Coimbra University and Hospital Centre and a consultant for WHO, Alexandre is President of the Portuguese Association of Hospital Managers and hold various positions in EAHM, EHMA and a number of healthcare organisations around the world.

266 COVID-19: Unforeseen and Unpredictable Pandemic

Amir A. Mahabadi
Amir Mahabadi is an attending physician at the Department of Cardiology and Vascular Medicine, West German Heart and Vascular Center Essen, University Hospital Essen, Germany.

256 Global COVID-19 Pandemic – Compelling Effects on Cardiovascular Medicine

Prof. Mamas A Mamas
Prof. Mamas is a structural interventional cardiologist, treating patients in both the elective and emergency setting. He is also the Associate Editor of Circulation Cardiovascular Interventions and leads a large research groups focussed around EHR research.

220 COVID-19 Pandemic: The Importance of Testing and Social Isolation

Prof. An Mariman
Prof. Dr An Mariman is a psychiatrist and somnologist at the University Hospital in Ghent. She is a lecturer in different educational programmes (medicine, nursing, etc) at the faculty of Medicine and Healthcare Science at the Ghent University, Belgium.

238 Crisis Communication: Challenges, Priorities and Perspectives

Iris Meyenburg-Altwarg
Being Managing Director of Nursing and Nursing Services and Director of the Education & Training Academy at MHH, Iris is a consultant for a number of projects, part of ENDA, WANS and STTI, and Visiting Professor at three universities in China.

206 Preparing Staff for Crises

Sourabh Pagaria
Sourabh Pagaria is responsible for Siemens Healthineers business in Southern Europe. He is a thought leader on how Data, AI and joint public-private approach can reshape the future of healthcare.

224 Imperatives for Rebuilding European Healthcare Systems Post-COVID-19

Jaume Perez Payarols
A specialist in paediatrics and management in healthcare institutions, Dr Payarols held many managerial posts in healthcare organisations. Since 2008 he is Director of Research, Innovation and Education in SJD Hospital, also leading the Research Committee there.

270 Going 'Liquid'. Digital Transformation and Big Data Strategy in SJD Children's Hospital

Carla Riera
Carla Riera is a Biomedical Engineer interested in developing, testing and improving healthcare tools to provide better experiences for both patients and medical specialists. Carla has recently engaged in an AI project focused on improving medical processes.

262 Virtual Consultations: Now or Never

Eric de Roodenbeke
Prior to becoming CEO of the IHF in June 2008, Dr de Roodenbeke worked at WHO/GHWA and the World Bank. He also held positions at University Hospital of Tours and the French government.

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Pau Sarsanedas
With his background in engineering and business, Pau has been managing innovative companies and leading industrialisation and commercialisation projects across different sectors. He is a founder of two industrial start-ups and a private investor.

250 Precise Automated Resuscitation with RESPIRA

Luís Bastião Silva
Luís Bastião Silva has a PhD in Computer Science and he is a specialist in Medical Imaging computation solutions. He is the CTO of BMD Software, an SME targeted to the development of novel biomedical software solutions.

275 How to Support a National Network for COVID-19 Identification in Medical Imaging Studies

Dirk Smeets
Dirk Smeets, Ph.D. is Chief Technology Officer at icometrix. He is head of the research and development team, including IT, product manager of icobrain and icolung, and information security manager. In his spare time, he loves to run and play soccer.

242 Imaging AI for Chest CT to Aid in Resource Allocation During COVID-19

Eugene Fidelis Soh
Eugene Fidelis Soh is CEO of Tan Tock Seng Hospital and Central Health in Singapore. He is a medical doctor by training with an MA in Public Health from Harvard University and is an alumni of the Senior Executive Programme at the London Business School.

226 Smart Hospital for the Future

Don Sweete
SNOMED International CEO, Don Sweete is the guardian of SNOMED CT's clinical terminology and has worked relentlessly to unite stakeholders across the sector, building and maintaining critical relationships with its global members and partners.

254 The Importance of Meaning: The Global Effort to Manage COVID-19 Through Collaboration

Prof. Andy Tatem
As a Professor of spatial demography and epidemiology at the University of Southampton and the Director of WorldPop and co-director of Flowminder, Prof. Tatem is working with governments, UN agencies, Gates Foundation, Wellcome Trust, etc.

234 COVID-19: Data Uncertainty and Effectiveness of Interventions

Prof. Alberto Torresin
As Head of Medical Physics Dept. at Niguarda Hospital and Visiting Professor at University of Milan, Prof. Torresin's work focuses on radiological optimisation. He is a member of AIFM, EFOMP, AAPM and ECIBC, Chair of ESMPE and Associate Editor of EJMP.

216 CoviLake Niguarda: Trying to Predict COVID-19 Patient Path

Matthias Totzeck
Matthias Totzeck is an attending physician at the Department of Cardiology and Vascular Medicine, West German Heart and Vascular Center Essen, University Hospital Essen, Germany.

256 Global COVID-19 Pandemic – Compelling Effects on Cardiovascular Medicine

Prof. Angelo Vanzulli
Since 1999 Prof. Vanzulli has been heading the Radiology Department at Niguarda Hospital, where he is also Director of the Department of Advanced Technologies. He is a member of the SIRM and RSNA and works with a number of journals (JCAT, Radiology, AJR).

216 CoviLake Niguarda: Trying to Predict COVID-19 Patient Path

Prof. Peter Vermeir
Prof. Dr Peter Vermeir is liaison officer at at the University Hospital in Ghent, Belgium. He is clinical professor in communication and hospital management at the faculty of Medicine and Healthcare Science at the Ghent University, Belgium.

238 Crisis Communication: Challenges, Priorities and Perspectives

Prof. Dirk Vogelaers
Prof. Dr Dirk Vogelaers is a specialist in Internal Medicine with special focus on infectious diseases at the University Hospital in Ghent, and at the faculty of Medicine and Healthcare Science at the Ghent University, Belgium. He is president of the Medical Council of the Ghent University Hospital.

238 Crisis Communication: Challenges, Priorities and Perspectives

Ian Weissman
Ian Weissman is a radiologist and strong patient care advocate. He leads multiple national initiatives with an interest in improving patient and family-centred care and clinician wellness. Dr. Weissman was awarded the Advocate of the Year Award through the American College of Radiology in 2019.

210 COVID-19: New Pandemic Offers a New Chance to Be Well Together

Pål Arne Wøien
GM of Life Cares Solutions at GE Healthcare Europe, Pål Arne Wøien joined the company in 2003 and since then has held various managerial positions within GE. Former Managing Director at Datex Ohmeda.Pål Arne holds a B.Sc. degree in Cybernetics.

232 How the Digitisation of ICU can Power the Fight Against COVID-19

Mariuccia Zambelli
With over ten years of marketing experience in the med-tech industry, Mariuccia is responsible for developing and maintaining PENTAX Medical's marketing and business development strategies across Europe, Middle East and Africa.

243 COVID-19: PENTAX Medical Talks Supporting Improved Patient Outcomes

Editorial

Christian Lovis

HealthManagement.org, Editor-in-Chief, IT

Head - Division of Medical Information Sciences, University Hospitals of Geneva

Professor of Clinical Informatics, University of Geneva, **Switzerland**

christian.lovis@hcuge.ch | @chr_lovis

COVID-19 Care Continuum

Think back to January 1, 2020. Can you even remember what the outlook was for a new decade in your area of healthcare? The first phase of the deadly coronavirus disease, COVID-19, has practically swept away any memory of the status quo before it hit like a tsunami and healthcare scrambled to fight it.

Today, months later, more than 200 countries and territories have been hit by the virus, with over 3 million cases worldwide and over 200,000 deaths. As healthcare continues to fight COVID-19, HealthManagement.org has also raced to produce the first of several special editions dedicated to healthcare response to the crisis. In this special issue, COVID-19 Care Continuum, we focus on the impact of the COVID-19 pandemic and how countries around the world have dealt with this crisis.

Radiologist Prof. David Koff examines the impact of COVID-19 on research. Two expert cardiologists, Prof. Mamas Mamas and Giuseppe Galati communicate their experience of fighting the pandemic in the UK and Italy, while Prof. Eugene Fidelis Soh talks about the 'smart' management of COVID-19 in Singapore.

Surgeon and healthcare futurist, Rafael Grossmann looks into the potential of telehealth uncovered by the pandemic, and Miguel Cabrer and colleagues talk about the need for virtual consultations during these times to reduce patient flow in hospitals.

Prof. Andy Tatem describes how population data are used during pandemics. Eric de Roodenbeke suggests how health leaders can sustain their organisations with the support of the IHF, and Ian Weissman examines how the COVID-19 pandemic is impacting the health of patients and healthcare workers.

Prof. Valentin Sinitsyn looks at how technology has aided imaging-based diagnosis for COVID-19, while Amir Mahabadi and Matthias Totzeck discuss the compelling effects of COVID-19 on cardiovascular medicine.

These are only the highlights of the issue's rich content, which also includes communication during a pandemic, preparing your staff for crises, creating a 'liquid' hospital, and many other topics.

Enjoy, comment and keep sharing your COVID-19 stories with us!

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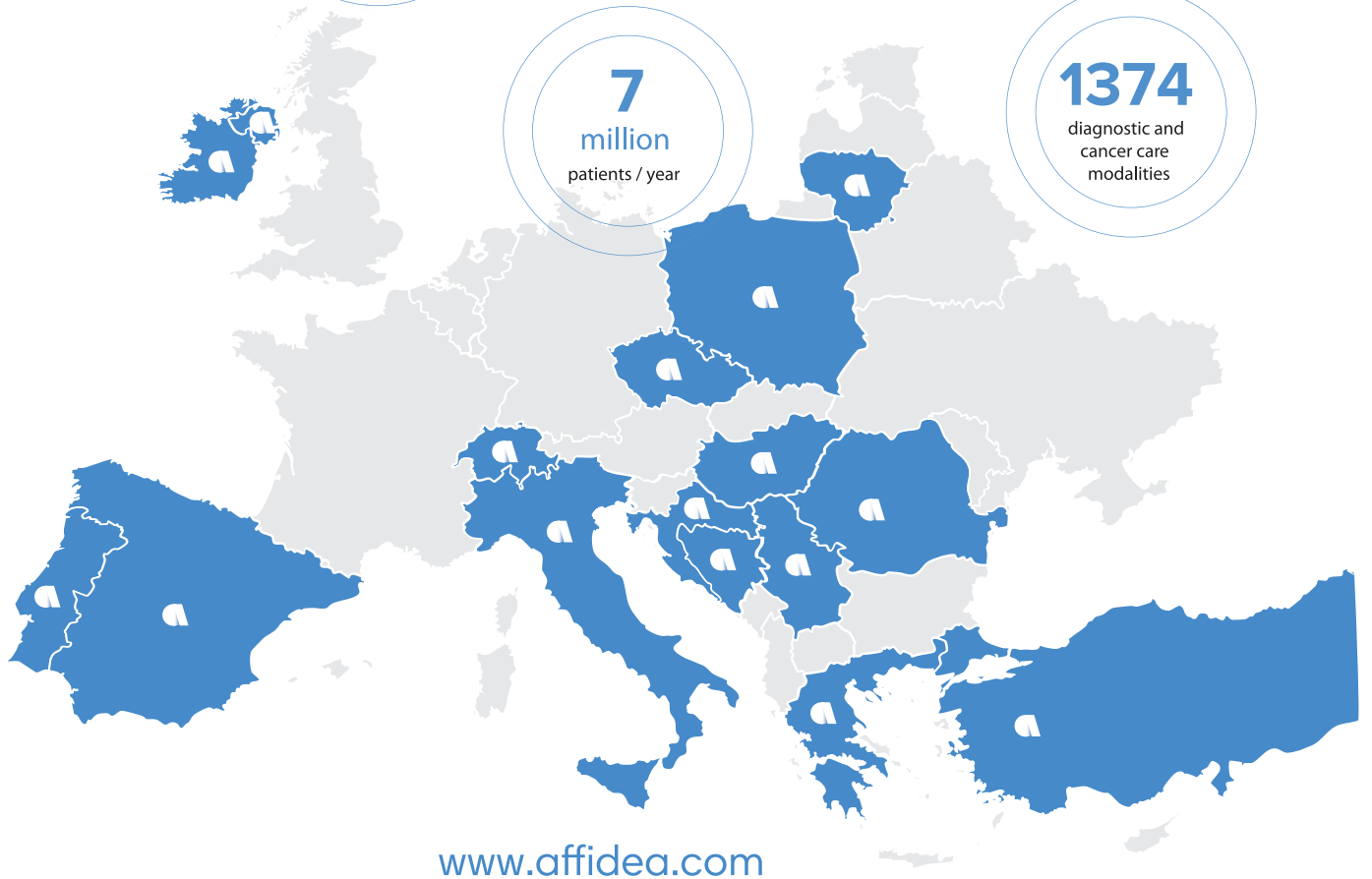

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Editorial Board

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Editor-in-Chief EXEC
Centro Hospitalar e Universitário de Coimbra, Portugal
al@healthmanagement.org

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Hamilton Health Sciences; McMaster University, Canada

Prof. Elmar Kotter
University Hospital Freiburg, Germany

Prof. Heinz U. Lemke
International Foundation for Computer Assisted Radiology and Surgery; University of Leipzig, Germany

Prof. Lars Lönn
National Hospital, Denmark

Prof. Elisabeth Schouman-Claeys
APHP Medical Organisation Directorate; University of Paris 7, France

Prof. Valentin Sinitsyn
Federal Center of Medicine and Rehabilitation, Russia

Dr. Nicola H. Strickland
Imperial College Healthcare NHS Trust, UK

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University of Pavia, Italy

Prof. Amiran Revishvili
Scientific Center for Cardiovascular Surgery, Russia

Prof. Massimo Santini
San Filippo Neri Hospital, Italy

Prof. Ernst R. Schwarz
Cedars Sinai Medical Center, USA

Eugene Fidelis Soh
Tan Tock Seng Hospital and Central Health, Singapore

Prof. Dan Tzivoni
Israel Heart Society, Israel

Prof. Alex Vahanian
Bichat Hospital, France

João Bocas
Digital Salutem, UK

Miguel Cabrer
TopDoctors CIO and Founder of Idonia Medical Image Exchange Palma de Mallorca, Spain

Richard Corbridge
Boots, UK

Dr. Marc Cuggia
Pontchaillou Hospital, France

Dr. Peter Gocke
Charité, Germany

Prof. Jacob Hofdijk
European Federation for Medical Informatics, The Netherlands

Prof. Werner Leodolter
University of Graz, Austria

Prof. Eric Lepage
Agence Régionale de Santé Ile-de-France, France

Prof. Christian Lovis
Editor-in-Chief IT
University Hospitals of Geneva
cl@healthmanagement.org

Christian Marolt
Executive Director
HealthManagement.org, Cyprus
cm@healthmanagement.org

Prof. Josep M. Picas
WAdaptive HS, Spain

Prof. Eric Poiseau
IHE Europe, France

Prof. Karl Stroetmann
Empirica Communication & Technology Research, Germany

Diane Whitehouse
EHTEL, Belgium

Ing. Martin Zeman
CESNET, Czech Republic

Industry Ambassadors

Dan Conley
Beacon Communications, USA

Marc De Fré
Agfa, Belgium

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AHIMA International, Spain

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Breakthrough Genomics, USA

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Regional Ambassadors

Joan Marques Faner
Son Dureta University Hospital, Spain

Dr. Thomas Kaier
King's College London, UK

Dr.Mahboob ali Khan
Imam Abdul Rahman Bin Faisal University, KSA

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Estonian Nuclear Medicine Society, Estonia

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Pitié Salpêtrière Hospital, France

Andreas Sofroniou
Limassol General Hospital, Cyprus

Dr. András Vargha
National Centre for Patients' Rights, Hungary

Anton Vladzymyrskyy
Virtual Hospital m-Health, Russia

Team

Christian Marolt
Executive Director cm@healthmanagement.org

Iphigenia Papaioanou
Project Director ip@healthmanagement.org

Barbora Terešková
Vice President Client Management bt@mindbyte.eu

Anastazia Anastasiou
Creative Director art1@mindbyte.eu

Lucie Robson
Editorial Director lr@healthmanagement.org

Samna Ghani
Senior Editor sg@healthmanagement.org

Maria Maglyovanna
Staff Editor mm@healthmanagement.org

Marianna Keen
Staff Editor mk@healthmanagement.org

Dran Coronado
Staff Editor dc@healthmanagement.org

Katya Mitreva
Communications Director km@healthmanagement.org

Anna Malekkidou
Communications am@healthmanagement.org

Sabahat Shamsuddin
Communications office@healthmanagement.org

Sandip Limbachiya
Head of IT

Sergey Chygrynets
Front-end Developer

HealthManagement.org

is a product by MindByte Communications Ltd

Brussels Office:
Rue Villain XIV 53-55, B-1000 Brussels, Belgium
Tel: +32 2 2868500, Fax: +32 2 2868508
brussels@mindbyte.eu

Limassol Office:
166 Agias Filaxeos, CY-3083 Limassol, Cyprus
Tel: +357 25 822 133, Fax: +32 2 2868508
office@mindbyte.eu

Headquarters:
9, Vassili Michaelides, CY-3026, Limassol, Cyprus hq@mindbyte.eu

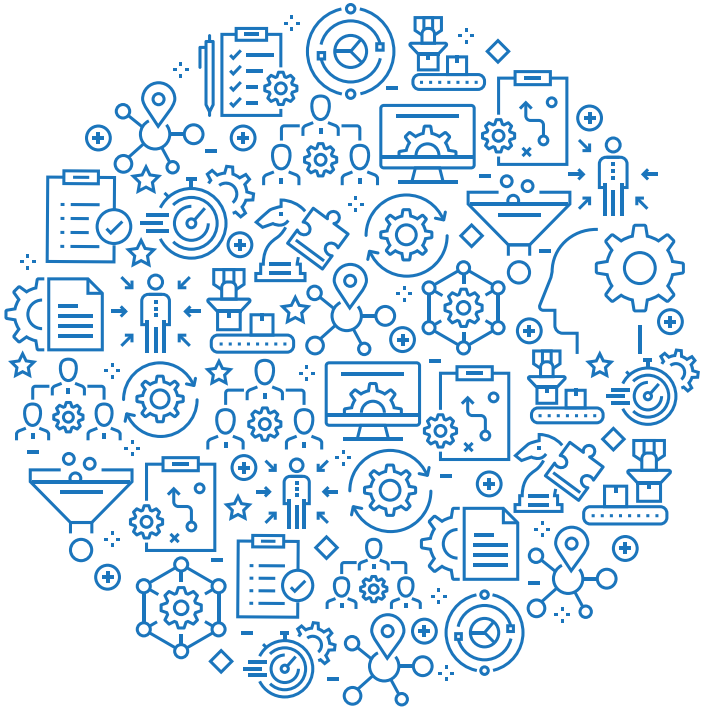
@Healthmanagement.org
@ehealthmgmt
HealthManagement.org
healthmanagement_org

Have your say. Engage!

The COVID-19 pandemic has changed the world. As the number of patients increases, so does the demand for healthcare services. How long can the system sustain this crisis? How are different countries handling this challenge? We explore this and more.

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

Preparing Staff for Crises



Summary: Staff management during critical times can be and often is very challenging. Therefore, there is a need to learn new processes, acquire new skills/information and use new approaches. A veteran nursing expert talks about how you train, inform and support your staff to achieve the best possible outcomes during a crisis.

Work during a crisis is always challenging. Even if we had similar experiences in the past, this does not mean that we have learnt from them or that they are applicable now. Currently, many of us are faced with the necessity to upgrade skills through emergency training, both for our staff and non-qualified volunteers; to rapidly devise a communication strategy ensuring no critical information is lost; or to embrace 'online' as the new reality of our work. Of course, it is impossible to cover all the weak spots in the given circumstances, but we should take this crisis as an opportunity to see what is lacking, learn from our mistakes and think about how we fix them once back to normal.

'Emergency' Staff Changes

Professional interdisciplinary crisis teams that can make and implement situation-related decisions are an essential element of a crisis management strategy. They need the competence to make those decisions and the flexibility to act across the board. While being structures parallel to the management, these teams should include specialists and not only managers.

Their work requires professional competence and trust, therefore the members of such 'emergency' teams must be the people with a high level of acceptance in the organisation, people who are qualified, highly knowledgeable and experienced in the specialised field. Someone from the top management with little knowledge about daily routines of emergency services is not a good fit for this role.

Also, the 'normal' management team is not suitable and/or may not be available to act as an 'emergency' team, since it is engaged in the day-to-day health related activities, which must continue. However, the management is still involved in all critical decisions.

To implement the emergency strategy and ensure the provision of care, it is also necessary for a healthcare facility to form technically skilled and experienced working groups (procurement, medical necessities, technology, media, adapting conventional work processes, etc).

Special attention should be given to how you manage your staff. For example, I now work 14 to 16 hours per day. The workload is enormous. In such circumstances some flexibility is needed to allow the personnel to use their expertise to the full extent. At the same time, there is a need to have someone in charge who gives clear instructions to the staff and whose authority is not disputed. There should be clear and strict hierarchy, which would enable better functioning of the organisation. So you have to find a way to somehow combine these two approaches.

Information Dissemination

We should remember that when there is a crisis, it is for all of us. During such times people are really disturbed. It is important not to frighten staff and public, so the information we share and the way we share it must be chosen carefully. Information must be provided on a regular basis and in a centralised and transparent manner.

An important element here would be regular meetings and dissemination of information to all internal departments and the general public. Decision-making must be transparent and clear, and messages about the management and specialist participation are necessary, eg as interviews that are credible and honest. A news bulletin issued once or several times per day, always at the same time, can help to deal with uncertainty. People should understand, for example, that they will read the news every day at 6pm.

> "Members of 'emergency' teams must be the people with a high level of acceptance in the organisation"

When disseminating information, the process should be efficient for both the organisation and the employees. If possible, avoid completely new communication structures. Stick to the usual means of communication, otherwise people may have difficulties embracing novelties and a lot of information may get lost on the way. Take advantage of the current work process, which is familiar to the staff and which they understand. Even in normal times, there must be a known and practiced emergency plan to only be adapted or expanded in a critical situation.

Here, however, one major change should be mentioned – all those online meetings that we, and the entire world, are having now. Since the beginning of the crisis the majority of our meetings are held online – and I must say we feel 'not bad' about it. By now we have already realised that after this crisis is over, we should rethink the way we communicate. We have to decide whether we need so many meetings, either in person or remotely. For us this will be one of the 'lessons learnt' and a potential area for improvement.

Emergency Training

Crisis training is difficult to incorporate as 'theory' into regular education and training programmes during normal times. It would be much less efficient because people do not feel the stress, do not understand the pressure, so they simply cannot relate. With this in mind, the main goal of such training would be to teach people how to behave. This process should be as easy and engaging as possible, so using practical and/or visual exercises as well as gamification techniques would be the most effective strategies here (eg scenarios for coping with crises, films, etc).

Telehealth is another emerging area, in which many of you probably see the lack of proper training. In general, we should see this crisis as an opportunity to advance the adoption of these new technologies and to ensure they are used afterwards. The problem is that amid the crisis it is very difficult to introduce such new formats of care with the staff. You can only succeed with this very early into a crisis, because the staff needs time to get used to and learn how to handle them. It is much better to incorporate telemedicine into your practice in normal situation. If you had not done that, then this is your opportunity to learn and think, very clearly, about these strategies afterwards.

Dealing with Non-Clinical Workers

Since the beginning of the pandemic, our hospital has engaged with many non-clinical personnel and volunteers. We have trained over 1,000 people – qualified, semi-qualified and non-qualified, including soldiers, cleaners, ie people who do not know how to work in these specific emergency settings.

For example, cleaning staff do know how to clean, but you have to tell them about the current changes and challenges, how to carry out the procedures to maintain sterility, their recommended dress code, and so on. These are very important to keep them safe and healthy. It is often necessary to allow more time for the additional training effort because in contrast to the health professionals, there is no background knowledge and certain additional hygiene measures are not necessarily comprehensible. This can be quite a challenge.

To succeed, first and foremost, a suitable and motivated training team should be created. This team must develop brief and concise training materials adjusting their usual programmes, extracting the most important points and presenting them in an understandable manner, with simple wording and images. This is because people lack the specialised skills, knowledge and qualifications in the specified area. Examples of circuit training units should be available for the most important tasks as well as standard operating procedures (SOPs) for specific frequent activities.

Due to such large volumes, the training sessions must be kept short. We have so far developed 11 different training sequences with a training effort of approximately 20 minutes per sequence. As such,

we manage to complete the training in one day. Additionally, there are about 20 SOPs dealing with vital-sign devices and their critical values for respiratory rate, pulse, etc. These SOPs are clearly visualised and attached on-site at the place of use because volunteers and non-clinical staff must know precisely which tasks are assigned to them and what the specific working conditions and expectations are.

Motivation and Support

Appreciation as well as honesty, credibility and transparency are effective strategies to support your staff. Active employee protection should be in place, and health must have high priority. Support can also come in the form of ensuring the greatest possible flexibility in the provision of work (eg home office), expanding childcare facilities, psychosocial offers, supply of drinks and food, and so on.

Crises always involve additional and often unexpected challenges. Voluntary absence and resignations that may start to appear are usually a sign of fear, uncertainty, physical and mental overload and lack of knowledge. Only information, transparency, honesty and appropriate staff management help in these circumstances. Talking to people is, probably, the best approach here. You cannot push them, so you talk to them and find out what causes the change in their behaviours. You can then fill in the gaps if they lack information, or try to help with whatever issues they may have so that they feel more secure and can continue to perform their duties.

Share and Care

In conclusion, I would like to stress how important it is now for all healthcare professionals to support each other. We need to work with our networks, talk to others, learn from each other, share the information, knowledge and experience we have with other people – so that they do not repeat our mistakes and are able to improve their situation. This comes from my own experience – I use all available means of communication to share what I know with others and to interact with my staff. Just be open – this would be my advice.

Interviewee: **Iris Meyenburg-Altwarg**
Managing Director of Nursing, Medical University | Hannover Medical School (MHH)
Director, Academy for Nursing Education & Training | MHH | Hannover | **Germany**
President, European Nurse Directors Association (ENDA)
Meyenburg-Altwarg.Iris@MH-Hannover.de | mhh.de
@iris-meyenburg-altwarg-35102820

Key Points

- Professional interdisciplinary crisis teams are an essential element of a crisis management strategy, as are technically skilled and experienced working groups.
- When managing your staff, combine certain flexibility with strict hierarchy.
- Information must be provided on a regular basis and in a centralised and transparent manner. Stick to the usual means of communication and learn from the increased online presence.
- Crisis training should be as easy and engaging as possible.
- If you had not put telehealth in place before the crisis, then now is a good time to learn and plan for the future.
- When dealing with non-qualified staff, it is often necessary to allow more time for training. A suitable and motivated training team should be created, and proper materials developed.
- Support your staff with appreciation, honesty, credibility and transparency. Talking with people may be the best approach to deal with fear and uncertainty.
- During a crisis, it is really important for all healthcare professionals to support each other. Be open and share what you know with others.

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COVID-19: New Pandemic Offers a New Chance to Be Well Together

Summary: A physician examines how the COVID-19 pandemic is impacting the health of patients and healthcare workers, and proposes strategies to improve wellbeing.

The COVID-19 pandemic of 2020 offers a new challenge for the world community not seen since the Spanish Flu pandemic of 1918 (Bernhardt 2020). The world community, in large part, has come together in this crisis to share ideas, crowdsource, and innovate to contain this viral pandemic until a vaccine and/or established treatments become available (Piore 2020).

> **"Healthcare workers trained to save lives are being forced to make ethical choices regarding "who lives and who dies"**

Governments, industry, scientists and private individuals have united to rapidly overcome challenges, and are sharing ideas to develop vaccines, 3D print personal protective equipment for frontline workers, and sew protective masks for one's community (Jacobs and Abrams 2020). The worldwide community response has demonstrated the best of the human spirit.

Enduring this protracted challenge and maintaining resilience becomes even more important as people are put into new situations that run counter to the human condition such as being asked to socially distance to protect one's community. Human beings by nature are social individuals, and this creates new stressors (Leader 2020; Chen 2015).

Healthcare workers who have not been trained for war, are working around the clock to save lives in wartime conditions without sufficient protective gear, and without established treatments to save patient's lives. This forces healthcare workers to make ethical decisions about rationing limited healthcare resources like ventilators for their patients. Healthcare workers who are trained to save lives are being forced to make ethical choices regarding "who lives and who dies," and this can cause moral injury for the clinician (Emanuel et al. 2020; BBC 2020).

Prior to the COVID-19 pandemic, a large societal wellbeing initiative had already begun to help individuals be healthier given the increasing incidence of depression and suicide in our society (Fox 2018; Healy 2019). Healthcare workers, in particular, have faced new challenges in their workplace that has led to an increasing incidence of burnout (Dyrbye 2017). Of concern, is that clinicians are leaving a critical need profession after taking a Hippocratic Oath to heal others (USA.gov 2012). They are being forced to leave a profession (a calling for many) to heal themselves after sustaining moral injury caused by external stressors such as overwhelming clinical volume, a lack of autonomy and perceived ineffective leadership (Carville et al. 2020).

Organisations, professional medical societies and individuals have recently come together, across the world, to heal the healers. Here are several examples. The National Academy of Medicine has recently published a landmark consensus study report in 2019 called Taking Action Against Clinician Burnout: A Systems Approach to Professional Well-Being since supporting clinician wellbeing is critical to improving patient care (National Academy of Medicine 2020). A Charter on Physician Well-Being was recently published through the Journal of the American Medical Association (JAMA) in 2018 to promote the wellbeing of healthcare professionals by establishing societal, organisational, and interpersonal/individual guidelines (Gold Foundation 2018). Contemporary thought leaders in the area of wellbeing such as Tait Shanafelt MD have raised awareness, and have made recommendations regarding healing the professional culture of medicine (Shanafelt et al. 2019).

Professional medical societies like Radiology have become involved, and in 2018 and 2019 convened an

Intersociety Meeting to foster a roadmap to wellness and engagement (Kruskal 2019). Recently, in 2019 the American College of Radiology (ACR) developed a Wellbeing Programme that contains a rich collection of webinars and articles curated by a team of dedicated radiologists and ACR staff intent on improving the wellbeing of their colleagues and patients (ACR 2020). Social media has become an important form of communication allowing the exchange of new ideas through open dialogue, and through vehicles like Tweet Chats on Clinician Well-Being such as one conducted in May of 2019 through the Journal of the American College of Radiology (Wakelet 2019).

These innovative and proactive wellbeing resources, recently developed, have allowed professional medical societies, like radiology, to quickly pivot and build on these positive initiatives by curating and sharing new wellbeing resources that specifically address the challenges of COVID-19 such as a sense of isolation caused by necessary temporary social distancing. These COVID-19 specific resources address important behavioral health areas such as improving mindfulness, fitness, and sleep, and are freely available for all to review on the ACR's WellBeing Programme website (ACR 2020).

Together, we will overcome this new pandemic challenge through improved communication across the world, and by sharing new proactive strategies to optimise patient care as well as effective mentoring, mindful listening and empathy for our colleagues and patients.

This COVID-19 challenge has given us a tremendous opportunity to be well together now, and for the future.

Author: Ian Weissman
Attending Radiologist, Milwaukee Veterans Affairs Medical Center | Milwaukee, U.S. | Chair, American College of Radiology Patient and Family Centered Care Outreach Committee
milwaukee.va.gov | American College of Radiology | @DrIanWeissman

Key Points

- The COVID-19 crisis has led to heightened cooperation within healthcare and the wider community for better care.
- The medical community has given more focus to staff wellbeing through innovative online resources.
- These positive resources are available now to decrease the risk of burnout and moral injury to patients and healthcare workers during this pandemic crisis.

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Management of COVID-19 in Italy

Guiseppe Galati is a consultant cardiologist at San Raffaele Hospital in Milan, Italy. His specialties include chronic heart failure, cardiac magnetic resonance, echocardiography, myocardial disease, public health and health economics. HealthManagement.org spoke to Dr. Galati about the management of COVID-19 in Italy.

Do you think your country used a good strategy to contain the virus? Have any other countries implemented measures that you think have worked well?

We can divide the results of the management of this pandemic in three big categories. One is the availability of ICU places in the most difficult time when you have the tsunami of COVID-19. The second area is the availability, and access of PPE for the healthcare professionals and the third area is the availability and distribution of the test for COVID-19. If I evaluate my country in these three main fields, I have to say that we did a great job with respect to the availability of ICU places. When this pandemic started in Italy before the 21st of February, we had, for example, in Lombardy, which was the red zone where we still have more cases compared to the rest of Italy, we had only 720 places of ICU before the crisis, and in two weeks, we were able to more than double this number, and before the 13th of March, we had 1400 ICU places. This is published in a paper in JAMA (Grasselli et al. 2020). Italy implemented an effective protocol in Lombardy as to how to manage the emergency, how to create a triage zone, how to pre-screen, how to use PPE, how to ventilate, and how to put people in the intensive care unit.

The first point is extremely important because, without the availability of the ICU places, the number of people who died from this disease in Italy would have been three or four times higher. The second and third areas have some similarities because the management was suboptimal. Unfortunately, this was because a lot of Italian people and also physicians at the beginning of the crisis in Italy considered this virus similar to the influenza virus, and they overlooked the seriousness of it. I don't give any fault to them because these physicians and experts based their decisions on data coming from China. I'm talking about the weeks that went from the 21st of February to the 28th-29th of February. We now know that the data from China was not reliable. The Chinese have corrected their data about the number of people who died and the number of people who were really infected from the virus. Therefore, in the beginning, this wasn't considered deadly and was treated like influenza. This made us overlook this disease during the first week.

It is also important to highlight the suboptimal management by the World Health Organization (WHO), who, till the end of February, recommended that surgical masks would be sufficient for healthcare professionals. Unfortunately, we now know that the surgical mask for healthcare professionals, in particular, when you perform invasive procedures like intubation, does not offer sufficient protection as this mask does not have any filtration capability. It only protects you from droplets and no more. Hence, this was very suboptimal for healthcare professionals and was also a major reason why many healthcare professionals in Italy died from this disease in the first week. After one week, we realised that we needed the FP2 and FP3 (also called N95 masks in North America) as these masks have more discretion capability. Unfortunately, we did not have the availability of the right PPE in the first few weeks, and the right PPE became available more or less in the second week of March, and progressively they improved. The full head-to-toe coverage became available mid-March.

If we talk about the test for coronavirus in Italy, it was made available from the 21st of February to the 29th and the first week of March to all people who were symptomatic and to all healthcare professionals and other people who had contact with the person that was confirmed as COVID-19 positive but also those who were asymptomatic. Even here, I would like to highlight that the WHO made a significant intervention in our country and Europe and claimed that this was not the best practice and that we should only test those who were symptomatic, and even now, we are doing the test only in symptomatic patients. This is probably not the optimal management situation because we need to identify the contacts, and we need these tests for healthcare professionals and for people who were in contact with those infected as this can give us the power to put these people in quarantine. This is a very critical point, as many of our healthcare professionals died from coronavirus - more than 128 physicians (as

of April 16, 2020). This is a very dramatic number. Therefore, when I consider my country, I have to say that the management, considering all areas and problems that we faced, was good. I believe we were the pioneer in the Western world with respect to the management of the coronavirus outbreak.

> "In the beginning, this wasn't considered a deadly disease because of data coming from China, and it was compared to influenza virus"

You asked me also if there were other countries that had a better strategy of management compared to Italy. I have seen a lot of comparisons between Italy and South Korea. This is not a proper comparison because, yes, South Korea is a democratic country, and yes, they applied a very good strategy in tracing people. But our culture and our habits are very different from both the Western and the Eastern world. It's very difficult to use an application to map and to track people at every moment of the day, every time and everywhere. In our country, this is considered a violation of privacy. In Lombardy, they have started using an application to track and trace people, but it is important to remember that in the European Union, this can be done only on a voluntary basis. We cannot track people without their consent. Therefore, the South Korea model is very difficult to apply in the Western world because we are a very different country with a different political system. In Italy, Europe, and the USA, we can advise and suggest, but we cannot oblige people to stay at home. We have also taken strong and effective measures in some Italian cities. We deployed the police and even the army for controlling people, but this is the maximum that we can do in a democratic country. You can't kill people if they go outside the home. I think Italy was the real pioneer in this disease and serves as a model for other countries in terms of the good things that we did and the mistakes that we made. We now see the same pattern in other countries.

We know that this disease affects the lungs. In your opinion, could other organs and systems be affected?

After more than two months of this pandemic, we now have more evidence that this virus can also affect other organs. For example, we have seen some cases of myocarditis in which the myocardium was involved. We have also seen the ability of this virus to provoke and to stimulate thromboembolic events. Since the first week of March, we started to use enoxaparin to give anticoagulation because we saw a lot of thromboembolic events. Hence, other systems can be affected, in particular, the cardiovascular system. There has also been some acute coronary syndrome and alteration of the endocrine and the metabolic part in particular, and there was an alteration of the lipids and glucose metabolism. So the answer is yes, there are different organs and systems that could be affected by this virus.

Patients with comorbidities are dying more than those without. Patients with cardiovascular disease, in particular, have shown higher mortality. What is the scientific evidence? What is the interplay between COVID-19 and cardiovascular diseases (new complications or aggravations)? How can we manage cardiac involvement?

In Italy, we have had high mortality with this disease, and this is related to the fact that we do not have the real number of people who were affected. Also, Italy is second only to Spain in terms of people with comorbidities and the mean age of people. As per the data from the Ministry of Health in Italy, the mean age of people who died in Italy is 79 years, and the median age is 80 years. 66% of the people who died were men, and 34% were female. We don't know why the men died more than the females. When we talk about comorbidities, 61.5% had three or more comorbidities, 20.7% had two or more comorbidities, and 14.5% had one or more comorbidities. Only 3% had no comorbidities. Hence, there are a lot of comorbidities, in particular, heart failure. Heart failure has a five-year mortality of 50%, and heart failure patients are aware that we have artificially prolonged their life using pharmacological and non-pharmacological treatments. When you put a disease like COVID-19 over a disease like heart failure in old patients, unfortunately, in the vast majority of cases, this will result in death, because these are two very deadly diseases. There is a crosstalk between the lungs and the heart in a vicious cycle that brings death to these people. If you expand your view with other comorbidities such as COPD, chronic kidney disease, cancer or any other disease that affects the immune system, there is scientific evidence that this virus, when affecting people that have comorbidities, results in death. Also, consider that this virus can kill younger people, and at the beginning, we didn't know this.

You asked me about the interplay between COVID-19 and cardiovascular disease. You have to consider two scenarios. In people who have had no previous heart disease, COVID-19 is able to generate a new cardiovascular disease, such as myocarditis or pulmonary thromboembolism, if you don't give anticoagulation prophylaxis or in some cases, although not frequent, acute coronary syndrome.

Patients with existing cardiovascular disease such as those with heart failure or coronary artery disease, have the highest probability to die because there is an interplay of pneumonia caused by COVID-19 and heart failure. For example, if you have left heart failure and you also have pneumonia, you can have biventricular heart failure or a worsening of previous heart failure. Hence, there is an important crosstalk between organs and systems during COVID-19.

> "The South Korea model is very difficult to apply in the Western world because we are a very different country, and we have a different political system"

Resource allocation is a controversial issue. How about the problem of ICU places' availability, and how about the shortage of mechanical ventilators? Do we have any evidence that old people were prevented from access to ICU places or to invasive mechanical ventilation? Do you think that chance of survival had a role in resource allocation?

Throughout this pandemic, Italy has given a very flexible response. We increased ICU places from the start, and there was never a saturation in Italy or in Lombardy, nor in Milan. However, I spoke with the Director of Cardiology in Bergamo, which probably saw the darkest face of COVID-19, and they had a waiting list for intubating people and only in Bergamo there were some old people who were prevented from being intubated, but it was an emergency situation there. In the rest of Italy and also here in Milan, there was never a waiting list for intubating people, and we never prevented people from being intubated based on the chances of survival or their age. I think we were luckier than the people in Bergamo. As for the ventilator issue, there were some concerns in the first half of March, because we had no help from the rest of the European Union, but luckily, Italy is a very friendly country, and we are well respected and have good international relationships. We received a lot of aid from China, Russia, and the USA. We also have excellent physicians and an important internal industry. We converted some of these industries to produce ventilators; for example, Ferrari is helping to produce ventilators.

Different treatments are being applied. What is your personal experience, and what is the scientific evidence?

There is a recent publication in JAMA (Sanders et al. 2020) that provides a review of all the treatments that have been tried in different countries across the globe. Unfortunately, for any scientific evidence about treatment, we have to wait weeks or months before we can see some results. We have case reports, and several clinical trials have been approved by the European Medical Agency, the FDA and the Italian Health Agency. They have tried different drugs like Lopinavir/Ritonavir, but the results have not been effective. There is a trial with Tocilizumab directed against the Interleukin-6 to block and stop the inflammatory storm. Then there is hydroxychloroquine, but we don't have any trials about this. The use of this drug from home has resulted in some deaths because hydroxychloroquine, when taken at home, can be risky because there is no monitoring of an electrocardiogram. The drug can prolong the QT interval and generate ventricular arrhythmia that can lead to death. This happened in some countries in the world. Other drugs that are being tested are drugs that block the fusion of coronavirus with the other cells, for example, Umifenovir. Hence, there are several drugs that are being tested, but up till now, we don't have any scientific evidence of benefit. We probably have to wait. The final stop of coronavirus will be given only by a vaccine, and that will probably be available in 2021.

Do you think the spread across the globe could have been curtailed? Earlier and wider use of testing could have had a role in this?

From the beginning, we didn't receive reliable and prompt information from the original country in which the virus spread ie China. The virus entered Italy and Europe in a very silent way. It is the opinion of our physicians and scientists that the virus probably arrived here in the middle of January. At that time, China did not release the correct data nor the fatality of the virus. Also, Italy and the USA were overly criticised because they were the first countries that blocked flights from China. We were criticised for being racists, but that was not the case. This measure was undertaken for the health of the people, but it was already too late because the virus had already spread in Europe and in Italy from the middle of January. You can say we could have prevented it but only if other countries had been as honest as Italy. Another reason why it spread globally was that at the end of February-early March, Italy launched an alarm telling other countries to beware. This was a deadly virus and extremely contagious. The data of China probably are not reliable. This was the message to all other European countries and countries in North America and South America, but this was not understood. Even in the first week of March, the Spanish government claimed that they

did not have coronavirus, and they continued to play soccer matches. Similarly, in France, they celebrated Women's Day on the 8th of March in a square in Paris, and it was full of people. Nobody understood. The UK was still relying on herd immunity until their Prime Minister was admitted to the ICU. Hence, in the beginning, it was not understood that this was a very contagious and deadly disease.

How important is physical distancing? Can it play an important role in stopping the transmission?

Yes, social distancing is working because it gave us the opportunity to flatten the curve. In the case of Italy, it gave us a gap between the ICU place availability and the total number of cases. This way we never achieved the saturation of the system. For example, Spain applied late social distancing in Madrid, and they had a problem with ICU places. Therefore, the later you apply social distancing, the higher is the peak of the pool, and you have the risk of achieving saturation of your healthcare system. In Italy, social distancing has worked very well. The majority of Italian people, 90 to 95%, followed social distancing guidelines.

What was the lesson from this pandemic to healthcare management and, in particular, to your national healthcare system?

I have to say that COVID-19 gave a hard lesson to our health care system. We were completely unprepared. We were structurally unprepared. Over the last 15 years, there have been progressive cuts of healthcare in Italy – cuts in hospital places and cuts in the number of physicians and nurses. Coronavirus put in the spotlight this problem because it showed that we have no place to put the people with COVID-19, and we had to find space in one or two weeks. If we had not done this, the number of people who died would be three or four times higher. Next time, we need to be prepared, and we need to invest in healthcare and invest more in hospitals and ICUs. We also have to improve the salaries of our healthcare professionals. Many of our physicians have left Italy because they are not compensated properly compared to other countries. We have to improve the quality of life of healthcare professionals if we want a better healthcare management system. In Milan, we have created a COVID-19 centre with 200 spaces, which can help us in case of a second wave. We will probably not have a vaccine if this virus comes back in October or November, and we will need more defined treatment, better testing, and more effective quarantine measures. People will have to use masks whenever they go out, and there will be more effective social distancing. But the important thing is that if you don't put your attention or focus on the healthcare system, you will not save lives. The health of the people should always be the first priority.

Interviewee: Giuseppe Galati

Consultant Cardiologist | San Raffaele Hospital | Milan, **Italy**

giuseppe.galati5@gmail.com | @GiuseppeGalati

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CoviLake Niguarda: Trying to Predict COVID-19 Patient Path

COVID-19 is a new and largely unknown disease, which makes it difficult for clinicians to make prognostic decisions. CoviLake Niguarda is a project aimed at creating AI algorithms and a decision support system (DSS) feeding from a datalake of all relevant patient information to support clinical decision-making on the front line.

Since the first COVID-19 outbreak in Wuhan, China, researchers are collecting data about the novel coronavirus to better understand its characteristics and behaviours and, eventually, to help in both treatment and prevention of COVID-19 in populations around the world. One such promising initiative, CoviLake Niguarda, is being launched in Italy as a collaboration between major hospital, academic and industry entities.

Problems and Goals

The CoviLake Niguarda project consists of activating and feeding a vendor neutral archive (VNA of Agfa HealthCare) and a datalake (of InterSystems) with anonymous images and clinical data related to COVID-19 cases within Ospedale Niguarda, the largest and one of the most important hospitals in Milan, Italy.

Currently, 80% of the 1,000-bed Niguarda is allocated to treat COVID-19 patients, as are most of its staff. COVID-19 is a complex disease, and detailed information about the virus and its mechanics is still unknown. This adds to the burden of clinicians on the front line. The clinical problem with the COVID-19 patients is the very broad spectrum of manifestations, from mild flu-like symptoms to pneumonia and respiratory distress. The ultimate goal of the CoviLake Niguarda project is to try to predict the possible scenarios of the disease development in each patient and to support the prognostic decision-making for radiologists, emergency department physicians, anaesthesiologists, infectologists, and other specialists.

In particular, the clinical goals are:

1) Prognostic prediction: Identification of (bio)markers to predict prognosis and stratify patients based on disease severity.

Image: Courtesy of Agfa HealthCare

2) Therapeutic forecast: Identification of (bio)markers to predict the most appropriate therapeutic intervention.

3) Active monitoring (during hospitalisation): Identification of (bio)markers to classify individual susceptibility linked to evolution to severe forms.

4) Active monitoring (at discharge): Identification of (bio)markers to identify residual frailty situations that need further monitoring.

5) Differential diagnosis of active/residual disease: Categoriser to distinguish active/residual COVID19 manifestations from similar pathologies.

Data Acquisition and Methodology

Thanks to the voluntary contribution of Agfa HealthCare, InterSystems, Medas, Sazai, QUIBIM and Nextage, it was possible, in a very short time, to design a state-of-the-art computer system to support clinical-scientific research aimed at diagnosis and treatment through a large interdisciplinary group that includes radiologists, physicists, anaesthesiologists, infectologists, pharmacologists, and emergency department physicians, among others.

At this stage, the team is working to create a solid foundation for the project focusing on the quality of data to be used to train the artificial intelligence (AI) system, and the methodology behind it. While collecting data is a relatively simple task, putting together and connecting the clinical and imaging data is a novel approach, for which the datalake format has been chosen. Datalake is an 'open container' filled with relevant information from different sources, such as images, CT scans, ultrasound, x-ray, blood tests, etc – anonymised and properly labelled.

Notably, Niguarda, with two other major facilities in Italy, was one of the first hospitals in the country to be digitalised. It partnered with Agfa HealthCare back in 2001, and since then all their data are stored online, which now makes over 250 Tb of patient history only in radiological data. For the CoviLake Niguarda, this makes it possible to have both retrospective and prospective assessments of a patient. In other words, current observations and predictions can be complemented with the data from years ago, if needed. Whether the patient had been in the hospital before, what their treatment was, whether there are any underlying conditions – all this information can be extracted, added to the datalake and used to support the decision-making process and, as the pandemic develops, to follow the patient's quality of life post-COVID-19.

Rigorous anonymisation of the clinical data and images has been another important topic that the group has had to address. The solution adopted has found the consent of the Niguarda Ethics Committee to allow the ongoing study. It enables application of high-level competencies that are not specifically connected to the GDPR profile and opens the data up to be used by other research groups.

Technological Aspects

The clinical documents and the archived images, correlated by the datalake, will be the subject of analysis and study by the University of Milan and the QUIBIM company of Valencia that, with the support of clinicians, will try to create AI algorithms and a decision support system (DSS) to help better understand the mechanisms by which the COVID-19 virus acts/evolves. This is expected to provide clinicians with greater insight into a patient's potential reaction to the infection and the degree of support they might require.

The technology part of the CoviLake Niguarda project includes:

- The acquisition, through special integration of images and clinical documents of COVID-19 patients being studied, from the PACS and Niguarda Repositories systems.
- Anonymisation, through specifically designed computer modules, of images and clinical data.
- Submission to the VNA and the datalake of anonymised images and anonymised clinical data respectively.
- Installation and configuration in a functional way to the project of the VNA and the datalake, and tools for the correlation between clinical data and images.
- The study, analysis and implementation of AI algorithms and a DSS system, using images and data present in the VNA and the datalake, and aimed at giving answers to the project clinical questions.

Project Coordinators

Dr Marco Bosio, CEO of the ASST Great Hospital Niguarda, drives a large 'teaching hospital' with multidisciplinary skills oriented to patient care. Under his leadership, professionals from different

disciplines work together to address the challenges of these years, including the COVID-19 pandemic.

Dr Angelo Vanzulli, Director of the Department of Advanced Technologies and Professor of Radiology at the University of Milan, will coordinate the clinical-scientific research that will be carried out by a team of multidisciplinary doctors including radiologists, anaesthesiologists-resuscitators, pneumologists and virologists.

Dr Alberto Torresin, Director of Medical Physics of Niguarda, Professor in the Department of Physics of the State University of Milan, is responsible for the technical aspects of the CoviLake Niguarda, while Dr Maurizio Menni of Sazai, an innovative start-up in Milan that deals with AI in the medical field, cooperates with the technology partners.

Timeline and Plans

In the next 2-3 months the group is planning to feed into the datalake all the available data for nearly 1,000 patients. 10% of those will be used at the initial stage to train the AI system, and the rest to test and adjust its ability to predict the development of COVID-19 in patients. It is expected that in about six months the project will deliver preliminary results with the AI system set up and will have the ability to analyse the data. Additional evaluations might follow, if necessary.

For the time being the research is focused on COVID-19, since it is a new and unknown disease. It is too early to say if its results can be applied to other diseases, but the methodological approach may be of interest for future studies of other kinds of pathologies with similar clinical questions.

Furthermore, there are aspirations to expand the datalake to the regional level with the support from Agfa HealthCare and other companies. Currently, the project is at an early stage and has been authorised to run only in Niguarda, but cooperation with other hospitals in the region is a future option, which is being looked into.

Interviewee: Prof. Angelo Vanzulli

Director, Department of Advanced Technologies, Professor of Radiology | University of Milan | Milan | **Italy**

angelo.vanzulli@ospedaleniguarda.it | ospedaleniguarda.it | unimi.it

Interviewee: Prof. Alberto Torresin

Director, Medical Physics | Niguarda Hospital | Milan | Italy

Professor, Department of Physics | University of Milan | Milan | **Italy**

alberto.torresin@ospedaleniguarda.it | ospedaleniguarda.it | unimi.it

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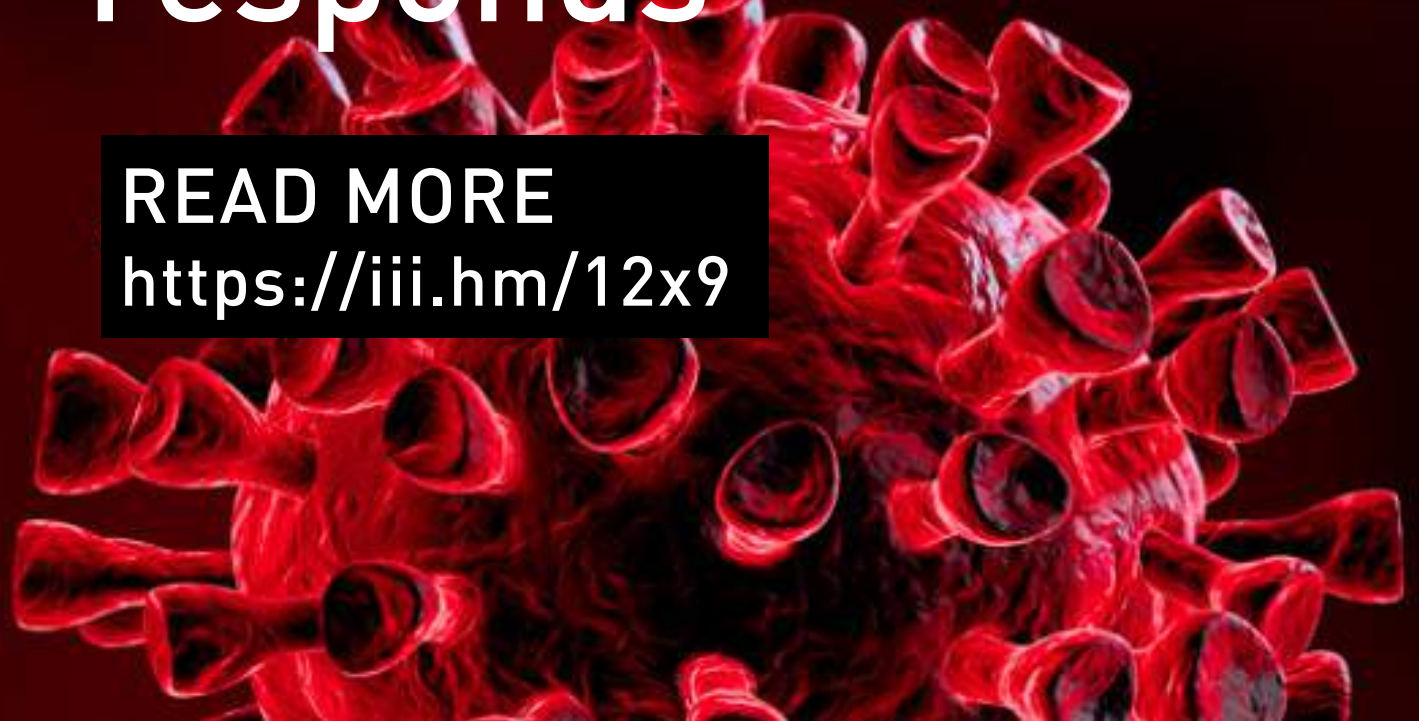


COVID-19 Pandemic: The Importance of Testing and Social Isolation

Prof. Mamas A. Mamas is a structural interventional cardiologist, treating patients with underlying coronary artery with percutaneous coronary intervention (PCI) in both the elective and emergency setting and undertaking Transcatheter Aortic Valve Interventions (TAVI). He is also the Associate Editor of Circulation Cardiovascular Interventions and leads a large research groups focussed around electronic health record research. HealthManagement.org spoke to Prof. Mamas about the COVID-19 pandemic and its management in the UK.

Do you think your country is taking enough precautions to contain the virus, and have any of the other countries implemented measures that have impressed you or that you feel worked well?

South Korea has done a fantastic job of controlling the virus. It has been very aggressive at the start of the pandemic, in identifying cases, in contact tracing, and then enforcing isolation of those cases that were found to be positive through digital solutions such as tracking through mobile phones, smartphone activity, and so forth. In the UK, our approach has been less robust; we don't have a proper means of testing. The only people that are getting tested currently are those admitted to the hospital. However, the vast majority of people (around 80%) that are infected with this condition won't be admitted to the hospital. Since we're not testing these people, there's no way of contacting them, and there's no way of enforcing isolation.

The second thing is that the UK initially adopted a herd immunity approach. What that means is that you rely on a certain number of individuals to get infected, and typically, you would need 60-70% of the population to be infected, and that would then result in the protection of the other population. If a significant proportion of the population has caught it and they're immune to it, the spread of the disease is much lower because you've got fewer people that are susceptible to it. The problem is that when people started to realise what impact this would have on health care services, the government switched their approach and implemented lockdown and social isolation. That's almost trying to bolt the door once the horse has left the stables and missed the opportunity to be able to control the situation. It all comes down to testing. If you cannot test your population and trace the contacts that they've had with and test them, you will have difficulty in managing this situation, and that's why many of the European countries, North America and the UK, haven't dealt with the situation very effectively. South Korea has been very proactive in dealing with testing and contact tracing, and therefore, they have limited the spread and the impact of the disease.

Do you think that aggressive testing could have curtailed the spread?

Some health care systems like South Korea adopted very aggressive testing and contact tracing, and the spread has been far far less than in countries that are not doing proper testing, including the United Kingdom and the United States. In the United Kingdom, testing is not available to the majority of people. It's only to those admitted to the hospital. It is not even available to healthcare professionals, and we're told that if you have a temperature or you or anyone in your family has a cough, you should self-isolate for two weeks. But then the temperature or the cough may not have anything to do with COVID. Many hospitals are reporting 20 to 30% of their staff self-isolating that don't even have COVID. The second thing is, if you're not testing these individuals, you can't contact trace. You can imagine if each of these individuals has been in contact with a number of people who may or may not be infected and not knowing who these people are and whether they're positive or negative results in a complete disaster for the spread of the virus. Countries have failed miserably

in aggressive testing of their population and aggressive contact tracing, and aggressive management of the patients with enforced isolation of those identified to be positive. Don't forget that the data was very confusing in January. We had the World Health Organization in the early part of January saying that Chinese data was suggesting that person to person spread was unlikely, and clearly, we all know how wrong that was. It would suggest to me that perhaps in China, contact tracing and testing in the very early stages of the disease were less robust.

> "It all comes down to testing. If you cannot test your population and trace the contacts that they've had with and test them, you will have difficulty in managing this situation"

I was traveling a lot in February and March, going to different meetings. I was shocked when all the reports were coming out of China, and it was spreading to Italy. I was in the US, and I arrived back in the UK, and no one tested individuals, no one measured temperatures, no one had questionnaires around whether you've had a cough or you're breathless, or you're unwell. There are tools that were used only in the latter stages when traveling was stopped. The global response was relatively poor because a lot more could have been done in trying to test individuals that were travelers. Places like London, New York, Paris, and Rome that now have a huge rate of infections are the travel hubs for airplanes, and there were no robust mechanisms or systems for screening passengers. Carriers were arriving in a country free to mix with the population, and there were no checks as to whether these people were infected, or who they're coming in contact with. The public health response has been very poor and has been reactive rather than proactive.

We know that this disease affects the lungs in patients who reach the severe phase. Could other organs and systems be affected by it?

There is a lot of data as to how COVID-19 can influence the cardiovascular system. There have been a number of papers that have shown that between 1 in 10 and 1 in 15 patients with COVID-19 have abnormalities in cardiac biomarkers, suggesting that there is cardiac involvement or cardiac damage. People that have elevated biomarkers have a worse prognosis and worse outcomes than those without. A small proportion of people with COVID-19 get a dysregulated inflammatory phase, and this can affect systems of the body. When these patients get really sick and enter the Intensive Care Unit, they tend to have multi-organ failure, renal dysfunction, cardiac dysfunction, circulatory collapse, and that's part of the dysregulated inflammatory process that's affecting all the organs in the body.

How long do you think a lockdown is feasible for countries?

We are all aware of the economic impact of the lockdown. In the UK, the GDP has dropped over the last couple of months below what it has been for probably close to 100 years. The last time that GDP dropped so much was in the Great Depression of the 1920s. The GDP drop has been more than the crash in 2008. From a public health perspective, having a lockdown for as long as possible will control the spread of the virus. There's no doubt about that. On the flip side, though, the longer you have the lockdown for, the greater will be the economic impact. You can't separate the economy of the country with the delivery of healthcare within a country. An economic crash will Impact individuals' health quite significantly, in that you won't be able to afford proper health care delivery. It's always a balance between the economic well-being of the country and the benefits that brings to population health versus trying to have a lockdown to limit the spread as much as possible. The solution cannot be worse than the process. You have different approaches. For example, Sweden hasn't adopted a limitation and lockdown, and so the impact on the economy will be much less compared to places like the UK and other places in Europe that have the lockdown. There is a lot of discussion on how long we should continue this lockdown because there will be a big economic crash, and that will have an impact on the healthcare of the population.

If you look at the trends in China, they were able to get back on track within three months or so. Do you think that things will get better for other countries three or four months down the line?

There are a lot of questions being asked about Chinese data. I don't know how robust or non-robust this data is. The problem is that we don't have great data because we don't know what the denominator is. All we know is the number of people that are admitted to the hospital or that have a test and whether it's positive or negative. But don't forget that in Italy, and in a lot of Europe, the vast majority of individuals are not having the test. We're not testing the population, so we have no idea whether it's increasing or decreasing, or staying the same. Or what proportion of the population has been infected because, for immunity to work, you need about 70% of the population to be infected. If we do testing and we find that 60 to 70% of the population has been infected, that would be a good argument to stop this lockdown or reduce its severity. The second bit is: how do you define cases? You can only say that there's been a COVID case or a COVID death by testing for it, and different countries do different things. If someone dies

in the community, does that count as a COVID death? If a patient is tested to see if they have COVID or not, and if they go to the hospital, and die before the test result comes back, is that a COVID death? Just looking at the number of deaths from COVID and the number of cases from COVID may not necessarily be the most robust way of looking at infection rates. It depends on how many patients you're testing, who you're testing, and what you're counting as a case.

> "Just looking at the number of deaths from COVID and the number of cases from COVID may not necessarily be the most robust way of looking at infection rates"

So, testing clearly is very critical. Why do you think countries are not doing it?

It's a number of things. First and foremost is the capacity. There are different types of tests. There is a viral test, and there is an antibody test. Some of the antibody tests that have been developed aren't as robust as what would be needed for clinical care, and you may get a lot of false negatives. PCR methods are much more accurate as long as you do a good swab, but they are time consuming and so doing PCR techniques as a means of population screening will be difficult because there may not be the facilities to run hundreds of thousands of these tests every day.

What about resource allocation in case of a shortage of ventilators as the number of cases increase? Should chances of survival be the criteria?

There can be shortages even in the best healthcare systems with the greatest resource. Look at the United States, for example. They are still reporting shortages. In the United Kingdom, we have 8000 ventilators that have been called by the government, and a number of manufacturers have been approved to try to get additional ventilator production and support to the United Kingdom.

With all of these discussions, first and foremost is: does the patient actually need more ventilation? Could you achieve a similar benefit in a proportion of patients using CPAP, where we know that there is a much greater CPAP resource than formal ventilation? Particularly for the milder cases, perhaps thinking about using CPAP may make it more optimal. Secondly, there have been a lot of discussions about being able to use a single ventilator to ventilate more than one patient. It may be challenging because you have to find two patients with similar ventilation requirements and similar volumes required because you can't support a 150-kilo man and a 40-kilo lady with the same settings. You have to find people that are similar enough that you can do that, and that will be challenging, but that might be another potential way of dealing with the ventilator issue. The third way of doing it is what they're hoping to do, which is by doing lockdown and social isolation. What that does is, it slows the spread of the infection. Rather than everybody getting infected at the same time and having a big impact on the healthcare service where you can't ventilate everyone, if you do social isolation, and slow the spread of infection, it may be that the same number of patients get infected, but they get infected over a longer period of time, and therefore there's not the density of patients or the number of patients that need a ventilator.

Finally, as with anything in medicine, there have to be questions about how we allocate resources because resources are not infinite. We do this in medicine all the time. It's just that now, it's a lot more overt because there is a much greater need for this limited resource - the ventilator. You have to think about patients' chances of survival. For example, if you have multimorbid, very frail patients that have other life-limiting conditions such as active cancer, what is the benefit of them being ventilated if it's a limited resource, and you're preventing a younger patient without co-morbidities and without life-limiting conditions receiving treatment? You will think about the chances of survival. That's always challenging because we're only now understanding the condition and we only have limited data as to what are the factors that have better chances of survival, and what are the factors that have worse chances of survival. I think we also need to consider the patient's background health status as well and think about their quality of life currently, and what we're trying to achieve. If a patient has a life-limiting condition, I'm not sure if that is the best use of the resource.

With all of these things, we have to think about the resources that we have, and try to minimise the use of resources hence why social isolation is so important, and a lockdown is so important. But then when we are faced with a number of people with limited resources, we have to allocate based on those where we feel that the chances of survival are greatest and the quality of life after survival will be greatest. These discussions are very difficult because there are no official guidelines for how to run this. You have to do it within an ethical framework where there's a full discussion within the care team. This is not a decision that an individual can make. It has to be a whole team and also involve patients because I have dealt with patients many times in my career that may say, "Doctor, we've had a great life. I don't want

to go on the ventilator. I would rather put boundaries around the aggressiveness of my treatment." I think that's reasonable. That's an informed discussion with the patient and their family.

Should doctors be involved in making this decision, or should resource allocation decisions be taken by a hospital committee?

That would be difficult. Often the people that are on the committees don't do clinical work. I'm not sure that they would provide any insight whatsoever. I don't agree it should be the individual. It should be a team. But it should be the clinical team that is involved in the use of this resource. It should be the intensive care team there on the floor on a day to day basis, not the administrators that haven't been in a clinical environment for 20 years. I don't think they offer a valuable opinion. Decisions should be made by clinical teams looking after patients and involved in active clinical care.

Do you think healthcare systems across the world have failed healthcare professionals?

I've been speaking to physicians in North America and in Europe. The protection offered to healthcare workers is poor. In many ways, national recommendations do not go far enough in protecting healthcare workers. Many of us believe that the recommendations are based on the availability of PPE as opposed to what is the best PPE. There have been many physician deaths in the US, UK, and Italy. Many of these were avoidable deaths because of inadequate protection. The guidelines have said that COVID spread is only through droplets. But a lot of studies have suggested that that might not be the case. It may be aerosol spread, and the surgical facemask may be ineffective for healthcare professionals. We should be using N95 masks as that would be much more effective with aerosols. If you look at the way that the Chinese protect their workforce, particularly in the latter stages, where they had full hazmat suits on, all of them had N95 and compare it to what we did in the NHS, with the face mask and plastic apron and scrubs unless it's an aerosol-generating procedure, there's a big difference. It's clear that we're placing our staff at risk by inappropriate guidelines and inappropriate protective equipment. This will eventually lead to a shortage of healthcare workers if doctors keep getting sick. The reason is twofold. Number one: they really are getting sick. Number two is the issue that if a member of that family has a fever, the requirement is for healthcare workers to self-isolate for 14 days, even though the cough or the fever may have nothing to do with COVID. Children have constant fevers. It may have nothing to do with COVID. But because we don't have proper testing or widespread testing, we're mandating healthcare workers to self-isolate for two weeks and in many hospitals, between one in three and one in five of their healthcare worker are off sick for self-isolation.

Is there anything else you would like to share?

I think there are many negatives about how this situation has been handled by governments and policymakers. But I think there are many positives about how the healthcare community has dealt with this. One of the real eye-openers has been around the exchange of information over social media. At the end of the day, we are dealing with a healthcare condition where there isn't an academic space. Up to three or four months ago, no one knew that this condition even existed. But now, over social media, between societies, we're having an exchange of information across the globe. We have Chinese physicians doing webinars with UK-based groups with American groups. I've been involved in webinars with Italian intensive care physicians over social media. We're all working together exchanging information about protocols, management strategies, presentations, how to structure our services. I think this is amazing. One of the comments that I made in one of the webcast I was involved in with TCTMD was how would this have been managed ten years ago when we didn't have such active social media? It would have been very different. The exchange of information between colleagues across the globe now is instantaneous. And we've had a very quick adoption experience and protocols from our Chinese colleagues who have been absolutely fantastic in sharing their experience with us, with our Italian colleagues who have been amazing sharing their experience with us. We now have a pool of expertise across the world that we can access with a click of a button. I think that has really, to me, stood out as to how we should work as healthcare professionals across the globe.

Interviewee: **Prof. Mamas A. Mamas**

Professor of Interventional Cardiology

Associate Editor, Circulation Cardiovascular Interventions

Member of E-Cardiology Group of ESC ESC Cardio-Oncology Council | **UK**

mamasmamas1@yahoo.co.uk | @mmamas1973

Imperatives for Rebuilding European Healthcare Systems Post-COVID-19

How European healthcare systems can rebuild in the post-COVID-19 era.

The COVID-19 crisis has laid bare the very foundation on which the European healthcare system is based. So many revelations, so many regrets. To bring this into perspective, let us look at some hard numbers. At the time of writing this article, the novel coronavirus had infected more than 800,000 people (1) in Europe alone, claiming the lives of more than 66,000 of them.

If this is not alarming enough, take a look at this: those infected in Europe comprise over 52.5% of the total cases (2) reported in the world at this time, and the mortality due to COVID-19 in Europe is over 71% of the global number. On the other side of statistics, the continent is home to only about 6% of the world's population (3).

With this discrepancy in numbers, it comes as no surprise that European hospitals and paramedics are massively overwhelmed (4). The purpose of reiterating these numbers is to impress upon the necessity of improving the European healthcare systems. What is it about the European healthcare systems that needs to be changed to be prepared for such crises in the future? Is it the way hospitals function as holistic organisational units? Or is it how doctors and nurses who provide primary healthcare are trained?

Contrary to popular belief, primary healthcare is not merely about doctors and nurses treating someone with an illness. It goes a lot deeper than that, as the World Health Organization (5) so clearly describes. Effective primary healthcare also means that authorities should draft actionable policies that can effectively deal with probable health threats to the people. Additionally, at the ground level, people, families and the larger community must also be equipped to take responsibility of their health as well as that of the people around them.

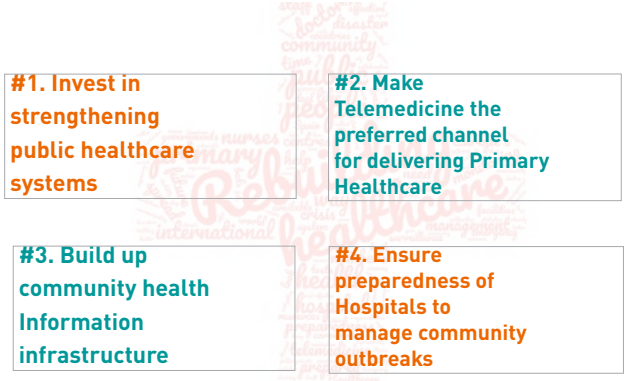
All three levels of primary healthcare can be improved by heeding the imperatives that the COVID-19 crisis has been communicating to us through its aftermath. Here are some of these imperatives:

Imperative #1: Invest in Strengthening Public Healthcare Systems

The approach to healthcare must change. Over time, government investment in public healthcare systems has seen a decline in Europe. As a result, those factions of the society that most depend on the affordable public healthcare systems are often unable to gain equal access to healthcare facilities. The elderly population is heavily impacted, as are the people inflicted with chronic sicknesses.

However, privatisation of healthcare is still desirable for efficiency and quality patient experience. In the post-COVID-19 world, enhanced public-private partnership is the way to go. This will help governments to improve the scale and efficacy of the public healthcare infrastructure within their allotted budgets.

Imperative #2: Make Telemedicine the Preferred Channel for Delivering Primary Healthcare



Since it is all about social distancing when it comes to preventing the spread of the coronavirus, building more robust telemedicine systems in Europe's hospitals is important. Firstly, this will reduce the pressure on the hospital infrastructure and resources such as beds, nurses etc. Secondly, those who are healthy will stay that way (6) by not physically visiting a doctor unnecessarily or out of undue panic. Thirdly, people who are ill but can be treated online by qualified doctors without the need for special medical equipment can receive prompt and cost-effective care. Lastly, telemedicine will also keep those at the forefront of providing healthcare – doctors, nurses, sanitation staff – safer. Overall, this could be an excellent way to ease the burden on Europe's primary healthcare framework.

Some primary signs of the increasing importance of telemedicine have already been seen in Europe,

particularly in the UK, Spain (7) and Israel (8). It is a trend that European hospitals and healthcare professionals must take forward even after the COVID-19 crisis ends.

Imperative #3: Build up Community Health Information Infrastructure

As we vividly know now, lack of information can have disastrous consequences. In the wake of the outbreak, Bill Gates (9) shared some useful insight into how disease surveillance and greater visibility of available resources, including human resource, can help fight the spread of a disease like COVID-19. Hospitals can play their part in such preventative surveillance.

For instance, monitoring the health status of international visitors could save Europe a lot of trouble. Many American universities (10) require information about tuberculosis tests from incoming international students. Many African countries require a yellow fever vaccination certificate (11) from international visitors. In the future, similar and more rigorous tests may have to be recommended by European healthcare systems to collect information from all international travellers.

European governments should also set up Artificial intelligence (AI)-driven community health monitoring centres. These centres would become enormous treasure troves of information. Using AI and machine learning, the spread of contagious diseases could be predicted and monitored. Such centres would, of course, need help in the form of hospital admissions data from all private and public facilities so they can take timely and effective actions to contain the transmission. Encouragingly, AI is already being used for screening patients and monitoring symptoms in China, the US, South Korea and many other countries.

Imperative #4: Ensure Preparedness of Hospitals to Manage Community Outbreaks

Preparedness is the key to mitigating a disaster. There are two aspects to consider when it comes to being prepared for a healthcare emergency:

Disaster management drills

To ensure preparedness for disasters like COVID-19, the onus falls on the hospitals to design disaster management drills that cover multiple emergency scenarios. However, disaster management drills cannot be limited to individual hospitals. They need to be conducted at community level and should include both public and private hospitals. During this crisis, many countries in Europe failed to find a proper collaboration model between Public and Private hospitals. We cannot risk repeating that failure. Thus, drills need to be team events that can test the coordination between multiple hospitals in a city or country even.

Flexibility of infrastructure and staff

Another aspect of preparedness is how flexibly hospital spaces can be re-designed and re-allocated to quickly set up temporary infrastructure like isolation wards, beds and even ICUs. Many leading hospitals in the US have had to do exactly this to deal with the increased patient volume. A judicious and smart use of all available space is a must in such emergencies. Moreover, hospital staff should be trained for smooth reassignment of responsibilities in situations when the demand is excessively high.

If healthcare authorities and health systems could incorporate even some of these imperatives in their practice post the COVID-19 pandemic, Europe's healthcare system will be so much better prepared for the future, however unpredictable it may be.

Author: **Sourabh Pagaria**

Executive Vice President & Head of Southern Europe | Siemens Healthineers

sourabh.pagaria@siemens-healthineers.com | @SourabhPagaria

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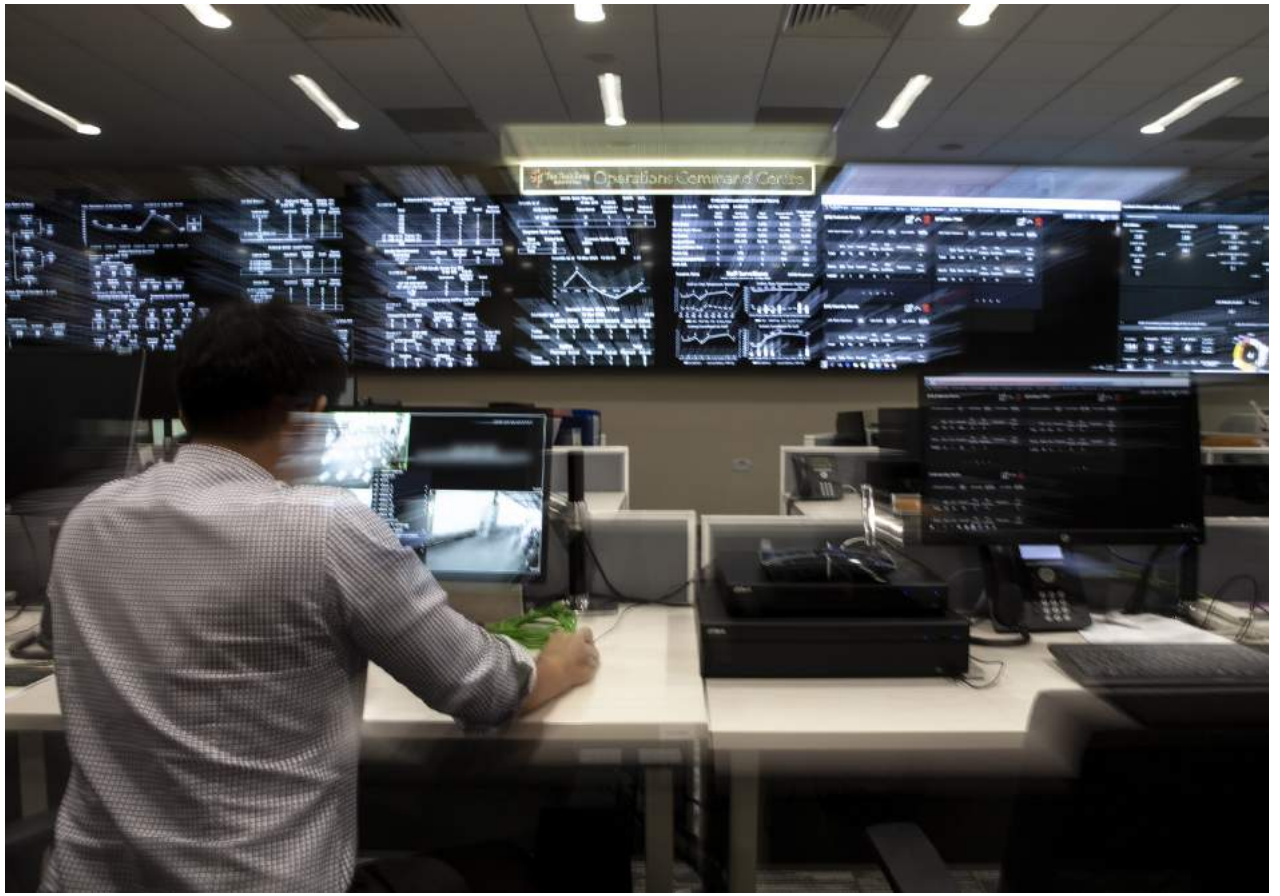
Smart Hospital for the Future

PLAY VIDEO

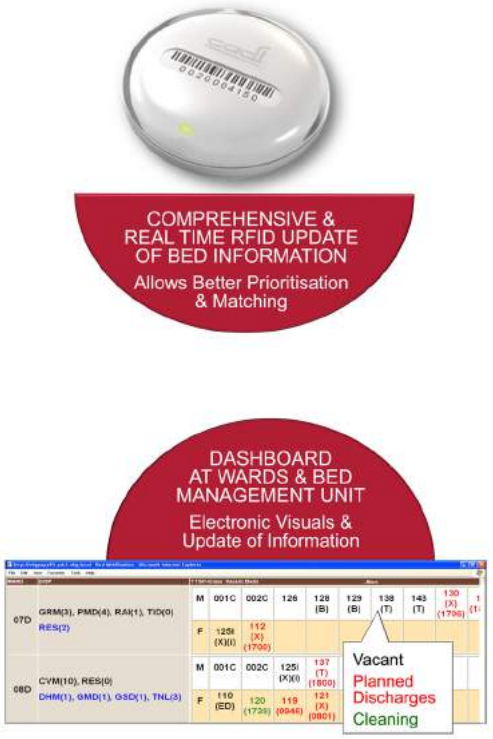
Summary: Tan Tock Seng Hospital, a large multi-disciplinary public hospital in Singapore enters into the future of Hospital Operations with Command, Control & Communications (C3) capabilitites at its new Integrated Operations Command Centre.



On 22 Jan 2020, Singapore raised its Disease Outbreak Response System Condition (DORSCON) (Singapore Government 2020) level from green to yellow, in the face of the increasing number of novel coronavirus (COVID-19) cases linked to China. Two weeks later on 7 Feb 2020, it was raised to orange, the second highest level of alert on the back of a few local cases without any links to previous cases or travel history to mainland China.

Tan Tock Seng Hospital (TTSH) was at the epicentre of Singapore's outbreak response to COVID-19. It was back in 2003 that the hospital was also designated the SARS hospital in Singapore then. Lessons were learnt from SARS in 2003 and H1N1 in 2009 and these lessons helped us to develop a state-of-the-art 330-bed facility for Infectious Diseases – the National Centre for Infectious Diseases (NCID). NCID was officially opened in September 2019 to always be prepared for a containment strategy in the event of another outbreak. The plan was for the main hospital to support and augment NCID with manpower and resources, and transfer existing patients back to the main hospital to free up capacity for outbreak response. This was to be tested for the first time during this outbreak.

In about a week from activation, TTSH scaled up operations to open a large 24/7 screening centre



that can see 200 patients at any one time, and support the manning and opening of 200 Negative Pressure Isolation beds for outbreak purposes at NCID. This was scaled up to the full 586 beds with contingency plans ready for beyond 586 beds. This was a massive undertaking for the hospital that operated at 90-95% Bed Occupancy Rate during Business-As-Usual (BAU). BAU ambulatory services had to be scaled down to less than 50% to free up manpower for deployment to fill three shifts at the NCID. Services such as Laboratory had to operate rapid round-the-clock testing and the Hospital's Clinical Epidemiology team conducted intensive surveillance in terms of contact tracing and activity mapping for patients, and sickness surveillance and twice-daily temperature monitoring for all staff. Staff from various departments were mobilised, mask-fitted and trained to assume their outbreak roles. Critical supplies for the outbreak were reviewed based on new norms of higher burn-rate and for longer term continuity. In addition to the outbreak response at NCID, the hospital conducts enhanced pneumonia screening for local surveillance, and all patients with pneumonia are isolated at the main hospital until tested negative twice over 24 hours.

More than two months into DORSCON orange, Singapore has gone into "Circuit Breaker" mode to have our residents stay at home, our schools to use home-based learning and our non-essential workplaces to close with work from home options. The number of COVID-19 cases has increased and community isolation facilities have opened to converse healthcare capacity for those who need acute and intensive care. It is a critical time for us to contain the outbreak and to sustain our healthcare workforce and capacity. TTSH and NCID attends to 70% of the confirmed and suspect cases of COVID-19 in Singapore. Local GPs and Polyclinics screen for suspect cases and refer them to NCID and other public hospitals for confirmation and containment. To date at TTSH and NCID, we have screened more than 18,000 persons and admitted more than 3000 patients for confirmation and containment. At the same time, we continue to operate our Emergency Department (Singapore's busiest) and our Business-As-Usual wards at 70-80% bed occupancy rate. With the likelihood of a more prolonged outbreak, we are looking beyond surge to sustainability and optimising our schedules and processes to enable better resource management and efficiency, allowing staff sufficient rest for the journey ahead.

One important strategic advantage that the hospital has to manage our crisis response to the COVID-19 outbreak is our integrated systems approach to Hospital Operations. The recently-opened TTSH Operations Command Centre (OCC) featured our new Command, Control and Communications (C3) system that went live in December 2019. It provides real-time visibility, flow management and resource optimisation to enable Hospital Management to coordinate, and make timely and effective decisions. However, given the multiple and evolving changes in workflows during an outbreak, the C3 system needed to be reconfigured for an outbreak scenario.

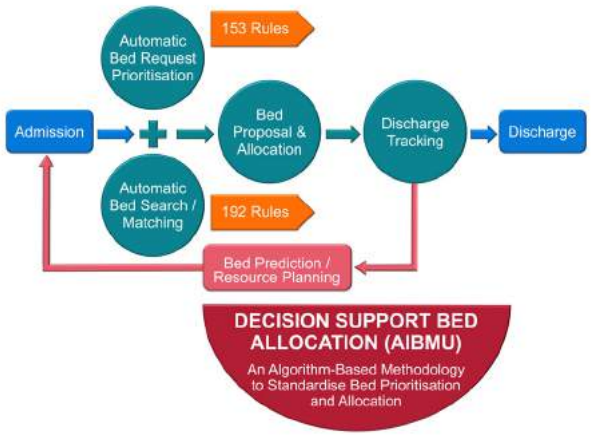
Taking Command of the Hospital's COVID-19 Outbreak Response

We were in the midst of developing the Outbreak Scenario for C3 when COVID-19 struck. There is no better time to accelerate the development of our C3 Capabilities for an Outbreak Scenario than during an outbreak itself. Adapting the system quickly for our outbreak response workflows, C3 has given us a strategic advantage in communicating and coordinating our responses across our hospital. The key success factor in our outbreak responses lie in our ability to communicate and coordinate hospital-wide operations, based on reliable and timely data from across multiple systems and the frontline. Reporting is also streamlined to prevent confusion and disruption to frontline operations. The system provides for visibility on frontline operations and prompts hospital management on key decisions in the ramp up of our outbreak response including deploying manpower, ensuring critical supplies, and facilitating the opening and capacity management of our screening centre and outbreak wards at NCID. As an integrated operations command centre for TTSH and NCID, it also allows the coordination between our BAU and Outbreak responses that need to work hand-in-hand for an integrated response.

With our newly commissioned Real-Time Location System (RTLS) for tracking patients and staff at NCID, live video streaming and analytics from key ground operations across our hospital, and the real time

clinical surveillance data, we are able to coordinate and respond more effectively across our hospital. These capabilities when fully developed and integrated with C3 can enable better and timely decision making to aid our response, and free up frontline staff from manual reporting when they are already busy caring for our patients. We are still in rapid agile development to learn as much as possible during this outbreak. There is no crisis to waste. It is important we learn as we do, and not just learn after it is done.

> **"There is no crisis to waste. It is important we learn as we do, and not just learn after it is done"**



Driving Systems Innovation in Hospital Operations

Even without disease outbreaks, healthcare delivery has been increasing in complexity as there are many different parts in our care delivery system to coordinate and integrate for a smooth patient journey throughout our hospital, from admission to discharge. The journey towards an integrated Operations Command Centre did not happen overnight for us. With continuously improving our processes, stacking up new technologies and redesigning our workforce, we had taken a deliberate and systems-based approach to innovating our hospital's operations, while building a collaborative culture across our clinical and operations staff.

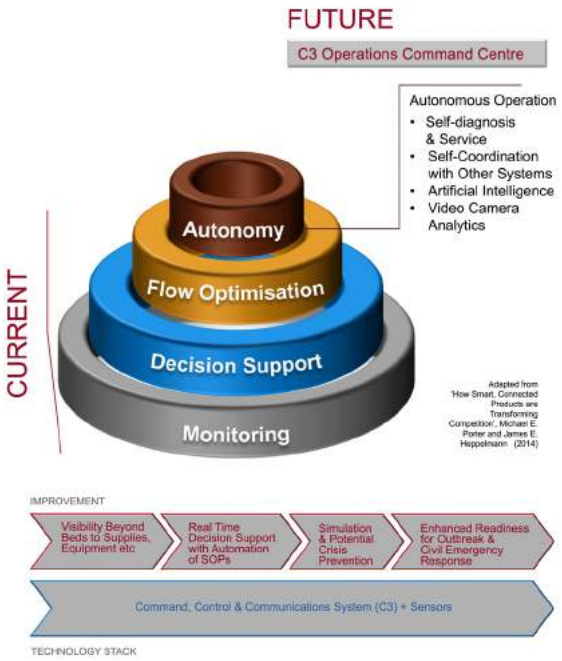
More than 10 years ago, we embarked on a determined journey to better strategise and manage TTSH's regularly high bed occupancy. We had avoided one-third of potential admissions by fast-tracking them for review at our outpatient clinics and day facilities, and shifted 70% of all surgeries to an ambulatory setting. Yet with 1700 beds across the hospital, we were full house more days than not with more than 85% of patients via our Emergency Department (ED). Back then, staff across the hospital were making multiple phone calls, filling out forms and charts just to assign a bed to a patient waiting at the ED. It was high time that we moved from this tedious and untenable "Pen, Paper, Phone" method of bed allocation, to one where processes are automated and optimised for patient care and bed utilisation. To do that, we needed real-time visibility to track where our resources and our patients are and their status.

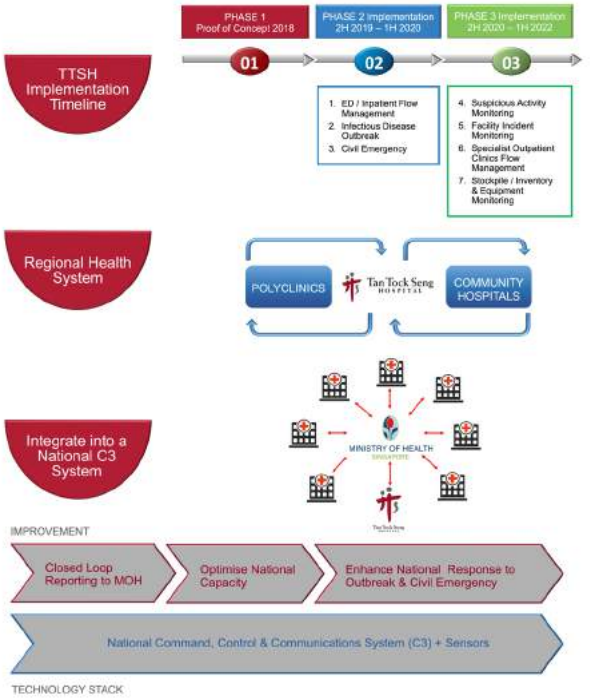
In 2008, we implemented a Real-Time RFID-Tagging System, which allows us to automate admission and discharge workflows, and identify the location of patients. This provided visibility of beds in our system. When a patient is admitted, he is tagged with an RFID tag and his information is actualised automatically on the ward's dashboard, replacing the old practice of manual and at time inaccurate updates of the ward census on a whiteboard. The system enables the location tracking of our patients even as they go for their tests, scans and procedures outside the ward. It greatly facilitates coordination and communication of the patient's location and progress between the care team and family members.

When a patient is discharged, the removal of his RFID tag automatically triggers the discharge processes including notifications to business office and housekeeping. A countdown timer set for 30 minutes is activated for housekeeping to completely turn around the beds and for OCC to assign the bed to the next patient waiting at our ED. We now have full real-time visibility of patients and beds in the system – their location and their status.

In 2011, we developed and introduced the Artificial Intelligence Bed Management System (AIBMU) to provide rule-based decision support on bed allocation based on priority and matching. There are 345 rules to prioritise and match patients to beds, which make the task of assigning beds beyond the ability of the human mind. Prioritisation rules were based on clinical triaging guidelines, established in consultation with clinicians, while matching rules take into account factors such as class of wards, gender, and specialty requirements to ensure operational efficiency. As a result, our AIBMU calculates and allocates the best available bed options in order to best match the patient's requirements and to ensure clinical prioritisation for urgent cases.

Nursing also introduced the Electronic Discharge Tracking System (eDTS) that optimises discharge planning with an estimated discharge date (EDD) and time. This allows us to predict the availability of beds coming online and for the AIBMU to allocate an upcoming bed that will be available soon in the system that better matches the patient's requirements,





reducing the rework of internal bed transfers later. From an army of staff managing beds, we now need only 2-3 administrative staff per shift to meet the bed allocation needs of a large hospital like TTSH with 1700 beds and growing.

As innovative as the AIBMU was in 2011 in changing the way we manage bed operations, in 2014 we started visioning something more transformative; work began on conceptualising a full Command, Control & Communications (C3) system that enables real-time hospital operations beyond bed management.

In May 2019, we unveiled our new TTSH OCC and soon after, its state-of-the-art C3 Smart Hospital System at our Ng Teng Fong Centre for Healthcare Innovation. Our OCC now functions much like an airport control tower, operating 24/7 to ensure efficient, safe and effective operations during peacetime and crisis. The C3 Smart Hospital System supports daily operations from the ED to inpatient wards to discharges, across the main hospital, NCID and the soon-to-be-up 600-bed Integrated Care Hub for rehabilitation and subacute care.

As the "brain" of our hospital, C3 is a smart system of systems that can sense, think and respond to optimise patient flow and care delivery. It enables a mind-set shift in hospital operations from resource management to flow optimisation to autonomous orchestration. Hospital data from across various source systems is pulled into a flow concept that highlights choke-points within the hospital and triggers standard operating procedures to respond to various incidents and situations. From fragmented operations, we now have the C3 capabilities to enable our hospital to run as a coordinated system to ensure better overall care experience for our patients. Over time, C3 will also incorporate machine learning and predictive analytics to ensure better prospective actions and forward planning rather than taking reactive measures.

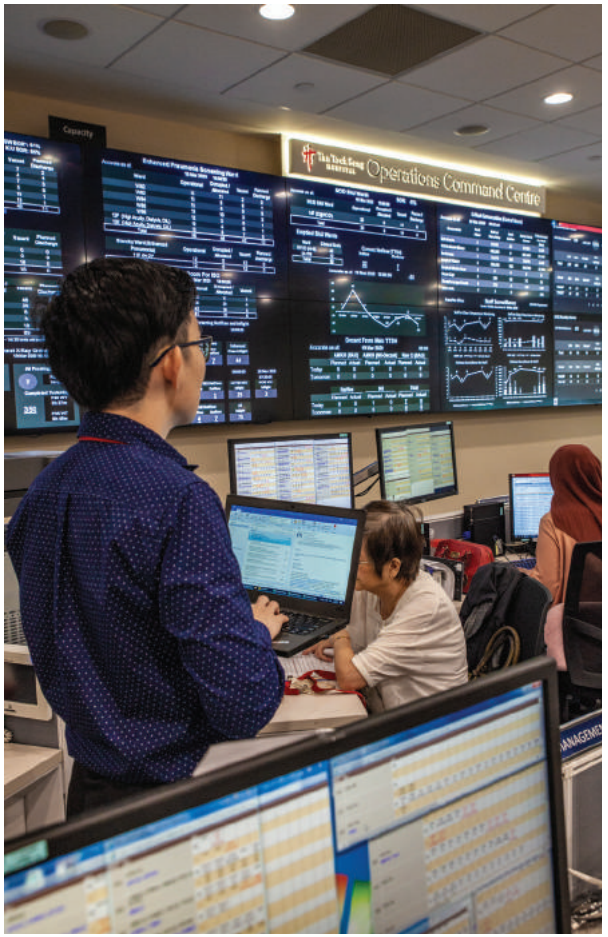
Our C3 Smart Hospital System is developed by TTSH, Integrated Health Information Systems (IHIS), Singapore Technologies Engineering Electronics (STEE) and supported by the Ministry of Health (MOH), Singapore. C3 is set to change the way hospitals are run. This is a first for Singapore's healthcare and possibly leading the world in hospital operations.

In the Pipeline for C3

Soon, we will introduce more sensors on the ground and digitalise manual processes to feed operational data to C3. More than just enabling awareness, there is a concurrent need to make sense of what we see on the ground as well. With better awareness of the ground situation and more information at hand, we can then make better decisions together.

Artificial Intelligence can also be built into the C3 system to make certain decisions autonomously. What we aim to do is to at least have 80% of operational responses automated, leaving about 20% of more complex situations for staff to review and address with real-time decision support by the C3 system.

The C3 Smart Hospital System is scalable across our healthcare system. Plans are in the pipeline to extend C3 capabilities upstream to join up the pre-hospital phase (ambulances) and downstream to Community Hospitals. This will facilitate care transitions and enable more seamless and timely patient care. C3 capabilities will be extended to MOH and other hospitals to enable our public healthcare system to load balance and optimise patient care and national bed utilisation.



The C3 Smart Hospital System is also stackable to expand its functionalities to other operational scenarios. Following the current C3 deployment for daily inpatient operations, other scenarios in the pipeline include outbreak management, supply chain management and critical equipment management.

Increasing Human Touch with Digitalisation

C3 is an exciting digital transformation of our hospital operations. Yet, our digital transformation has less to do with new technologies and more to do with our people. Better technologies should lead to better jobs, and in turn better value for our patients. We need to innovate innovation itself to enable transformation in the digital age. At TTSH, we adopt a systems approach to Healthcare Innovation called our Innovation Cycle. Every Innovation starts by redesigning our care and processes; then leveraging technologies to enable our care or process; and finally redesigning our jobs to focus on what our patients value.

This cycle is iterative and enables innovation to scale, spread and sustain.

Digitalisation in healthcare is about returning meaning to our workforce to find joy at work. Today, our nurses spend about 70-90% of their time in managing the ward processes and paperwork from admission to discharge. Better technologies like C3 can free them up from administrative tasks, and they will have better jobs and spend more time with patients. Digitalisation leads to more human touch, keeping complexity at the back and humans at the front. If we can reduce mundane and repetitive tasks, it will mean better decision support for our staff, better care experience for our patients, and more time to engage patients in their health and recovery.

With C3, the exciting future of hospital operations is beckoning.

Author: **Prof. Eugene Fidelis Soh**
CEO TTSH & Central Health | Singapore

ttsh.com.sg | @eugenefidelissoh | @TTSH | @efsoh

Key Points

- TTSH was at the epicentre of Singapore's outbreak response to COVID-19.
- COVID-19 was the first test of capacity for outbreak response.
- The new C3 system provides real-time visibility, flow management and resource optimisation for better management decisions.
- Healthcare crises are a valuable opportunity for learning on the spot.
- C3 frees nursing staff from administrative tasks so they can spend more time with patients.

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New Image Sharing Technology Transforms Radiology Services Across Yorkshire

The XERO Exchange Network, a new image sharing technology from Agfa HealthCare's Enterprise Imaging solution has been launched by the Yorkshire Imaging Collaborative, a collaboration of hospital trusts that collectively covers a population of over three million patients.

A new image sharing system has just been launched and is now available in seven trusts across Yorkshire and the Humber to manage high demand on the NHS during the COVID-19 outbreak. The system is called the 'XERO Exchange Network' and is part of Agfa HealthCare's Enterprise Imaging solution that allows hospitals to instantly view images and reports that were acquired at another connected site.

Some of the key benefits of the XERO Exchange Network include:

- Fast, secure and reliable transfer between hospitals without the need for CDs or DVDs
- Easy for staff to use
- Quicker diagnosis for patients

The Yorkshire Imaging Collaborative (YIC) is the official name for the trusts working together to improve radiology services. The new system will facilitate ease of access and quicker diagnosis across the seven NHS hospital trusts as well as at the NHS Nightingale Hospital Yorkshire and the Humber.

Adrian Watts, Imaging Informatics Programme Manager for Agfa HealthCare, said, "One of our fundamental goals working with the YIC has always been to make all images and reports available to authorised users across the collaborative."

The COVID-19 pandemic has increased the demand for radiology services. With the launch of this new system, patients will also benefit as, in some cases, it will help reduce the number of scans they need, lower the radiation they receive and the number of visits they need to make to the hospital.

YIC is part of the West Yorkshire Association of Acute Trusts (WYAAT) and includes the following trusts:

- Airedale NHS Foundation Trust
- Bradford Teaching Hospitals NHS Foundation Trust
- Calderdale and Huddersfield NHS Foundation Trust
- Harrogate and District NHS Foundation Trust
- Leeds Teaching Hospitals NHS Trust
- Mid Yorkshire Hospitals NHS Trust
- Northern Lincolnshire and Goole NHS Foundation Trust

The NHS Nightingale Hospital Yorkshire and the Humber are also live with the new software, and Hull University Teaching Hospitals NHS Trust is expected to be connected soon.

Clinical Lead for YIC, Dr Daniel Fascia said, "This new technology will transform the way hospitals deliver radiology services to patients for the better. Not only will the image sharing software reduce the time patients spend in hospital, it will allow for a quicker diagnosis and relieve pressures on radiology services across the region during this period of increased demand."

For more information, please visit iii.hm/12uv

Author: Rachel Coleman
Programme Support Manager | Yorkshire Imaging Collaborative
@RachelColeman

How the Digitisation of ICU can Power the Fight Against COVID-19

GE Healthcare introduces an out-of-the-box COVID-19 tailored solution that automatically captures data and provides quick and relevant COVID-19 clinical insights.

As the tsunami of Coronavirus "COVID-19" (SARS-CoV-2) cases surged across the globe from east to west, the scaling up of Intensive Care Units (ICU) in Europe accelerated to increase patient capacity and prepare clinical staff for its imminent impact. The unpredictability of the virus pandemic and uncertainty of science that accompanies the new disease still presents real and ready dangers to the people, economies and our healthcare systems.

We have experienced the first response to COVID-19 in Europe with the successful escalation of ICUs, reorganisation of teams and fast reaction to treatment planning. As we take a breath between waves, we can now start to see what worked well and share experiences from collected patient data to shape and prepare our future responses.

Scaling up to Optimally Manage the Pandemic

In the ICU, every second counts to make life or death choices for critically ill patients. In usual circumstances, access to quick and accurate patient information powers the decision making to help save time and lives. In today's COVID-19 climate, digital tools become of paramount importance when speed and accuracy of information is even more vital. The pressure of working in clinical environments has intensified - increased number of patients, a tired ICU workforce, and higher infection control measures than ever before.

The use of a clinical information system in the ICU that automatically collects real-time information from medical devices at the patient's bedside, and displays the data for remote and instant review in a central ICU location, offers huge time and treatment potential. It reduces the need for manual, paper-based data collection directly in the care environment, saving time and reducing recording errors.

Saving Time Means Saving Lives

The Hospital Universitari Joan XXIII de Tarragona, part of the Catalan Health Institute in Spain, scaled up its ICU from 28 to 79 beds at the start of the COVID-19 crisis. Dr. María Bodí, Head of ICU Service states, "We went from two to six units as part of our Coronavirus capacity measures. The Centricity Critical Care solution gave us the opportunity to expand at speed. I cannot imagine being able to attend to patients in different units with different information systems - it would have been impossible to guarantee a high level of patient care."

Dr Bodí continues, "Being able to monitor patients at the bedside as well as remotely made things much easier when under extreme pressure. Having a process for data recording forces you to not leave any area of patient care uncovered - it improves the safety and quality of patient care. Although some of the staff deployed to ICU during the crisis had not used the system before it has been easy for them to use. The information in the system will always be found, recorded and recalled in the same way and this has been key to systematising the work."

A Reliable and Scalable Solution to Fight an Unpredictable Virus

In response to the pandemic, GE Healthcare has quickly mobilised a Centricity High Acuity 'out of the box' COVID-19 tailored solution. Implementation in a matter of weeks includes online training and remote support. It automatically captures data from monitoring and respiratory systems from multiple vendors' models, saving nursing staff the time of documenting manually at the bedside.

Providing quick and relevant COVID-19 clinical insights, it also captures and displays the information as trends that can be combined with medication, fluids and care documentation to provide a single overview at a glance. Furthermore, colour coded worklists provide a tailored

structure for preconfigured admission, discharge and care documentation helping speed-up those processes and save nursing time.

Enabling a Rapid COVID-19 ICU Digitisation Strategy

The review of COVID-19 patient data using the tailored Centricity solution can be accessed at the bedside or a central location in the ICU, outside of high contamination areas, or in a remote location on other floors or buildings of the hospital. Multi-patient lists help with care prioritisation and the ability to review and alter treatment plans without needing to be at the actual bedside.

Medication order sets can be tailored to provide standardised care and fast prescribing for the most common medications to help support bedside staff that may have variable experience levels. For example, redeployed staff from other clinical specialities now working in ICU can be steered and supported using the system to standardise the quality of patient care.

Rule-based notifications can alert bedside staff for timely medication administration or execute planned care tasks. Notifications for patient deterioration could be displayed at the bedside and on the central patient list to provide prompt care responses. The built-in Lung Protective Ventilation clinical expertise, for example, focuses on a combination of lung protective ventilation guidelines, trends from ventilators, targets and smart notifications when measured ventilation values are outside of the target set for the individual patient (Figure 1).

Consistency in the Delivery of ICU Care From Visiting Staff

One of the key challenges facing ICU during the first wave of COVID-19 was the shortage in staff numbers, either due to contracting the illness, the need to isolate due to symptoms, or the requirement for more to cover the larger number of beds. This led to nurses and clinicians from other specialties being deployed into the ICU environment. The use of the clinical information system therefore helped enable consistency in the delivery of ICU care from newcomers with different medical backgrounds.

Dr Bodí from the Hospital Universitari Joan XXIII de Tarragona adds, "We had such a scenario where physicians from different areas of the hospital like emergency, cardiology and anaesthesiology joined our ICU medical team in response to the COVID-19 escalation. I am very grateful for this collaboration as it has been essential in our efforts. We quickly reorganised ourselves at a team level and leaned on the systematisation of the system's processes to effectively train new professionals over three days – there was no time to wait months."

Unfamiliarity with the ICU environment could be very challenging for redeployed staff. However, with a digital ICU management system, rule-based decision support, notifications and protocols are provided at the bedside and at the central dashboard to help address these challenges. Worklists customised for COVID-19 as task reminders also provided consistency in the records and delivery of treatment.

Looking Ahead to Continue the Management of Pressures

"Preventing ICU from being overwhelmed has been key to managing the first wave of COVID-19 cases in Europe. Now the challenge is to learn from this experience and prepare for subsequent peaks as we look ahead to the rest of the year," says Professor Dr Mathias Goyen, Chief Medical Officer, Europe at GE Healthcare. "Software that automatically collects real-time information at the patient's bedside in the ICU offers potential for both huge time savings and improved treatment."

Dr Bodí agrees, the recent experience has yielded many learnings and important data for the future, "The value of all our clinical patient data from our COVID-19 experience is like gold. It shows how the

Integrated lung protective ventilation clinical expertise

oxygenation, haemodynamics, sedation and treatment evolved continuously. It is real information, what really happened in sequence. It is much more valuable than a retrospective report written by a doctor after an event. This information will be important to share with other groups and intensivists, even other countries, to be able to make prognostic or predictive models with decision support tools that could even be incorporated into the clinical information system itself."

The scalability and standardisation of ICU via critical care management systems have stood the ultimate test and demonstrated positive outcomes. The automatic collection of patient data, remote access and management of rules-based tasks have enabled staff to do the impossible - be in many places at one time.

Now we can see that anything is possible when we are tested to our limits. Intelligent, collaborative and connective health such as the digitisation of the ICU can combine traditional hands-on care and virtual surveillance to turn the tide against a global emergency, and power the fight for optimistic patient outcomes.

Author: Pål Arne Wøien

General Manager of Life Care Solutions | GE Healthcare Europe

@Pål Arne Wøien

COVID-19: Data Uncertainty and Effectiveness of Interventions

Summary: For the past 15 years Prof. Andy Tatem has been working with population data globally, and his team was one of the first to analyse the COVID-19 spread and interventions during the outbreak in China. He speaks with HealthManagement.org about public health measures, COVID-19 changing the nature of research, and how data could and should be used in a pandemic context.

On Whether COVID-19 is that Serious

It definitely is. The early evidence we see in terms of deaths and hospitalisations is way above anything in the past records, even if we go back to the 1918 epidemic it seems comparable. You only have to look at what happened in Iran or Italy – their health systems have been completely overwhelmed. And that has an impact. It is not only people with the disease that are dying, it is also others who should have been receiving care. It is also having to make decisions on who you treat and who you don't. Furthermore, the damage is there not only in healthcare, but also, for instance, in the economy.

On Value of Their Research

In our study (Lai et al. n.d.b) we tried to understand, which types and combinations of non-pharmaceutical interventions had the biggest effects, and the role of putting those interventions in place in different time periods. At the time of the research – back in February – only China had a major outbreak, and we were working to build a model of what was going on.

The results may help public health leaders to optimise the set of interventions needed and the timing of their implementation. Our findings show that case detection and isolation of confirmed

or suspected cases, if put in place as early as possible, are effective, as is scaling up the testing. In the countries that are the most successful in controlling the disease, testing is widescale.

Unsurprisingly, however, the biggest impact was from all these interventions combined. Social distancing and the travel bans added to that had a major effect. Our estimates show that the outbreak in China in February would have been almost 70 times greater if they hadn't put in place any of those interventions. Other modelling studies on policies in the UK and the US show similar results.

> "Our findings show that case detection and isolation of confirmed or suspected cases, if put in place as early as possible, are effective, as is scaling up the testing"

On Early Interventions in Low-Income Countries

How to ensure these interventions are in place early is now a major concern for low-income countries. The reason for implementing such measures in the richer countries is to protect the health systems from being overwhelmed, to 'flatten the curve,' ie to not get above the capacity of the health systems and minimise the amount of excess deaths. For low-income countries the challenge is that they already are reaching the limits of their health systems. This means they need financial support to be able to scale up testing and isolate cases, just as other countries have done. Some of that support is coming through aid agencies, but the capacity is just not there, for sub-Saharan Africa in particularly.

The recommendations here would be similar as what has been recommended to high-income countries and what many of them didn't put in place as early as possible because they didn't have the time to prepare. The situation is very similar – it is known that the outbreak is coming, so to reduce the impact on their health systems, low-income countries should ensure best possible testing and isolation.

In such countries, there are some positive aspects, eg their populations are far younger and the numbers of elderly people, that are really driving those excess deaths, are much lower than, say, in Italy. But on the other side there are many negative aspects with regard to their health systems, many underlying heath conditions, malnutrition across the populations, or the fact that social distancing is just something that many cannot do in low-income settings.

On Sweden and Denmark's Models

It is interesting to see. Every country is following a different path, experimenting. The UK, just like Sweden now, had started out with slower, 'wait-and-see' approach and then suddenly switched. Sweden already has a much higher death rate per population than the surrounding countries that have put in place stricter measures. So it wouldn't be surprising to see Sweden following them soon. Each country is ending up in a very similar situation. The question now is when they come out of this situation and how.

On Lifting of Restrictions in Europe

This is a very difficult decision. It is about finding the balance between the safety of the public and protection of economy, and I wouldn't want to be a politician at the moment to make that decision. If we just end the lockdowns, we are risking a massive resurgence of the disease. Across the world, there is still a very small percentage of population that have had this virus. This means the potential for spread and overwhelming the health systems is still there. We've already seen this with Hong Kong in particular. They put in place strong measures and then took some of them away. This led to a massive second wave coming in, and they had to tighten the measures again.

If you are considering taking away some of these interventions, you have to make sure that the testing and the monitoring is very strong. Then you can start to gradually lift up some of the restrictions, but at the same time be ready to put them back if there is any threat of resurgence.

On Herd Immunity

First of all, we don't yet know about SARS-CoV-2 immunity – if people are immune and how long that immunity lasts. Second, with herd immunity we need 60-70% of population to actually get the virus, and we are far from this yet. Plus, if we do get there, but too fast, then we will end up with many deaths and overwhelmed health systems.

On Uncertainty around Available Data

There are, indeed, massive uncertainties about the data on COVID-19. We cannot really compare case count across countries – it scales with testing, the more you test, the more you find. For example, in the UK many deaths that occur in care homes are not included in the regularly reported numbers. Yes, there is a very large proportion of elderly with underlying health conditions, but there are still quite a lot of deaths in younger age groups. It is all a balancing act again – trying to understand what the fatality rate is. We keep learning, and so many studies are ongoing.

On Streamlining Research

On the one hand, it is great that scientists can put out their research so quickly now. The way everything is

changing so fast has had a big impact on our way of working. We had to really adapt and do things as quick as possible, otherwise they become outdated. There are analyses that we have planned and wanted to do with the same rigour as usually, but we had to find ways to get results out quickly so that they are valuable to act upon. Take our study on interventions – it was online in early March, but it is still a few weeks until it is finally published in an academic journal. With things moving so fast, by that time it wouldn't have been so useful. At the beginning of February we put out another COVID-19-related study (Lai et al. n.d.a), an analysis of the spread down in China based on the air traffic data. It caught a lot of attention, but now we may not end up publishing it in a journal because things have change dramatically.

> "If we just end the lockdowns, we are risking a massive resurgence of the disease"

The information should be made available as early as possible, but the question is how accurate it is. The academic journals that do peer-review are trying to keep up, but many of those reviewers are already overwhelmed with their own work. It all comes down to responsibility of the scientific community to highlight and point out problems with papers that have been put out there as preprints with no review. I do see a lot of that happening on social media and news articles – when something has a bit of a headline, but the study hadn't been reviewed and there are major problems with it. I am hopeful there is a kind of self-correction mechanism in that, but it is still a concern as spreading unverified information can be dangerous.

In general, I am impressed by how quickly the scientific community has put together a lot of work, and has collaborated on making the results open – that hadn't happen so much in the past.

On New Research Directions

This outbreak is showing how we all are really connected, and the influence it has. The unprecedented speed of the spread has become a problem for so many countries. I have done many studies in the past on population movements, how diseases move around and the speed it takes them to spread. COVID-19 has broken all records.

It has also highlighted the challenges in the regions where countries are strongly connected, Europe is an example here. Right now we are trying to adapt the model we used in China to European settings, looking at how connected European countries are and what that means for strategies. If one country completely removes all of its interventions, it is still strongly connected to the rest of Europe – so how much of an impact that has for other countries in terms of the second wave that we anticipate will happen in all countries at some point.

On Ethical Side of Working with Data

In discussions around the coronavirus there have been two broad categories about the use of mobile data. First, the one we are more focused on, is about broad dynamics of how populations in general move around. There is no need to look at individual level data. It is similar to traffic statistics you see on Google maps, ie aggregated and anonymised monitoring of mobile phones that telecom companies are using routinely. These data are quite valuable in understanding the flows between the cities, or the general changes between mobility patterns.

Second is the ultrasensitive data, the kind that Singapore had used, ie contact tracing and surveillance of individuals. Here the real discussion should be taking place about the sensitivity of these data and the role of government in working with them. This can be, on the one hand, a very valuable tool if we are to get out of the lockdowns, but on the other hand, it is bringing up questions about governments tracking our movements.

On WorldPop Data and Future Outbreaks

At WorldPop, we're a group of about 30 researchers at the University of Southampton. For the last 15 years our work has been focused on integrating different data sets, mapping populations and their characteristics, mostly in low and middle-income countries where there are no strong systems for collecting data regularly on populations. We integrate household surveys and satellite data to try and build up that picture of where the populations are and who they are.

In this outbreak, the data on populations' age structures in particular have been used by many groups and organisations to see which areas have higher rates of vulnerable populations, eg males, elderly, etc. These can also be integrated with some other data that we produce – on poverty, on malnutrition – to identify

underlying health conditions and how those may vary within countries.

On WHO and Its Role in Crisis

The World Health Organization has been in the news a lot, for various reasons. They are relatively small funding-wise, but have a lot of influence, particularly in the low-income countries, which rely on their support and guidance. They are also influential in instructing or supporting countries in data collection and coordination.

I for sure trust WHO more than many governments.

I know many people from there, academics who are very rigorous, robust scientists trying to deal with all the politics across the world. This is not an easy task, to coordinate and provide guidance for setting standards across different countries where you have multiple types of politicians, all with different agendas. We have been part of coordination calls that they have put together for modelling groups. For us, it is very valuable to hear all those groups, and it is really only WHO that has the influence to bring all of them together to discuss ideas, models, data. So WHO does have quite a valuable influence, but it is more about guiding governments and setting standards, not so much about implementing interventions themselves.

On Patient Zero

Who was the first infected person is something that would be there in the months to come, when they start assembling the genetic data and comparing those with viruses that are circulating in the wild, to better understand where they actually came from. It may be the case that we will never know who was the first person. It is hard to be able to definitely say when the symptoms can look so much like influenza – and many people have influenza that time of the year.

On Data Manipulation

I have had quite a few experiences recently, with journalists in particular trying to get a story out of the work that we've done, eg about 'had China acted three weeks earlier, it would've stopped the global pandemic.' We cannot support that without data, and considering how much has been going on and how many political decisions have been taken – it's hard to say.

Clearly, some government or a newspaper may have an agenda to make a story out of some data. It is always a challenge to communicate something where there is a lot of uncertainty. We are trying to produce the best that we can, yet nothing is set in stone. It is still our responsibility to communicate our outputs, and it sometimes means building that uncertainty into decision-making. Nobody wants an uncertainty, however – they want a number to make a decision on.

Interviewee: Prof. Andy Tatem

Professor of Spatial Demography and Epidemiology, Geography and Environmental Science | University of Southampton | Southampton | UK

a.j.tatem@soton.ac.uk | southampton.ac.uk | worldpop.org

@AndyTatem | @andy-tatem-b199b018

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Call to Action for the Cardiovascular Segment of COVID-19

The rapid global distribution of the Coronavirus and the fear of collapsing healthcare systems have forced hospitals to concentrate on the treatment of COVID-19 patients and allocate their resources accordingly. As a consequence up to 80% of the elective cardiovascular (CV) interventions have been indefinitely postponed.[1] This measure resulted in a number of alarming developments. One was that the early presentation of patients showing potential symptoms of cardiovascular diseases (CVD) significantly decreased due to the fear of contagion in the hospitals or limited access to overcrowded emergency services.[1,2] This could be the reason for a decrease of myocardial infarction incidence by up to 50%. In the current COVID-19 situation standard treatment protocols are shortened due to the fact that emergency-driven changes to hospital logistics conflict with important principles of CVD patient treatment.[2]

Additionally, cardiologists are facing the severe impact of COVID-19 on the cardiovascular health of the patients. There is increasing evidence that patients with pre-existing cardiovascular disease and cardiac risk factors, such as aging, hypertension, and diabetes, are more severely affected by the COVID-19 in terms of both morbidity and mortality.[2] A very recent meta-analysis of six studies showed that up to 14.6% of the included COVID-19 patients suffer from CV disease, up to 38.6% develop hypertension and up to 19.5% have diabetes.[3] CVD may even develop through COVID-19 in cases without prior symptoms or medical history.[3,4] It has been reported that acute myocardial infarction was the cause of death in patients hospitalized with Severe Respiratory Syndrome (SARS)[4], which is one of the main complications associated with COVID-19. Further, common drug therapies for COVID-19 may cause serious cardiovascular side effects, which can have essential impact on patient outcome.

Cardiologists around the world are now calling for action to coordinate measures that are urgently needed in order to avoid the aftermath of the COVID-19 pandemic. *"We believe that the COVID-19 crisis will have a memory, with longer term residual repercussions on the cardiovascular system."*[2] Patients who urgently require cardiovascular examinations and procedures are delayed, others fear hospital admission due to infection, which will – in the long run – result in the deterioration of the cardiovascular status ending up in long-lasting cardiovascular damage in many of the patients, as well as in patients surviving the COVID-19 infection.[2]

The need is to understand different mechanisms underlying the association between CVD and COVID-19, to reconsider the use of current drugs used in cardiovascular patients and to develop *"clinical cardiovascular biomarkers allowing for effective future management of such patients."* [2] As evidence shows that the prevalent manifestation and cause of death is severe respiratory syndrome (SARS), the early assessment of cardiovascular status of the COVID-19 patient is just as essential in order to prevent disease escalation and long-term sequelae.

To date blood pressure, cardiac output and other hemodynamic parameters can easily and noninvasively be measured using the patient's fingers to support educated decision making. As the inventor of a technology focusing on advanced noninvasive hemodynamic solutions, I ask myself if our quick and simple CNAP® monitoring could help cardiologists to easily diagnose the CV status of both, CVD patients in times of COVID-19 or COVID-19 patients with CV complications.

Author: Dr. Jürgen Fortin
CEO & Chief Scientific Officer | CNSystems| **Austria**
fortin@cnsystems.com | www.cnsystems.com

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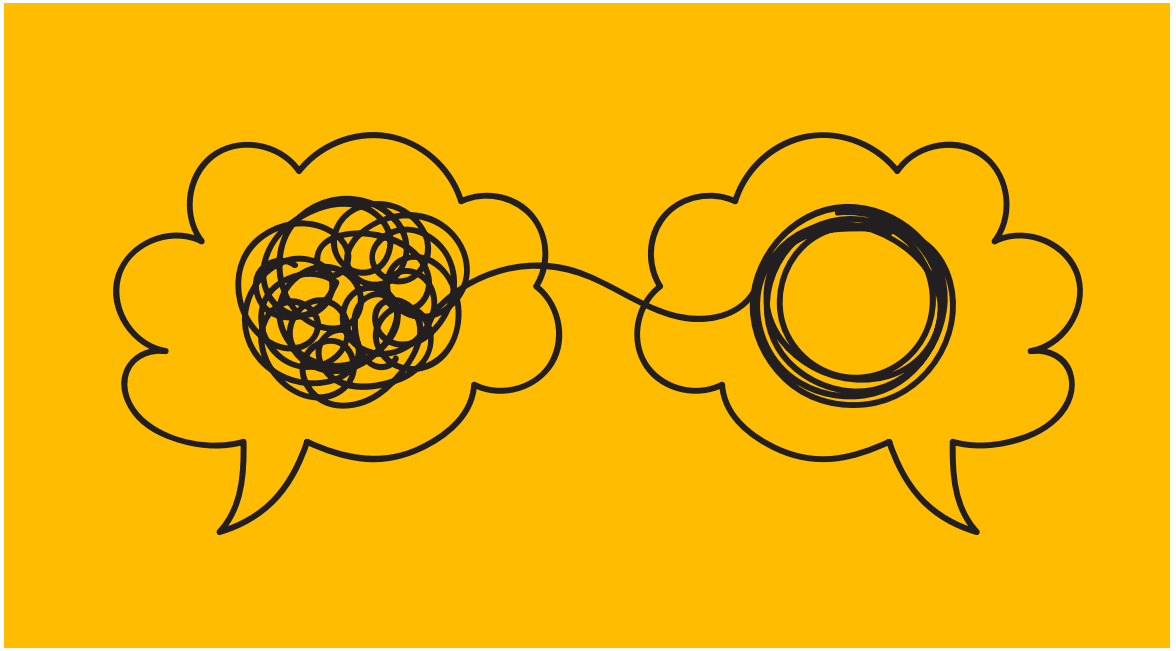
Crisis Communication: Challenges, Priorities and Perspectives



Summary: Communication during a crisis is always a challenge and even more so with the unprecedented COVID-19 pandemic. A group of experts from Ghent University in Belgium talked to HealthManagement.org about the elements of a communication strategy, workflow arrangements and adjustments required in critical times and the ways of how COVID-19 is changing communication as we know it.

While seasonal influenza has become an element of everyday life, COVID-19 is completely new to us, with no vaccine or treatment so far. And something new and unacquainted always causes more anxiety and uncertainty at all levels. It may well be that COVID-19 is here to stay, and with a partially immunised and partially vaccinated population (hopefully resulting in more mild cases but possibly not in eradication) it will also become something 'acceptable,' just another recurrent, manageable disease. But until then the coronavirus will remain a source of stress. Because without solid long-term data, which will be accumulated over time, it is very difficult to make reliable predictions and arrange communication around the virus. This does not mean, however, that we should not be prepared, manage our messages properly and be transparent about and acknowledge the uncertainties.

Communicating Infectious Disease Outbreaks

First of all, such outbreaks raise specific concerns about both patient and healthcare worker safety as we have seen with SARS, MERS, or Ebola. For communication, the most important would be effective and clear policies introduced early on, thus mitigating and avoiding as much as possible the spread of misinformation, speculations and fake news. Otherwise we run risks of losing trust with the public, which, if combined with accompanying economic hardships, is not a good mix.

Such communication policies, however, would be useless without preparedness for the eventuality of a pandemic, even

more so with a high-risk pathogen. This preparedness needs to be pre-emptive, even in the absence of an active problem. Contingency plans must already be in place, including one for communication. This can be based on what has been learned in the past (eg recycling of prior plans developed in response to previous outbreaks such as Mexican flu). We should not wait until the problem is at our doorstep to start developing this framework. With COVID-19 we had an early warning back in January, with the outbreak in Wuhan, and the rest of the world should have anticipated the risks and invoked their contingency plans at that time. As an example of lack of anticipative preparedness, Belgium lacked a strategic PPE stock.

It is also necessary to be authentic and trustworthy. We do not know for how long this crisis will last, and there is nothing wrong in admitting that. Had the authorities and the medical community done so in due time, many lives could have been saved. Pursuing this path helps to address issues of unpredictability, uncertainty (especially when confronted with a new infectious agent) and anxiety.

Communication should be structured – one example would be the use of the WHO guidelines, eg on personal protective equipment, as a framework here. It should also be consistent throughout a health system, based on the previously discussed plans. With the structural complexity in Belgium this is particularly challenging. Different authorities need to be aligned and the advisory committees installed are multiple and require strong centralisation. Hospitals fall under the federal authorities and were better prepared for the COVID-19 epidemic than care homes for the elderly, which are under the responsibility of different community governments. The structures were not adapted, for example, to transfer personnel and trained nurses from hospitals to nursing homes, but this urgent need prevailed above regulatory restrictions.

Compulsory Elements of Strategy

During a crisis, responses need to be prompt, pre-emptive, systematic and up-to-date. The availability of new information and new developments require dynamic as well as considerate responses. In our world of social media, true and fake news, it takes no time for unnecessary speculations to spread. We need to communicate with our organisation directly, through a dedicated channel, so that everybody is updated on all the news. In other words, there should be the right communication at the right place at the right moment.

Practical questions raised by the community or the workforce require specific, trustworthy and clear answers. These answers can change over time, but at any given moment need to be coherent and realistic. Quality communication needs to include the rationale behind your decisions. And this stands at all levels, from country to hospital.

Any conflicting information carries a risk of harm, but unfortunately it abounds. In Belgium, we see this at ministerial level, for example. One minister says longer journeys outside are not allowed while another sees no need for this restriction, and this debate spills over to the media. Neither there is consistency at the European level. In France, the 1-1-1 rule is in place [at the time of the interview]: you can go out for one hour for one kilometre with one person. In Belgium, you can walk or bike as far as you wish. However, if you want to rest on a bench, you are not allowed to. Why do rules vary so much? How do we explain that to an already frustrated and tense public? In any case, the current crisis has been addressed mainly at national levels, and, in a way, the European approach has not prevailed.

Last but not the least part of a communication strategy, especially now, is empathy. We need to speak from our hearts and incite the feeling of empathy in our audiences. Otherwise people would have difficulties grasping the seriousness of our message. Our health minister at the federal level in Belgium has managed to do that with just a one-liner, 'Blijf in uw kot,' stay at home – and she will be remembered for that. That was a very short, powerful and transparent message and a sign of leadership.

What Does Not Matter

Personal or organisational agendas have to be put aside giving way to the more general objective of community health targets. We need to coordinate with different hospitals across the whole health system. Again, this is easier said than done. In Belgium, hospitals are now in lockdown. But of course, everybody is thinking about how we restart the activities, the economy. Our organisation is planning to gradually go back to work – and do so in a cautious, deliberate and proportioned way in order to meet non-COVID-19 related healthcare demands that are at risk of being neglected. However, partner hospitals in our region demand the lockdown to be prolonged. This represents a potential conflict of personal/individual institution vs. the general community healthcare organisational agenda. Healthcare works as a network, and personal agendas need to be superseded by the needs of general capacity to accommodate patients during the peak, in particular to ensure sufficient intensive care capacity. And this, once again, highlights the importance of preparedness. The more prepared you are, the earlier you will be able to gradually return to normal activities, as well as to provide capacity during the peak phase of a pandemic and dynamically adapt.

There is, of course, a danger of frustration among staff. We see this imbalance in our teams. There are those who are actively involved in coping with the epidemic, they are engaged, they cooperate – the nurses in intensive care, the intensivists, the emergency department, pulmonary medicine and infectious

diseases department staff. At the same time, facilities such as surgery, operation wards have been shut down, and a number of physicians are out of work and may feel neglected. Note that in Belgium physicians in the university hospitals have salaries, but in most private institutions their income depends on the number of surgical and other acts they perform. So now they may have less income, just like restaurants and hotels. This may generate tension, but the situation may also be a partial game changer. It would not be surprising to see the COVID-19 crisis facilitating the shift in how physicians are paid for their work. These shifts will differ from country to country and from situation to situation, but there may be major changes in society in general and the healthcare community in particular.

"The most important would be effective and clear policies introduced early on, thus mitigating the spread of misinformation, speculations and fake news"

Work Arrangements

For remote work, SMART targets must be in place, developed by the leaders of the organisation and ensuring traceability, measurability and clear timeframes for all tasks. The organisation should also provide adequate IT support for uninterrupted workflow. Every staff member working remotely must have a single channel of instructions with goals clearly set and procedures explained.

In Ghent University Hospital, we have protocols, which define the outputs of all workers. Such protocols have to be prepared in advance, because when a crisis strikes, it may well prove too late to develop them in a hurry. Again, in Belgium the collaboration between communities may be hampered by complexity. Since a couple of years ago, hospitals have committed themselves to collaborate in regional networks of 4-8 hospitals. Within these networks we can share protocols that we can use, for example, during emergencies. So an emergency and a crisis such as the COVID-19 epidemic may or should represent an opportunity for accelerated cooperation on a wider scale, with protocol sharing in networks or nationwide. This is one useful lesson for us to learn from the pandemic – we can, in fact, rapidly work together when there is a problem, so we probably can also cooperate better when there are no problems. This is really an eye-opener for all the healthcare workers in Belgium proving strengths and resilience of the healthcare system.

Having protocols in place, however, is not enough. People need to know how to apply them. The training centre of our hospital is putting a lot of effort into educating our staff on the practical implementation of those protocols, for example, teaching our nurses how to use personal protective gear.

All this applies not only to the staff workers but also to volunteers. What differs is that your messages to them need to be very down-to-earth, easily understandable and clear. Face-to-face sessions with an expert explaining the basics is an appropriate format. Tasks should be tailored to the competence, with clear guidelines, instructions and support. Also, workers and volunteers should feel our gratitude and appreciation. All of them are overloaded, so we have to invoke the feeling of mutual solidarity and be the role models for them. In the end, it all comes down to leadership. When you have a good leader, the rest will follow.

External Communication Policies

In healthcare, upholding ethical standards in communication is of utmost importance, and during a crisis this should be reinforced, especially when it comes to privacy. In our organisation there is a workforce of up to 6,000 people, so, of course, it is impossible to completely avoid the leaks. The danger here is that workers may not have the correct information and what they release to the media or the public or the wider healthcare community may be misleading, and then urgent corrections would be needed. The golden rule of communication is to first communicate internally and afterwards externally. Therefore, each organisation must have one single point of contact for pre-emptive, correct and assertive external communication on hospital policies. This must be clearly relayed to all the staff with no exception.

There is as well a lot of communication happening internally, between the staff members. This is an important part of the workflow, and an organisation needs to guide it by strengthening formal channels, such as staff meetings, direct messages from the management, and so on. In our hospital the policies have been set from the very beginning by our CEO and Chief Medical Officer – we have a pandemic, there's a problem, and here's what our communication strategy is. Such structured approach is a sign of a strong organisational culture, which comes before anything else. You can have the best strategy, but if a culture is absent, nothing helps. As they say, culture eats strategy for breakfast.

Dealing with Stress and Overload

The current situation generates many uncertainties due to the lack of scientific data and evidence, and we need to acknowledge this. Here creating a trustworthy and caring environment is a must. Trust is a – if not the – key principle of risk communication. It is developed through responding to people's concerns, for example,

with explanation of how to use protective gear or training personnel who are redeployed to unfamiliar healthcare settings. The staff should feel our empathy and gratitude for their extra efforts. For this, a strong intervision framework is necessary, so that people can talk with colleagues or receive psychological support if needed. On a very practical level, there needs to be baseline support, such as providing day care for children or catering.

What Will Change

One risk here is that our focus would narrow down to the crisis issues only while neglecting the upholding of normally required activities. We should keep this in mind and do our best to avoid such a scenario.

Our current experience will definitely lead to increasingly structured communication. A well-structured communication strategy and efficient communication flow from top to the floor are necessary. This means, for example, thoroughly explained and motivated decision-making with simultaneous strengthening of hierarchy and decrease in anarchy.

The opposite flow, however, is also very important. In the words of Michael Porter, management have to go down to the work floor to see what is happening there and talk to people. With COVID-19, the top level not only has the information on infection and mortality rates, but can put this in perspective by keeping in touch with the people at the front line. Furthermore, this, too, helps to develop a relationship of trust between the management and the staff.

Post-Crisis Communication

In our hospital, there has been a lot of mutual support among the members of the staff, and this is encouraging. And just as now, we will need to continue expressing our gratitude to all the workers and supporting them after the crisis has passed.

One of the ways would be adjusting work schedules. This would allow for proper recovery and 'delayed grieving.' For the moment there is a lot of stress but also great involvement from everyone in the hospital. After the pandemic, however, those who worked with COVID-19 patients in the intensive care, may face mental health issues, such as PTSD, sleep disorders, mood and anxiety disorders to name a few, and require psychological coaching. We are already seeing the signs of that, which means that we need to get prepared.

To ensure good work-life balance, we have a reserve of nurses on alert waiting to be called in for help. For those who are feeling overwhelmed, a hotline is operated by a team of a doctor, a nurse and a psychologist who can help with queries and issues. In each ward a dedicated person provides psychological support to those in need.

With all this in mind, it is encouraging to see the unprecedented levels of solidarity in the European healthcare – in the UK, France, Spain, Italy, between the hospitals, among health workers. Hopefully, this kind of solidarity will hold long after this crisis is over. And communication and sharing of experiences will support this. Where communication is well-structured, staff is more engaged and motivated to work for the sake of better healthcare, and this raises the quality of healthcare as a whole and may improve patient outcomes.

Interviewee: Prof. Peter Vermeir

Clinical Professor, Faculty of Medicine and Health Sciences | Ghent University | Ghent | **Belgium**

Peter.Vermeir@uzgent.be | @peter-vermeir-774a4a28 | @peter_vermeir

Interviewee: Prof. Dirk Vogelaers

Staff member, Internal Medicine Department | Ghent University | Ghent | **Belgium**

Dirk.Vogelaers@UGent.be

Interviewee: Prof. An Mariman

Staff member, Internal Medicine Department, Faculty of Medicine and Health Sciences | Ghent University | Ghent | **Belgium**

An.Mariman@UGent.be

COVID-19: PENTAX Medical Talks Supporting Improved Patient Outcomes

How is COVID-19 affecting patient management?

Due to the COVID-19 outbreak, critical care units are overloaded with patients who require urgent and successful guided intubation for treatment and airway management. The more patients with COVID-19 there are, the greater is the need for treatment and continued patient management.

What does this mean for endoscopy patients?

All endoscopies on COVID-19 patients, or suspected COVID-19 patients, should be considered high-risk. The main endoscopic challenge is minimizing the risk of contamination from procedure to procedure. For diseases not related to the outbreak, endoscopy departments must now implement additional hygiene procedures while treating patients affected by COVID-19. To ensure patient safety, proper processes must be in place to minimize the risk of cross-contamination.

How do needs in EMEA markets differ?

Market demands vary depending on patient needs and hospital resources. Italy and Spain hold the largest number of COVID-19 infected patients, but the number of ICU beds, access to medical equipment, and healthcare personnel all play a role in each market's needs during this pandemic.

In many markets, clinicians require an increased number of endoscopes and faster turnaround of available endoscopes with the best hygiene conditions. We are helping achieve this by offering solutions that fulfill the growing needs and ensuring scopes are readily available at the point of care, safe and virus-free for the patient. Our PlasmaTYPHOON offers ultrafast drying of endoscopic channels, so we can greatly reduce the endoscope turnaround time. For storage and transport, the PlasmaBAG provides a dry, closed, dust-free and aseptic atmosphere created by ozone injection.

How has PENTAX Medical responded to urgent demand in critical care units?

At the onset of the COVID-19 outbreak, we donated $430,000 worth of medical devices to fill urgent needs. Since then, we have seen incredible acts of humanity during this challenging time. Supporting ICUs is a crucial step in fighting COVID-19. As feedback from ICU clinicians highlights the need for more scopes, we have increased the production capacity to keep up with this demand, aiming to support the growing needs and provide greater access to safe and efficient solutions.

You recently organized a COVID-19 webinar, together with Prof. Arcidiacono and Prof. Lepelletier, 'The equipment journey from patient to patient.' What were the key takeaways?

This webinar provided an opportunity for peers to share their knowledge in managing this crisis. Prof. Arcidiacono covered valuable best practices, including the relevance of changing processes and behaviors, using procedures to reduce the risk of infection between patients. Prof. Lepelletier shared his in-depth knowledge of factors for infection transmission and insight into potential solutions to minimize the risk of contamination and infection.

For future webinars, what are the upcoming topics?

We will continue to team up with clinicians to address and share best practices to manage the COVID-19 pandemic. The next webinar, 'COVID-19 – Into the next phase: Management of people, processes and products in endoscopy,' will be held on 13 May, 2020, at 14:00 (CET), and focus on the second phase of the pandemic.

In conclusion, what are your final thoughts on combating COVID-19?

PENTAX Medical is fully committed to supporting the treatment of those affected by COVID-19, and to ensuring endoscopes and supporting medical equipment are readily available. As we work to better serve our healthcare systems, we would like to thank all critical care personnel for their continued efforts to help the patients during the COVID-19 pandemic.

Author: **Mariuccia Zambelli**
General Manager Marketing and Business Development Europe, Middle East and Africa PENTAX Medical
www.pentaxmedical.com | @Mariuccia Zambelli

Imaging AI for Chest CT to Aid in Resource Allocation During COVID-19

Evaluating the severity of pulmonary disease burden can help predict patient outcome in COVID-19 (Colombi et al. 2020; Revel et al. 2020). Quantifying lung pathology is, therefore, a crucial element in the resource and capacity management optimization of healthcare systems. The need to make a more objective decision on whether or not to send a patient home or to the ICU is growing together with the surge in COVID-19 cases.

ico**lung**, a CE-marked AI software, objectively quantifies lung pathology on chest CT scans in COVID-19 patients in a matter of minutes. It is the first CE-marked CT AI solution, resulting from a multinational collaboration in response to the COVID-crisis. ico**lung** is developed by ico**metrix**, a Belgian AI company, who leveraged their AI expertise and shifted their focus from brain to lung quantification in their fight against COVID-19. As a result, ico**metrix** is currently offering ico**lung** pro bono.

The Role of CT in COVID-19

The Fleischner Society, a panel of 29 experts including 15 radiologists and 10 pulmonologists, provided the first consensus statement on the role of chest imaging in COVID-19. The Fleischner criteria describe recommendations in the form of scenarios based on disease severity, risk factors, pre-test probability, and the availability of resources. The criteria indicate the need for imaging in moderate-to-severe COVID-19 patients, independent of their COVID-19 test results. In these patients, CT can be used to confirm potential alternative pathologies in RT-PCR-negative patients and for risk-stratification in RT-PCR-positive patients (Rubin et al. 2020).

The degree of lung involvement on CT is an essential aspect of the pulmonary status as it correlates well with the severity of the disease and the outcome (Colombi et al. 2020; Revel et al. 2020). This degree is calculated by a score reflecting the percentages of affected tissue in each of the five lobes. Hence, CT allows a reliable assessment of pulmonary status to facilitate risk stratification for clinical worsening, which can support the triage of patients within the hospital.

For the quantitative assessment of affected lung tissue, AI tools are valuable. These algorithms, trained on CT images from confirmed COVID-19 cases and non-COVID-10 cases, allow for a fast, accurate, and quantitative analysis of chest CT scans. Hence, they alleviate the growing burden on radiologists, who must review and prioritize an increasing number of patient chest scans each day. With ico**lung**, lung involvement can be assessed in a fast and objective way, resulting in a standardized quantitative report complemented with annotated images for the radiologist to review and use in their reporting. As a consequence, radiologists can report a more complete pulmonary status, including exact percentages of lung involvement.

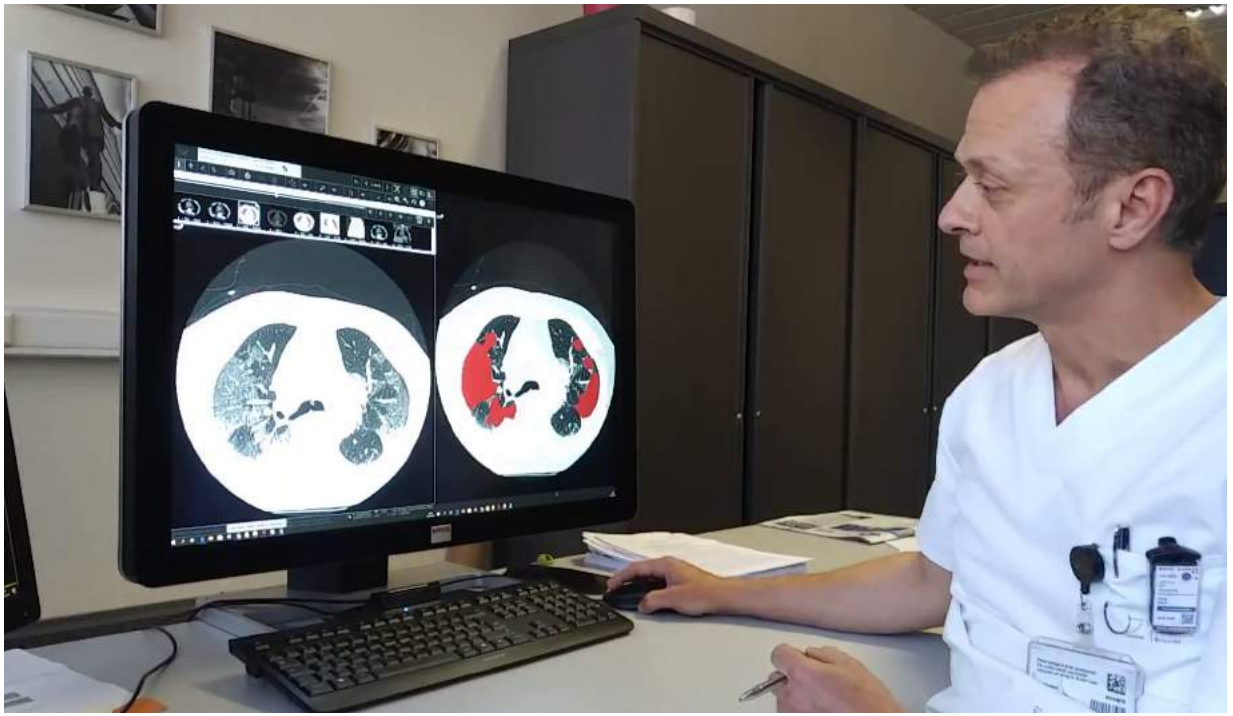
*"The ico**lung** AI tool can provide a clear percentage of affected tissue, which radiologists can't do. Of course, we still look at the scans and the radiology expertise is very important, but it's great that this*

can go hand in hand with an accurate qualitative evaluation by AI," says Professor Johan de Mey, Head of Radiology at UZ Brussels.

The Impact on the Healthcare System

Quantification of lung pathology in COVID-19 patients is found to increase the specificity to predict ICU admission or death, meaning that clinicians will be able to better identify patients who can be sent home or to a non-ICU bed (Colombi et al. 2020). Pulmonologists, emergency physicians and intensive care physicians could, therefore, make a more informed treatment decision when knowing the extent of pulmonary infiltration in COVID-19 patients.

AI tools such as ico**lung** can introduce consistency in this process by standardizing the quantification and



Prof. Dr Vandenbroucke, Radiologist at UZ Brussel, Belgium.

returning an exact percentage of the total and regional lung pathology. This not only adds information to the CT report but can also impact workflow by speeding up the radiological reading and standardize the reporting, which is essential in a time-sensitive clinical setting.

Why is quantification for chest CT with AI so impactful? The difference between 25% versus 30% lung involvement may have a significant impact on the outcome prediction and treatment pathway of patients, but is impossible to visually assess. AI assists in making an objective, fast and standardized call. As a result, resources can be allocated to patients who need them most!

ico**lung** is a valuable clinical tool for the assessment of lung involvement in admitted COVID-19 patients. It assists in the risk-based stratification of COVID-19 patients and potentially can save ICU beds for those needing them most. Since ico**lung** is a CE-marked medical device, it is available for clinical routine practice in the EEA, and, hence, allows for fast and reliable quantification of lung involvement with potential impact on clinical decisions.

Author: Dirk Smeets

CTO | icometrix | **Belgium**

dirk.smeets@icometrix.com | @dsmeets | @dirk-smeets-03a3364

icometrix.com

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Grading COVID-19 Severity with CT: CAD and AI

Summary: A radiologist working with COVID-19 patients in Russia looks at how technology has aided imaging-based diagnosis and what this could mean for future practice in grading disease severity.

The pandemic of COVID-19 has presented an unprecedented challenge to modern global healthcare. Today everybody understands that diagnostic imaging has critical importance in detection, grading, and follow-up of this potentially fatal disease. Computed tomography (CT) has proven itself as the best imaging modality for the detection of the most important and typical imaging patterns of lung parenchyma changes in COVID-19 pneumonia.

Guidelines of the most influential national and international radiological societies recommend against the wide use of chest CT for screening, diagnosis, and surveillance of COVID-19 patients. They advise to use it for the differential diagnosis, detection of complications, and cases when results of CT may influence patient management and prognosis.

On the other hand, the typical patterns of COVID-19 pneumonia are well known (multiple peripheral ground-glass opacities (GGO) with or without areas of consolidation and some other manifestations). In cases of COVID-19, and the high occurrence of the disease, CT has a high sensitivity for the detection of patients with COVID-19 pneumonia. For this reason, in most hospitals in Russia, the standard approach is to perform chest CT for all patients admitted with suspected COVID-19 pneumonia. Structured reports for such patients are very important. The common practice is to use reporting guidelines from RSNA/ACR/STI defining imaging appearances as typical, indeterminate, or atypical for COVID-19.

A less clear situation exists in the grading of disease severity. There are recommendations to use simple subjective scales of the severity of changes in the lungs such as mild-moderate-severe or mild-moderate-severe-critical. Several more complicated grading scales have been proposed. But practical experience shows that the visual scoring of multiple areas of GGO or opacifications in the lungs is very

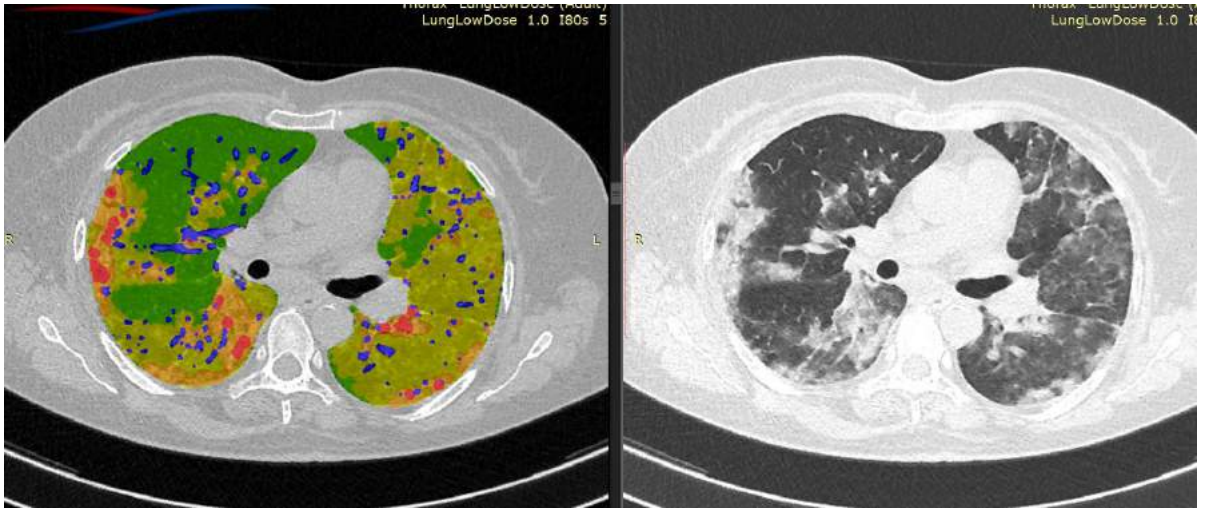


Figure 1.CT scan of lungs of a patient with COVID-19 pneumonia. Right side: native CT, lung window. Multiple areas of ground glass opacities, consolidation, and reticulation are seen in the both lungs. Visual grading of disease severity is difficult. Left image: the result of computer processing of CT dataset with dedicatedsoftware (MultiVox). Normal lung parenchyma is marked green, GGO, yellow, consolidation, orange and red and vessels are marked with blue.

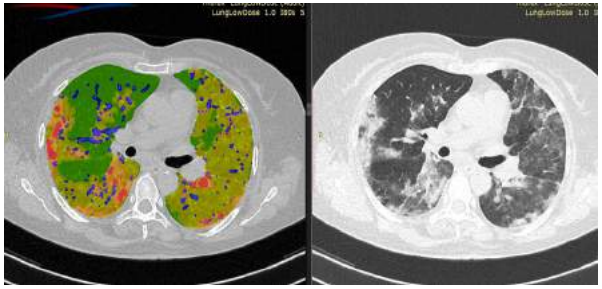


Figure 2. Follow-up of COIVID-19 progression with CT. Right side — processed CT image on the day of admission. The total volume of GGO/consolidations in the lungs — 7.2 %. Left side — processed CT image after 5 days. The total volume of GGO/consolidations in the lungs — 26 %, indicating the progression of the disease.

subjective and varies from one radiologist to another. It looks like, for this purpose, the software for computer-aided diagnosis or artificial intelligence (AI) capabilities to detect, delineate, and analyse GGO/consolidations in the lungs allow for much more accurate and reproducible results. These technologies have proven themselves very useful in follow-up studies. Today there are plenty of Computer Aided Detection or AI solutions for COVID-19 from different manufacturers and vendors. Probably they can give different results from the same datasets. But in the setting of the COVID-19 pandemic, these differences are not so significant, and I believe that they are rather small. They are not time-consuming and help the radiologist to be more objective in grading the disease severity and its progression or regression.

I believe that the epidemy of COVID-19 will accelerate the development and performance of such computer-based assistance for radiologists. Besides the obvious practical value, they are going to be the very useful tools for research of COVID-19 outcomes, patient prognosis, and efficacy of the drugs and other types of treatment in upcoming clinical trials on COVID-19.

Author: Prof. Valentin Sinitsyn

Member of HealthManagement.org IMAGING Editorial Board, University Hospital of Moscow State University, Professor, Chief of Radiology Department Federal Centre of Treatment and Rehabilitation | Moscow, **Russia**

vsini@mail.ru | msu.ru | @MSU_1755

Key Points

- CT has proven itself as the best imaging modality for the detection of typical COVID-19 lung features.
- Chest CT has high sensitivity for detecting signs of the coronavirus disease.
- AI technology could play a role in helping grade the severity of COVID-19.

Telemedicine Post COVID-19

Summary: Renowned surgeon and healthcare futurist Rafael Grossman speaks to HealthManagement.org on telehealth, robotic-assisted surgery and a new healthcare mindset in a post COVID-19 world.

What are your most important impressions in terms of attitudes towards and implementation of telemedicine in the present COVID-19 environment?

One good thing that has come out of this horrible pandemic and all this suffering, cost of life, resources and social and economic disruption, is that finally, everyone is realising that telehealth, telemedicine, remote connectivity and communication, make sense.

We've been struggling for decades to get telemedicine adopted, to change the culture of the healthcare community to embrace telemedicine and for regulators to change regulation. To get administrators in hospitals to have the vision that virtual connectivity is not a substitute but a complement to what we do through physical contact has happened quickly because we have had the desperate need for it.

Where do you think the medical profession could take telehealth implementation once the COVID-19 crisis has passed?

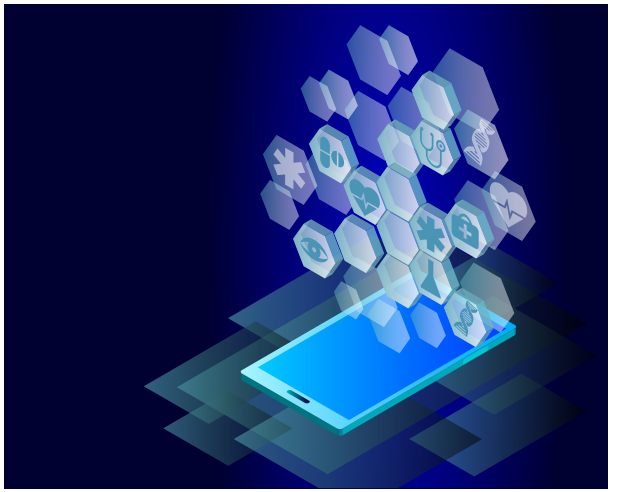
When it comes to telemedicine, I keep saying it's just like making a phone call but better. I think the biggest gain we will have is that people will see it as a natural way of communicating in healthcare, just like they see it as way of communicating in non-healthcare related life. You can call your mother 1000 miles away on FaceTime, WhatsApp or Skype; in the same way, you can call your provider.

The most important point is that using telemedicine is not a substitute to what we do: it's a complement. Sometimes you see the patient physically, sometimes via video. Sometimes you call the patient, sometimes you email and sometimes you send out a paper letter. Telemedicine is just another way of communicating under special circumstances and in response to needs.

How can we keep such telecommunications efficient?

The American Telemedicine Association has very good guidelines on the correct protocol for a telehealth visit. Without such guidelines, people could be lost. I think that is very important to first gain new people adept with telemedicine and to retain and encourage the ones who are fearful.

How do you think healthcare can leverage the COVID-19 experience with telemedicine and tele-health? Should CIOs be developing business plans to support future telehealth deployment?



Right now we are in a warzone. But I think that if there is time and if there are resources, then they should be thinking about the future, perhaps a year from now.

Organisations have pillars like finance, patients, community and employers etc. Telemedicine has to be a pillar. The biggest pillar is communications and telemedicine has to be another facet of communication. Years from now when everyone is deploying telehealth, you want to be the leader. You have to be the one people follow, not the follower.

The Office for Civil Rights at the U.S Department of Health and Human Services announced lifted penalties for healthcare providers that use telehealth during the COVID-19. Should this lift remain in place once the crisis is over?

This was an excellent move. I think the privacy of health information and the privacy of any personal information is very important. It's something that should not be violated. But the paranoia over the privacy of health information has been one of the major hurdles for the implementation of e-health, telehealth and telemedicine. After this pandemic ends, we will have a change of mindset towards use of tele-health. We will see that we can still keep the conversation private and use the best tools that we have to keep the conversation and the data safe but, at the same time, not be an obstacle to communication.

"The most important point is that using telemedicine is not a substitute to what we do, it's a complement"

Where else would you like to see technology disrupt healthcare during and following the COVID-19 crisis? Is there anywhere that is ripe for a 'shake-up'?

I think that there are so many areas where we can improve. From education to trained diagnostics to therapeutics, there are so many tools out there – and most of them created for non-medical use. They can, potentially, be life saving tools.

From connecting by video to virtual reality, augmented reality and extended reality for education and simulation, to therapeutics within the operating room, for example. I think we have seen some advances in these areas but we need to do much more to make adoption standard and routine. Again, this is not a substitute but as a tool and complement to traditional teaching methods and delivery.

Let's talk about wearables as well. We have all this data that is floating in the cloud and nobody is using it. This data is very powerful and big data and its analysis brings us to Artificial Intelligence (AI) with Machine Learning (ML), robotics and Natural Language Processing (NLP). These three facets constitute AI and can be exploded in healthcare in ways we cannot even imagine. I think that's where we are going. ML, Deep Learning, robotics and NLP are going to have a tremendous impact on healthcare but we need to push it. The times of crisis are the times we have to become more inventive and innovative. That will be a good sequel to this COVID-19 crisis.

Do you see greater potential for remote surgery because of this healthcare crisis?

Absolutely. One of the facets of AI is robotics. Robotic-Assisted Surgery (RAS) is the next step of the evolution of surgery, just like 20-25 years ago minimally invasive surgery was the next step. Now we see technology is exploding in the UK and in the other parts of Europe, which is really going to revolutionise the way people are going to approach RAS. If we add an AI component, you could have an RAS that is somewhat semi-autonomous. I think that we are decades away from autonomous robotic surgery but semi-autonomous RAS is not far off.

How will telehealth and RAS play into the concept of the decentralised hospital where people can receive care at home?

For those of us fortunate enough to be living within first-world healthcare systems, brick and mortar hospitals will become more decentralised over the next five years. It's already happening in the UAE and with Kaiser Permanente. They already have a lot of their patients using wearables, transmitting data to providers and they can go to the cloud and find their data and communicate with this material. The COVID-19 pandemic will awaken a lot of such factors for improving healthcare. Telehealth has proven it's worth and it will open up our minds to other possibilities.

Interviewee: Rafael J. Grossman

Healthcare Futurist, Technology Innovator, Surgeon & Educator | U.S.A.

rgrosssz@gmail.com | rafaelgrossmann.com | @ZGJR

Precise Automated Resuscitation with RESPIRA

An innovative solution to ventilator shortages has been found in Spain - a relatively simple and cost-efficient alternative named RESPIRA.

One of the major problems for hospitals fighting the COVID-19 pandemic has been the lack of emergency ventilation devices. GPAINNOVA, a multinational company from Spain, has a simple and efficient solution to this – RESPIRA.

Novel Approach

RESPIRA is an ICU ventilator based on AMBU automation for assisted ventilation. It has been designed specifically for the needs of intensive care doctors involved in the COVID-19 treatment, and its performance is comparable to that of high-class ventilators from top brands.

RESPIRA automates manual resuscitation devices (BMV or AMBU) with sensors for remote real-time monitoring of parameters, such as frequency, tidal volume, flow, Ratio I:E and pressure of air supplied to the patient (maximum/PPI, minimum/PEEP and plateau). These parameters can also be fine-tuned thanks to an automatic system with PLC and an actuator – the two main components of RESPIRA that enable the precise piston movement and air insufflation. It also incorporates an FIO2 sensor with external display to monitor oxygen supply while a smart module allows for parameter adjustment based on pressure and tidal volume.

Such adjustability is achieved with advanced sophisticated software PLC developed in cooperation with top engineers of Siemens Digital Industries. This world-class partnership is what distinguishes RESPIRA from other projects, open-source and non-homologated for medical device data transmission. For the high-quality components, which ensure safety and reliability, the RESPIRA project has the technical support of SMC, TEG and MAM.

Major hospitals in Spain including Hospital Clínic of Barcelona, Sant Joan de Déu and the Institute for Health Science Research Germans Trias i Pujol have participated in developing RESPIRA and running validation tests.

Upholding Standards

In Spain RESPIRA has passed all technical examinations for both the machinery and documentation, including those from Agency of Medicines and Health Products for Spain (AEMPS). This means that the device standards are similar to those of professional ventilators.

The first phase of the clinical trial is now completed. At this point RESPIRA is approved for use in all hospitals in Catalonia, and 45 of those already have it onsite. The device is currently in the second phase of the clinical trials, which means it has been approved by AEMPS to be used in several patients affected by COVID-19.

For other hospitals in Spain and other countries, the device can be used during the COVID-19 emergency with an authorisation by the health authorities. An exemption from CE-marking requirements for medical devices in limited circumstances was approved by the European Parliament on 17 April, 2020, to cover shortages during the pandemic, with only local authorities' permission needed. GPAINNOVA has also applied for CE and FDA certification and is trying to

fast-track the EU certification of RESPIRA as emergency medical equipment.

Work in Low-Resource Settings

GPAINNOVA is already in contact with several humanitarian organisations and plans to donate RESPIRA units to fight the COVID-19 pandemic in Africa. The device will be practical there, as it is very compact, light and portable. It can run on battery and has its own Wi-Fi, which allows to manage up to 16 units through one control station – a big advantage, considering the limited number of physicians in African countries. All this makes RESPIRA an attractive alternative to more complex ventilators, which hospitals there may not be equipped to install.

Manufacturing, Delivery and Support

RESPIRA is a locally manufactured product, with all the facilities located in Spain, and can be quickly delivered globally. So far, GPAINNOVA has received orders for over 21,000 units. It is upscaling its production to 300 units per day and has the capacity to increase further if needed.

GPAINNOVA has branches in the U.S, China and Hong Kong, and distributing partners in every other country of the world. This ensures not only fast delivery but also efficient technical support and maintenance. There is a 24/7 hotline for any kind of technical enquiries from hosting hospitals.

For health professionals, GPAINNOVA has created comprehensive training videos like this one, which complement a very detailed manual. In addition, another 24/7 hotline is operated by Hospital Clínic of Barcelona to provide assistance to clinicians who work with RESPIRA across the world.

The device is relatively simple, assembled mostly from standard parts. It runs on dynamic and complex software and even though the technology is quite superior, RESPIRA's advanced features are still being offered at a very competitive price, even more so with large orders. It is portable and can be operated onsite or remotely, with an accessory incorporating Wi-Fi. This makes RESPIRA a cost-efficient alternative to standard ICU ventilators. Post-pandemic, in ambulances or emergency care the device can be used instead of manual resuscitation bags.

About GPAINNOVA

GPAINNOVA is a multinational company based in Barcelona, Spain. It specialises in surface metal finishing machinery and runs a water drones innovative project. With a turnover of €5.9 million in 2019, the company has received an EU Horizon 2020 grant under the SME Instrument Programme (phase 2 – innovation project). It has also been ranked 76th in the '1,000 fastest growing European companies in 2020' list compiled by the Financial Times.

Author: Pau Sarsanedas

CEO & Founder, GPAINNOVA

info@gpainnova.com | gpainnova.com | respiradevice.com

Conducting Research in the COVID-19 Era

Summary: Under pressure in the age of COVID-19, David Koff stresses that researchers need to maintain high standards for their offerings to have value to the medical world.

COVID-19 is the worst pandemic the world has been going through since the Spanish Influenza of 1918, which claimed the lives of millions of people. As we watch the death toll climbing above that of the dreaded 2003 SARS-CoV-2 coronavirus, we dream of a way to eradicate this virus and go back to normal life. At the moment, there is no other choice than to practice physical distancing, remain at home as much as possible in self isolation, and hope to be spared by the virus. Our admiration and respect go to the frontline healthcare workers, nurses, physicians and all those exposed in hospitals and long-term care facilities, and to those selling us food and essential products or maintaining our infrastructure.

No surprise that so many researchers want to contribute to the fight against the coronavirus and, in the absence of treatment or vaccination, all ideas are welcome to decrease the disease burden, keep people away from the hospital, improve diagnosis capabilities or help stratify the risks of adverse outcomes. Many agencies and organisations are offering grants to support hundreds of projects, researchers are rushing to apply, and many see this as a unique opportunity to get funding with hopefully a faster and better success rate than with traditional competitive grants. As always, fast tracked peer reviews will have the pressure to quickly review the grants and separate between the best and the worst.

For us in Diagnostic Imaging, these past few years have seen the most disruptive change since the adoption of PACS, with the swift development of Artificial Intelligence (AI). It was natural for this growing community of engineers to join forces with radiologists to create new solutions to better diagnose and predict the COVID-19 disease from chest X-rays and CT scanners. The assumption is that anyone with cough and fever will get imaging when access to the molecular test RT-PCR is limited, the results can take up to five days, or the sensitivity is not reliable enough.

The Role of imaging

Access to imaging is not as simple as it looks, as there is a need to ensure safety of patients and health workers with strict infection control protocols slowing down the throughput.

The most recent Multinational Consensus Statement from the Fleischner Society gives recommendations that many will comply with (Rubin et al 2020). In summary, the essentials are as follows:

- Imaging is not routinely indicated as a screening test for COVID-19 in asymptomatic patients.
- Imaging is not indicated in patients with suspected COVID-19 and mild clinical features unless they are at risk for disease progression.
- Imaging is indicated in a patient with COVID-19 and worsening respiratory status.
- In a resource-constrained environment, imaging is indicated for medical triage of patients with suspected COVID-19 who present with moderate-severe clinical features and a high pre-test probability of disease.

Prior to that, the American College of Radiology recommended (ITN 2020) on March 11, that:

- CT should be used sparingly and reserved for hospitalised, symptomatic patients with specific clinical indications.
- Portable units should be used and CXR requested only when truly necessary.

The Canadian Association of Radiologists and Canadian Society of Thoracic Radiology (CAR 2020) made similar recommendations on March 24, 2020:

- Portable radiography and ultrasound should be utilised as much as possible.
- CT and CXR findings are not specific and can overlap with other infections.
- If performed, non-contrast full dose diagnostic CT is recommended.
- Negative CT and CXR does not exclude COVID-19 infection.

Imaging Appearance

The one view chest X-ray is more often normal in early or mild phases, demonstrating bilateral airspace consolidations in more advanced phases. But findings are not specific and overlap with other infections, including influenza.

The CT pattern may be comparable to organising pneumonia with ground glass opacities mostly bilateral,

peripheral and lower lobes, and which may have a nodular or mass-like appearance. There is usually no tree-in-bud, no pleural effusion, no lymphadenopathy (Simpson et al 2020).

Artificial Intelligence in COVID-19 Imaging

There is no doubt that the fight against COVID-19 can and will benefit from AI Imaging and there are many ways for AI to contribute as it is already advanced in detection of a number of lung diseases. For example, AI is already able to recognise pneumonia as demonstrated by the RSNA/Kaggle Pneumonia Detection Challenge in 2018 in which 1,400 teams participated. The teams used a dataset of chest X-rays from the National Institute of Health annotated by volunteers from the Society of Thoracic Radiology (Kaggle 2018).

It is expected that AI will help in many capacities, including but not limited to:

- Early recognition of the COVID pneumonia on standard portable chest X-rays; this is of particular relevance for countries that don't have readily access to the RT-PCR test.
- Risk stratification for patients admitted to intensive care units, helping to prioritise allocation of ventilators and maybe give some predictive indications to outcomes, allowing for changes in treatment plan.
- Short and mid-term follow-up of patients considered as cured to detect reactivation and recurrences.

But as pressing as it may be, research must not be rushed and follow a solid methodology. It would be useless and damaging to lead research projects on wrong assumptions or with poor quality material, leading to unreliable results. Strong collaboration between engineers and radiologists is required to validate the research question on the most updated knowledge.

Researchers must comply with Research Ethic Boards and privacy requirements, in most cases fast-tracked to enable research. Data used for the developments must be of good diagnostic quality, ideally DICOM, labelled with the most relevant information, properly de-identified using a recognised anonymisation tool and annotated to help identify the region of interest. It is important for these images to be validated by a radiologist and the diagnosis confirmed as ground truth is needed.

As many cases are required to train and test the algorithms, there are a number of initiatives to provide access to as many images available as possible; among these initiatives, I would like to mention the RSNA COVID-19 Imaging Data Repository (RSNA 2020). This library is an open data repository for research and education. The RSNA is inviting institutions, practices and societies around the world to contribute their cases to this database and collaborates closely with the European Imaging COVID-19 AI Initiative. In both cases, the participants will upload images to be shared in a secure way, taking into consideration privacy and ethics; the images will all be labelled, and participants will find limited tools to annotate their images on the site. The RSNA COVID-19 Imaging Data Repository should be made available in the coming weeks.

The Road Ahead

In the worst pandemic that the world has known in a century with devastating human and economic consequences, it is of utmost importance to conduct research to help fight the disease as fast as possible. But for the outcomes to be relevant and meaningful, this research must rely on a strong collaboration between engineers and radiologists, and AI developments must use high quality curated images shared by trusted healthcare institutions all over the world.

Author: Prof. David Koff

Department of Radiology, Director Medical Imaging Informatics

Research Centre at McMaster University | Hamilton, **Canada**

dkoff@mcmaster.ca | mcmaster.ca | @McMasterU

Key Points

- COVID-19 is the worst pandemic the world has seen since the Spanish flu 100 years ago.
- Research into the virus and disease must follow high quality standards.
- Strong collaboration between engineers and clinicians is necessary for quality AI research.

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For full list of references, email editor@healthmanagement.org or visit https://iii.hm/12tc

The Importance of Meaning: The Global Effort to Manage COVID-19 Through Collaboration and Clinical Terminology

Management of patient information and information standards regarding sharing, analysis and planning have become critical today. SNOMED International offers SNOMED CT, the world's largest clinical terminology with a collection of 350,000+ clinical concepts for improved management of patient data.

The global campaign to address COVID-19 is being advanced on many clinical and administrative fronts; across towns, cities, provinces, states, and nations. The impact of its reach has, and will continue to, extract human, social, and economic consequences globally. If there has been any learning fully absorbed across continents, it is the fragile interdependency of our ecosystems.

Embedded within this landscape is the management of patient information and the information standards that govern its sharing, clinical analysis and health system planning. True to its form, SNOMED International and its core product, SNOMED CT, serves as a foundational building block critical to the effective use of electronic health records. SNOMED CT is the world's largest clinical terminology, representing a collection of more than 350,000+ clinical concepts and built upon ontological principles, particularly useful when applied to structure patient data for research and planning capacities.

In cases where a global emergency persists and warrants action, the SNOMED International organization has responded swiftly to issue updated structured clinical terminology content to serve the public good. With current releases, clinicians, researchers and administrators globally are enabled to code, analyze and plan to address the Coronavirus effort with the most up to date terminology. Data on related hospitalizations give health care administrators a more comprehensive picture of the COVID-19 pandemic and its impact on its patients within the healthcare system. Leveraging coded data lends itself to identifying emerging outbreaks and structured clinical terminology is a key component to supporting leaders as they need to make critical decisions. To serve a global need without reservation, SNOMED International has also committed to include quality assured COVID-19 content in its Global Patient Set, a managed list of existing SNOMED CT unique identifiers, fully specified names, preferred terms in international English, etc. The Global Patient Set is free for use across the world and governed under the Creative Commons Attribution 4.0 International License thereby making our COVID-19 content barrier-free in the spirit of improving health care globally.

While the function clinical terminology serves is critical, it is perhaps the underlying structure and fabric of the organization that has evolved since early 2000 that has yielded returns amid the current pandemic. A global coalition of the willing, SNOMED International comprises a varied collection of Member countries which

SNOMED International Community Business Meetings

SNOMED International Member Forum

SNOMED International General Assembly

represent approximately a third of the global population across the Americas, Europe, Middle East and Africa, and Asia Pacific. A new year punctuated with a global crisis, SNOMED International Members have leveraged their international forum to discuss approaches, policy, content and implementation guidance concerning COVID-19.

New Zealand sharing its COVID-19 Community Based Assessment Data Standard, the United States presenting interoperability standards supporting the COVID-19 Novel Coronavirus Pandemic, the Netherlands, Australia and Canada releasing and sharing augmented COVID-19 content, and Sweden's creation of a specific reference set representative of COVID-19 terms and associated meanings are demonstrative outcomes of this global effort. Adding to this, many Members, the United Kingdom a prime example, have crafted implementation guidance for their respective jurisdictions and shared with the SNOMED CT community to discuss commonalities, differences and opportunities. The dialogue and contributions produced from this community has been extensive and contributes to the representative development of tools and resources.

Surpassing national borders, collaboration among our industry and collaborative partners have also strived to deliver benefits to a dedicated Member and user community. Joint collaboration efforts with HL7 International and Regenstrief Institute partners on the release of HL7 FHIR enabled codes for clinical and pathology information for the COVID-19 needs of users is one such example.

In the weeks to follow, SNOMED International will release implementation guidance driven by our collective efforts as both organization and Member community. What remains true is that our current reality is all encompassing and will affect each nation differently, exposing different terminology needs for each and reaching beyond the pressing needs for patient care.

To learn more about our Members and SNOMED CT, visit www.snomed.org or dialogue with our community on Twitter @Snomedct.

Author: Don Sweete

CEO | SNOMED International, United Kingdom,

info@snomed.org, @Snomedct | www.snomed.org

Global COVID-19 Pandemic – Compelling Effects on Cardiovascular Medicine

Summary: Quarantining and public interventions during the COVID-19 pandemic have raised concerns about a decrease in presentations for urgent and life-threatening cardiovascular diseases. Cardiovascular disease may remain undiagnosed for a longer duration. How can this be addressed?

Introduction

All members of the coronaviruses (CoV) are RNA viruses, which are known to contribute to the development of respiratory infections with mild to severe courses depending on the specific CoV subtype. The current spread of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) virus has generated a worldwide pandemic with yet unforeseeable outcomes. SARS-CoV2 causes the coronavirus disease 2019 (COVID-19). Estimates for case fatality ratio range from 0.2 to 20% depending on sex and age. Particularly high ratios are seen in some areas/countries, in older patients, males, and with preexisting cardiovascular risk factors and/or cardiovascular diseases (Madjid et al. 2020).

Virus Infections and the Cardiovascular System

Virus infections may have a profound negative effect in the cardiovascular systems. Influenza is the fourth most common cause of death in the United States of America (Madjid et al. 2007) and current data project that COVID-19 will be the third most common cause of death this year. The disease-modifying role of the cardiovascular system is incompletely understood. It is well known that virus-triggered diseases may generate cardiovascular disease, eg during influenza infections. This relates particularly to the development of myocardial injury, acute coronary syndromes, myocarditis, arrhythmia, and heart failure (Madjid et al. 2020; Madjid et al. 2007; Cowan et al. 2018). Virus-associated respiratory infections may cause sepsis and contribute to the destabilisation of arteriosclerotic plaques (Smeeth et al. 2004). Based on previous data for other viruses, several urgent issues must be clarified for CoV2: the relative contribution of cardiovascular risk factors to the course of COVID-19 disease and how COVID-19 infections trigger cardiovascular disease leading to a relevantly increased morbidity and mortality in these patients.

COVID-19 and the Heart

The most common symptoms of COVID-19 infection are fever, cough and shortness of breath, but affected patients may also be largely asymptomatic despite equally high virus copy load (Zou et al. 2020). In a larger reported cohort 14.9% of patients had hypertension, 7.4% diabetes and 2.5% coronary artery disease (CAD) (Guan et al. 2020). 5-10% of all patients require intensive care treatment in the scope of sepsis, septic shock, multi-organ failure and acute respiratory distress syndrome. Mortality rates are particularly high in patients >80-85 years (20-25%). However, hospitalisation rates are comparable in younger cohorts (Team CC-R 2020). Other studies reported that 4.2% of a series of nearly 45,000 patients from China had cardiovascular disease, but among those who died from COVID-19 cardiovascular disease was present in 22.7% of all patients (Madjid et al. 2020).

One of the most common cardiovascular adverse events in the course of COVID-19 is acute myocardial injury. Cardiac troponins signal myocardial injury in a wide range of cardiovascular disease including specific cohorts which are particularly threatened by systemic inflammation and toxic drugs (Giannitsis and Katus 2013; Michel et al. 2020). Infectious disease including influenza and also influenza vaccination may trigger troponin increases. However, the prognostic value of these largely retrospective observations remains incompletely understood (Engler et al. 2015; Musher et al. 2019; Pizzini et al. 2020). In a smaller, single centre cohort, 12% of the hospitalised COVID-19 patients had an increase of troponin (troponin dynamic), which was accompanied by an increase of inflammatory markers including cytokines (Huang et al. 2013). Mortality was particularly high when myocardial injury was present (Yang et al. 2020). In a larger cohort comparing specific aspects between survivors and non-survivors, troponin increases above the 99th percentile were present in 15% of survivors and 28% of non-survivors.

In another report of 187 patients hospitalised in the course of COVID-19, 35.3% had cardiovascular disease and 27.8% had myocardial injury as indicated by elevated

troponin T levels. 7.6% of the patients with neither cardiovascular disease nor troponin elevations died, while mortality rates in those without cardiovascular disease and troponin elevations was a high as 37.5% and 69.44% in cases of concomitant cardiovascular disease together with troponin increases (Guo et al. 2020). Cardiac injury is therefore regarded an independent predictor for mortality in addition to ARDS (Shi et al. 2020). This high incidence of troponin elevations in patients without known cardiovascular disease implicates a high but incompletely defined prevalence of myocarditis in COVID-19 patients (Xu et al. 2020).

Open Questions

Patients with cardiovascular disease are among those with the worst prognosis regarding hospitalisation, referral to ICU care, mechanical intubation, sepsis, multi-organ failure, and death as several retrospective analysis have outlined previously. The prevalence of cardiovascular disease in ambulatory patients or in patients from retirement homes is even less characterised. It will be imperative to analyse why specific patient groups are at particular danger of developing fatal outcomes and whether this relates to age or modifiable risk factors including obesity, dyslipidaemia and smoking. It is for instance not known why male patients are more likely to die from COVID-19 than women and whether this can be related to a higher percentage of male smokers in certain populations, eg in China. It can be expected that a large number of patients will present with acute coronary syndromes, acute myocardial injury, arrhythmias, and heart failure. The causal relation between cardiovascular disease and COVID-19 remains to be determined. A general inflammation of the vasculature and heart can be expected and was previously found in other virus-related infections, eg influenza.

Myocardial injury is one of the most frequent cardiovascular adverse events in COVID-19 patients. Prevention and treatment of myocardial injury have not been systematically studied in this disease. Data from other populations suggest that myocardial injury can be prevented in systemic disease such as rheumatoid arthritis, cancer, and cancer therapy at least in part by conventional heart failure therapy (Michel et al. 2020; Totzeck et al. 2019).

Further research is warranted to determine whether patients with optimal therapy of cardiovascular risk factors will exhibit superior prognosis. This refers to the use of statins to reduce LDL-C values according to guidelines, the use of hypertension medication, antithrombotic regimens in arrhythmia and acute myocardial injury/coronary syndromes and heart failure therapy.

Conclusion

Quarantining and public interventions ('lock-downs') are probable plans to reduce the burden on the health systems. However, it is believed that this will slow down transmission rates without reducing the overall numbers of people infected with the current or any future pathogen. In addition, concerns about potential infection hazards lead to a decrease in presentations for urgent and even life-threatening cardiovascular diseases. Cases of patients even with myocardial infarction, avoiding presentation to the healthcare system, have been reported. In addition, due to a lack of social monitoring especially of elderly patients by their relatives, cardiovascular diseases may remain undiagnosed for a longer duration. These effects lead to a presentation of patients at aggravated clinical conditions in reduced general state of health. Effective prognostication of patients at risk by assessment of established conventional biomarkers (eg troponin and natriuretic peptides) and new sources (including single biomarkers, patterns of novel inflammatory markers, or machine-learning) will help to determine which patients require intensive monitoring, advance diagnostics and preventive therapy.

Author: Amir A. Mahabadi
Attending | Department of Cardiology and Vascular Medicine | West German Heart and Vascular Center | University Hospital Essen | Essen, **Germany**
amir-abbas.mahabadi@uk-essen.de

Author: Matthias Totzeck
Attending | Department of Cardiology and Vascular Medicine | West German Heart and Vascular Center Essen | University Hospital Essen | Essen, **Germany**
Matthias.totzeck@uk-essen.de

Key Points

- The current spread of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) virus has generated a worldwide pandemic with yet unforeseeable outcomes.
- Virus infections may have a profound negative effect in the cardiovascular systems.
- Patients with cardiovascular disease are among those with the worst prognosis regarding hospitalisation, referral to ICU care, mechanical intubation, sepsis, multi-organ failure, and death.
- Due to a lack of social monitoring especially of elderly patients by their relatives, cardiovascular diseases may remain undiagnosed for a longer duration.

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Filling the Gaps: Learning From Each Other During the COVID-19 Pandemic

Summary: The COVID-19 crisis has created many challenges for health systems around the world. Health leaders have to focus on sustaining their organisations at all levels, and the International Hospital Federation is offering its support to them through a number of projects.

The ongoing coronavirus pandemic reminds us of how we are all interconnected. Whilst impacting different countries in different ways and to varying degrees, this pandemic has demonstrated that we all have a common ground – it is a healthcare crisis and its issues tend to be similar in one way or another.

Hospitals urgently looking for supplies of personal protective equipment (PPE), healthcare workers being exhausted up to the brim, patients overwhelming emergency rooms, doctors making difficult choices on who to treat first based on the patient's chance of survival – these are all common scenarios the global healthcare industry is facing today because of the COVID-19 pandemic.

At the same time, hospitals have drastically reorganised their wards to create specialist COVID-19 units and to scale up ICU beds while redistributing tasks and activities among their staff. If hospitals had to reduce activities for non-coronavirus patients, they have also had to find alternative approaches – the majority of them supported by ICT – to reach out to people mostly living in 'lockdown' situations. Many hospitals have mobilised their local communities for support, which has been given willingly, demonstrating how deeply anchored hospitals are in the community.

As an international organisation in this challenging time, the International Hospital Federation's (IHF) role is to serve as a platform for health leaders to support each other, not only during the pandemic but more importantly, beyond the pandemic. Going forward, hospital systems will have to reinvent themselves not only to recover from the initial pandemic wave that has exhausted their workforce and resources, but also learn how to live with the pandemic while fulfilling all other hospital duties. To realise this reinvention, it will be critical for hospitals to harness the creativity and innovation, which prevailed during the peak of the coronavirus crisis. Although the prevalence of COVID-19 has placed hospitals under unprecedented pressure, this crisis has also accelerated the transformation of health services and opened the way for the long-term adoption of new practices, which will enhance the efficiency and quality of care.

Sharing best practices is crucial. With healthcare systems 'zooming in' on their respective territories, the IHF is 'zooming out.' We aim to fill the knowledge gaps amongst countries by cultivating a space for healthcare leaders to exchange best practices and information. We have set up a dedicated resource portal containing updated information and guidance for healthcare leaders managing the coronavirus crisis. Grouped into six key management areas: staffing, equipment, hospital re-organisation, good practices, recommendations and responsiveness, the information provided through the IHF portal supports healthcare leaders in making informed decisions on how to better respond to the crisis.

Learning from each other. We are inviting our members and partners to participate in our COVID-19 webinar series, to share actions they have taken in their respective countries to mitigate the coronavirus crisis. The webinars have also been an avenue for participants to raise questions and air their concerns. The recordings of the webinars and the list of upcoming webinars are available on the IHF website. In parallel to our live webinar series, the IHF is launching a podcast series – 'Leading through COVID-19' – in which renowned healthcare leaders put forward pragmatic recommendations on dealing with specific topics resulting from the coronavirus crisis, such as how to better handle communications within and outside the hospital and prioritising hospital activities with limited resources.

Finally, to further facilitate the relevant exchange of information on how to support leaders in managing

their priorities and turning challenges into opportunities, the IHF has established a dedicated LinkedIn group – 'Together Against Covid-19' – for virtual discussion. This group welcomes health leaders from across the world to share suggestions, contributions and solutions in regard to COVID-19.

Beyond COVID-19, what is next? Healthcare systems are at the front line in this crisis, where there is much uncertainty. Whilst these systems work tirelessly on responding to the coronavirus pandemic, the IHF will support hospitals so that they could resume their activities in the best possible conditions post-pandemic by mitigating the consequences of the COVID-19 disruption. With the support of our members, the IHF has established the 'Beyond COVID-19 Task Force,' through which we will build a post-pandemic response based on the inputs of the Task Force members. This response will focus on three areas: human components; support systems and processes; healthcare delivery and access. The Task Force will also examine the important cross-cutting roles of finance and information systems across these three groups. The Task Force's first outputs are anticipated to be published in early summer.

The 'Human Factor'

As the COVID-19 pandemic places huge pressure on the ability of health systems to deliver safe, high-quality care, leaders will have to sharpen their focus on meeting the core needs of their staff, ensuring their wellbeing and sustained motivation to help them to deal with this rapidly changing situation. They will have also to draw lessons on skill mix and task shifting. In parallel, hospitals will need to regain trust amongst the communities they serve, to ensure patients have confidence in their services for non-COVID-19 health matters. Going forward, patient empowerment will need to continue, to ensure that they are engaged in decision-making processes not only concerning their health but also more broadly on healthcare services.

Support Systems and Processes

Hospitals and healthcare service organisations will need to work closely with suppliers and their partners to understand the impact of the COVID-19 pandemic on global health product supply chains, affecting key materials, finished health products, shipping and logistics. Moreover, hospitals will have to examine how their physical environments and technical infrastructures need to be adapted to enable greater flexibility in responding to exceptional healthcare situations in the future.

Services and Operations

During the coronavirus pandemic, it has been necessary for many hospitals to postpone non-urgent care (particularly operations with extended recovery times) and to repurpose staff to better manage the overwhelming influx of COVID-19 cases. Flexing to meet the demands of the coronavirus crisis has been the challenge of a generation for many healthcare systems. However, going forward, hospitals will need to consider the situation of communicable diseases. Reaching out to the population will accelerate the transformation of hospitals without walls and stronger collaborations with other stakeholders including better public and private coordination.

The wide-reaching COVID-19 crisis has brought us closer together. The IHF cannot overemphasise the importance of having a global community of healthcare leaders supporting each other by exchanging knowledge and support to overcome our common enemy. At the IHF, it is our duty as an international organisation to hold everyone together, while COVID-19 is trying to knock us down one by one.

Author: **Eric de Roodenbeke**

CEO, International Hospital Federation (IHF) | Bernex | **Switzerland**

ederoodenbeke@ihf-fih.org | ihf-fih.org | @IHF_CEO

Key Points

- The pandemic has demonstrated that we all, despite being in different countries, have to deal with common issues, such as a lack of PPE, staff exhaustion, or insufficient ICU capacity.
- The COVID-19 crisis has also accelerated the transformation of healthcare, and now hospitals need to harness creativity and innovation to enhance the efficiency and quality of care.
- For this, it is crucial to share best practices, learn from each other and start preparing for the post-pandemic reality.
- IHF has developed a number of initiatives to help healthcare leaders on this way. Those include a dedicated resource portal, a series of webinars, a LinkedIn group and the special 'Beyond COVID-19 Task Force.'
- Healthcare leaders have to focus on addressing the needs of their staff, working with partners and suppliers to support systems and processes, and maintaining their services and operations in cooperation with their stakeholders.

Oxygen – A Vital Need for the Fight Against COVID-19

Caption : Containerized PSA oxygen plant installed on the roof of La Roseraie Hospital near Paris, France

The serious health crisis in France, Italy, Spain and so many other countries highlights the crucial importance of access to medical oxygen for the treatment of COVID-19 patients. Hospitals are faced with the need for increasing supplies of oxygen necessary for the survival of patients. The oxygen delivered to them is produced in factories and then bottled or transported in liquid form to the hospital. In current conditions, while oxygen requirements are exploding and we are all encouraged to limit our movements, this pattern has shown its limits.

There is a solution to avoid the countless comings and goings of trucks needed to get oxygen to the hospital. This solution is called an oxygen generator. It has existed for over 20 years, but is far from being widespread, especially in Europe.

However, on-site medical oxygen production only has advantages: an oxygen generator produces medical oxygen continuously, at low cost and without requiring transportation or handling. Since 2011, European regulations have existed, which authorize the use of oxygen produced by generators in hospitals. Oxygen generators are medical devices, and the medical oxygen produced by a generator is registered in the European Pharmacopoeia and fully complies with the therapeutic requirements in hospitals.

NOVAIR, a French company based in Roissy, France, and a pioneer of this solution in Europe, has been developing and manufacturing oxygen generators in France for over 20 years. Its solutions are exported all over the world, and NOVAIR has thus equipped thousands of hospitals and clinics to self-produce the oxygen they need from the ambient air. It is time to encourage hospitals to adopt this solution, which is a source of autonomy for their oxygen supply and a contribution to reducing the CO2 emissions, an ecofriendly gesture for the planet.

How can on-site oxygen production provide an effective response to the increased oxygen requirements faced by our hospitals?

When a hospital is equipped with an oxygen generator, it becomes its own oxygen supplier: oxygen is produced on-site, on demand, from ambient air. The hospital thus becomes autonomous: it no longer has recourse to oxygen deliveries in bulk or in bottles and is no longer dependent on the capacity of its supplier to deliver.

Thousands of hospitals around the world are already using medical oxygen generators. Today, this autonomy is within the reach of all health establishments.

An oxygen generator in primary and secondary sources: an oxygen reserve in case of increased needs

The production capacity of a generator is sized according to the specific needs of each hospital. For hospitals with operating theaters and/or intensive care, the generators are doubled to provide double capacity compared to the nominal need. This oxygen reserve is precious in the event of an abnormal increase of needs, such as the situation we are living today.

With oxygen needs exploding due to the COVID-19 pandemic, oxygen generators' benefits prove to be more obvious than ever. For all types of hospitals, the production of medical oxygen on-site and its delivery on demand, without any logistic issues or CO2 emissions, is truly the oxygen supply format of the 21st century.

Author: Valérie Bokobza

Marketing & CRM Director, NOVAIR | Roissy-en-France | **France**
novairmedical.com | in@valerie-bokobza-38342a95 | in@groupe-novair | @NovairGroup

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Virtual Consultations: Now or Never

Summary: The use of virtual consultation and telemedicine is expanding rapidly due to the coronavirus crisis. Patients want to avoid hospitals and the health system prefers to keep non-infected patients away from hospitals to reduce congestion.

Oliver Wyman consulting ensures that more than 50% of medical appointments worldwide have been provided through telemedicine during the crisis (Oliver Wyman 2020). Some initiatives have been led by institutions already implementing tools and strategies, but independent doctors have also needed to find a way to connect with their patients. For this, standard communication tools like WhatsApp or Skype are being used even with the controversy generated around privacy and data protection.

For the Spanish insurance company, Sanitas, the increment has been exponential. The amount of daily video consultations has increased from 300 before the crisis to 5,000. Throughout 2019, Sanitas made 42,000 video consultations, while during March 2020 alone, 28,000 visits were telematic, with paediatric, gynaecology and psychology specialties being most in demand. Furthermore, the virtual follow up of pregnant women has grown by 59% (Minaya 2020).

By other hand, DKV in Spain launched an interesting initiative called "Doctors in front of Covid." Aiming to decongest the healthcare system and curb the contagion curve, DKV offers its telemedicine platform free of charge to make online medical consultations between volunteer doctors and patients. They have had more than 900 registered volunteer doctors answering health questions to patients and attending to medical needs from home without overloading the healthcare system.

It is clear that the COVID-19 crisis has boosted virtual consultation, and this trend should demonstrate its value for the future. A total of 65% of patients regard the use of video-conferencing for some medical appointments positively. Patients would like to receive copies of their reports and the majority of them (85%) would also like to view their imaging material (Cabarrus et al. 2015).

A virtual visit does not only imply the use of a videoconference system, as a doctor's appointment involves the examination and some exchange of medical documentation. The patient can bring previous examinations, and the doctor can deliver a report or prescription receipt. Therefore, to ensure the virtual appointment is properly executed there are three main tools that need to be put in place, all of them under the secure mechanisms required by data protection laws in each region:

- A communication system such as video, phone or chat allowing interaction with the patient.
- An electronic prescription system for delivering a legal and certified prescription that the patient can use to get medication at the pharmacy. There are different regulations and entities involved country by country which would need a separate analysis.
- A medical document and image exchange service covering the need of the doctor to deliver a report, a clinical note or any other medical document after the medical appointment. It is also necessary for a set-up allowing receipt of medical documents or even radiology studies from the patient previous to or during the visit, in the same way he would bring them to an appointment.

Idonia is a platform that allows professionals to share diagnostic reports, clinical cases and medical images with their colleagues and with their patients in a safe way. This improves the diagnostic process and contributes to the knowledge transfer of the scientific community. The cloud platform also allows patients to have a secure space where they can organise their documents and medical images to access them at any time and from any device (Shini 2012). European citizens, under GDPR, and as holders of data have the right to access and to obtain a copy of it in a common format and the right to the portability of data (Guanyabens 2019).

Idonia is a secure platform that uses an infrastructure certified by the National Security Scheme at a

High Level, and that meets all the requirements of security and privacy of the European General Data Protection Regulation (GDPR) (EU 2016) and local regulations such as the LOPDD.

> **"It is clear that the COVID-19 crisis has boosted virtual consultation, and this trend should demonstrate its value for the future"**

Hospital Initiatives for Virtual Service

Our priority and focus during this COVID-19 crisis is to support medical centres and doctors in delivery of consultation reports or even radiology images to their patients, as well as to help patients upload and exchange medical information ahead of a visit. The Idonia team has committed to offer their services to healthcare centres to promote telemedicine and virtual appointments, with the aim of reducing the number of unnecessary visits to hospitals.

We have helped many hospitals and individual doctors to better exchange medical information with patients remotely.

Marina Salud, a European reference site in digital health (HIMSS Stage 7), rapidly implemented a system of virtual appointments to keep assisting their patients. Healthcare professionals of Primary and Specialised Care from the Health Department of Denia, in Eastern Spain, are offering continued quality assistance by attending to their patients through a traditional phone communication system combined with Idonia for medical document exchange. Through the platform, physicians and patients can share any type of medical records safely in a controlled environment without using email.

Physicians and nursing staff in the healthcare space have reorganised in teams that work in turns at the hospital or in a telematic way. Primary Care facultative and nursing personnel carry out phone follow ups of patients, giving special emphasis to chronic patients and those with mild COVID-19 symptomatology. These follow ups are recorded in their Electronic Clinical History, thus remaining accessible to all healthcare professionals, both in Primary Care and at the hospital. The traceability of these clinical notes guarantees the continuity of medical care, which results in a greater security to the patient.

This way, doctors can keep their appointments with their patients in a telematic manner, whilst preserving the security and distance recommendations, although emergencies, care, analytics and anticoagulant dispensing are still carried out at the hospital.

The daily follow ups of COVID-19 patients provide information on the state and evolution, and allow the detection of the presence of severe symptoms. Patients that are considered to show severe symptoms after being evaluated by the Primary Care team are directed to the hospital. Through this remote assistance, patients receive daily attention and feel supported in the process. It also avoids the transmission of the infection, as they don't leave their home.

Another interesting initiative was engaged by Clínica Universidad de Navarra (CUN). CUN is a non-profit private academic hospital with two sites in Pamplona and Madrid.

Their patients are distributed across all Spanish regions and internationally, since they are a highly-qualified medical institution that receives many second opinions requests at an international level. In order to keep providing their medical service during the COVID-19 crisis, CUN has pushed teleconsultations across all the specialties. These video consultations are integrated in Idonia's patient portal and mobile apps. With the aim of facilitating receipt of

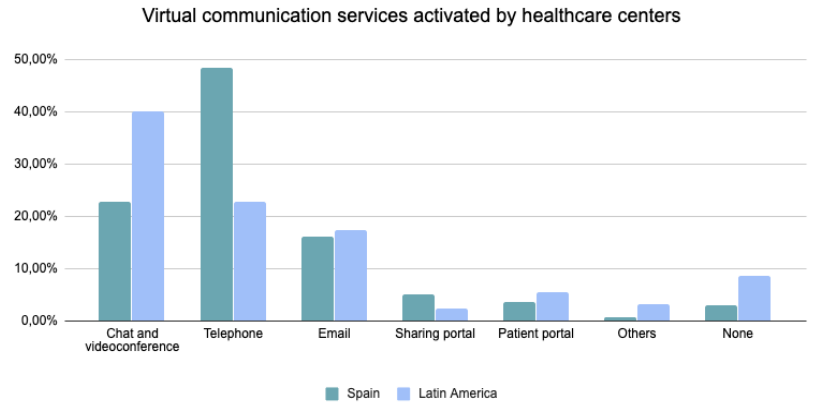

Figure 1. Results of the question "Have you activated any virtual communication service with your patients?" where users could chose more than one option

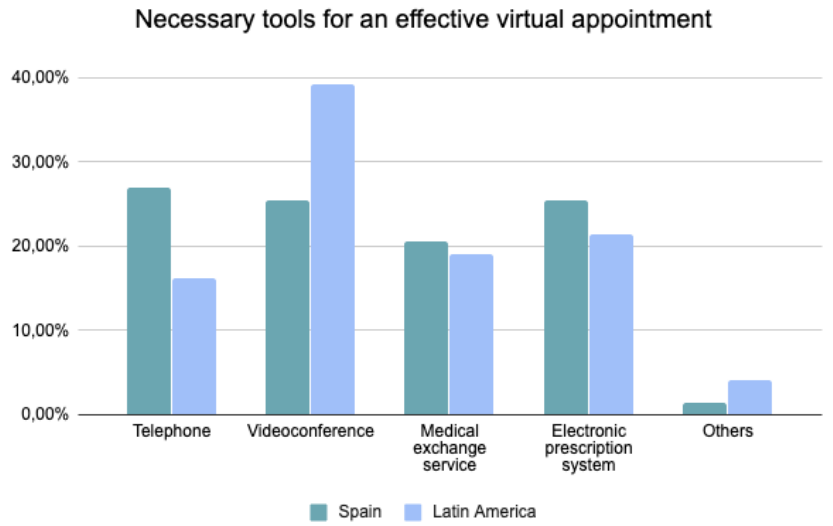

Figure 2. Results of the question "For an effective virtual appointment, which tools do you think are needed?" where users could chose more than one option

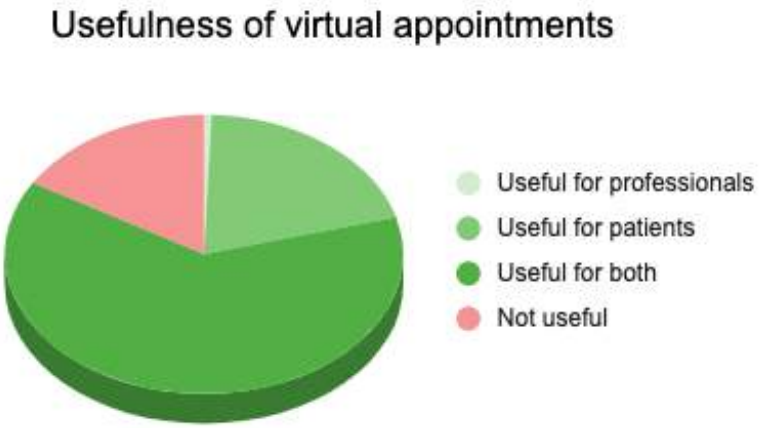

Figure 3. Results of the question "Who benefits most from the use of virtual appointments?"

clinical documentation and medical images from their patients to prepare these teleconsultations properly, CUN has decided to set up a new exchange service through Idonia.

A further health centre that has used Idonia to face this crisis is Clínica Tres Torres, in Barcelona. This clinic is using Idonia to upload medical documents and share them with their patients in a safe and easy way, in order to keep providing their services to the patients. So far, these initiatives have been well received by our professionals and patients.

In these times, where avoiding agglomerations is key to mitigate propagation of COVID-19, Idonia provides a great support in medical processes that can be carried out in a telematic way.

Opportunity to Learn

We also took the opportunity to analyse the market and measure the impact. For this purpose we launched a survey to medical professionals in Spain and Latin America (the markets where we have clients) in order to better know and understand the medical professionals' and hospitals' needs. We obtained 804 answers which provides a good basis for feedback.

The most relevant conclusion from our survey is that 94% of the responders have activated one or several tools for virtual communication with their patients. This shows the great value these systems have provided during the crisis.

It is remarkable to note that in Latin America users prefer videoconference (40%), while in Spain users prefer telephone (49%) for direct communication.

Secondly, we asked what the necessary tools they have identified are for keeping virtual consultations as something permanent.

From the results we see again the difference in preference of telephone versus videoconference between Spain and Latin America. However, regardless of the communication system, in both markets there is a clear need of medical exchange and electronic prescription systems, to provide a thorough interaction with the patient, reducing as much as possible the obstacles posed by distance.

Lastly, we wanted a better understanding on who obtains more benefit from the virtual medical visit: patients or professionals. A total of 63% of responders think that both are benefitted. Patients can cover their medical needs without going to the clinic or hospital, and doctors can provide their medical service remotely. It is also interesting to note that about 16% of responders believe that virtual consultations have been useful during the coronavirus crisis but would not necessarily be permanently of use in normal times.

Final Thoughts

The survey reinforces the idea that the crisis has heavily pushed for virtual care adoption, since 94% of medical professionals responders have implemented some kind of virtual consultation tools during the COVID-19 crisis and 84% of them believe they will continue to be useful after the crisis.

Our hope is that the push that the crisis has meant for digital health adoption will remain and health managers and medical professionals will take the opportunity to definitively change processes and facilitate delivery of care using digital health (Cabrer 2018).

Author: Miguel Cabrer
Member of HealthManagement.org IT Editorial Board, CIO, TopDoctors, Founder, Idonia Medical Image Exchange | **Spain** |
mcabrer@idonia.com | idonia.com | @mcabrer

Author: Nerea Elosua Bayés
Engineer, Idonia
nelosua@idonia.com | idonia.com | @IdoniaHealth

Author: Carla Riera
Biomedical Engineer, Idonia
criera@idonia.com | idonia.com | @IdoniaHealth

Key Points

- A significant number of patients and medics have reacted positively to the presence and advantages of telemedicine during the crisis.
- One large healthcare company recorded that the most in-demand telemedical visits were paediatric, gynaecology and psychology specialities
- The potential of telemedicine has been leveraged successfully during the COVID-19 crisis and healthcare should harness opportunities for the future.

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COVID-19: Unforeseen and Unpredictable Pandemic

Summary: The COVID-19 crisis has uncovered a plethora of issues with the health systems in Europe and is predicted to have enormous consequences – both in healthcare and elsewhere. In early April, our EXEC Editor-in-Chief Alexandre Lourenço talked to HealthManagement.org about the challenges hospitals in the EU have been facing and contemplated the changes in healthcare, economy and society post-pandemic.

Spread of COVID-19

One very interesting paper (Verity R et al. 2020) analysed the situation on the Diamond Princess cruise ship. In this very closed environment 18% of people who tested positive were asymptomatic. After passengers had been confined to their cabins, the spread of the disease fell substantially. Assumingly, we can extrapolate this proportion onto larger populations.

What we see is that after a number of confirmed cases, if there are no mitigation or suppression measures in place, the infection spreads exponentially. The EU member states were requested to implement measures promoting physical distancing, and this is what they did, some later than others. Some countries resisted to implement such measures, for example the UK, while others, such as Sweden or the Netherlands, were not implementing them instead relying on their citizens' sense of responsibility. But there are also the unfortunate examples of Italy and Spain that have been late to intervene. By the end of March, in Italy 9.5% population had been infected, in Spain over 15% (Flaxman et al. 2020).

Other factors played their role too, of course, such as different perception of physical distancing in different cultures or the density of the population.

Lifting the Restrictions

Without a doubt, these suppression measures are not sustainable and have to stop at some point to ensure viability of the economies. There have been some studies on the economic impact of the 1918 Spanish influenza and COVID-19 (Correia et al. 2020). The results show that the negative impact on the economy without the interventions would have been far greater than that caused by them. And we should keep this in mind while trying to find a balance between the suppression measures and the economic growth.

We live in a big uncertainty, and even though we need to rely on scientific data, no mathematical model can foresee the future developments. There is a joke, "Why did God create economists? – In order to make weather forecasters look good," and it reflects the current situation well if we talk about epidemiologists.

There is high probability of the second wave once the restrictions are lifted. Therefore, we need a highly effective vaccine, but there is very little chance that we get it from the first trials that are being carried out now. So we have to deal with this uncertainty, trying to protect the population, but also ensuring that the economy functions, even if not grows. In the end, it will be individual countries who have to make the decision, because any epidemiological scenario always depends on the evolution of the epidemic in each country. However, even if the national lockdowns are lifted soon, the travel restrictions will continue to be in place until we have an effective vaccine or treatment.

At the moment it is still too early to make any kind of predictions. So far we only see the number of new cases slowing down – Italy is plateauing, and maybe Spain will follow shortly – but the infection is not yet completely under control and we are still far from solving the problem.

Weak Spots in EU Health System

In the EU, healthcare is a country-level policy. And one of the consequences of the COVID-19 crisis could be increased cooperation at the European level here. We have already seen some signs of it, eg patients from Italy being flown to be treated in Germany, and patients from Spain in France. This cooperation among the member states is encouraging.

Since the beginning of the crisis, we have seen that efforts from the European Centre for Disease Prevention and Control (ECDC) were not enough. The ECDC was developed as mostly non-epidemic observatory and is not fit to deal with a pandemic of this magnitude. Most probably, we will have to strengthen this institution in the future and, in general, to implement a more consistent health policy at the European level.

This would be a positive development, in my opinion. No one was ready for this kind of pandemic. My generation had never seen anything like this, so we just couldn't foresee it. This is why states and multilateral organisations like the EU exist – to try to predict and prepare for consequences. I believe that the EU can be stronger in terms of health policies, to support countries, at least on the public health and civil protection levels, and to sustain the national policies.

Most Important COVID-19 Consequences for EU

This is a million dollar question. I believe that societies in general and health systems in particular will not be the same after those 'war-like' scenes we have been seeing in Italy and Spain.

One of the aspects we tend to overlook is the effect the suppression measures and the focus on COVID-19 care will have on other populations' health needs.

In the short term, the situation will be difficult for chronic patients who are not receiving care due to COVID-19. The mortality rates will increase, as will the demand for this type of care, so the health systems urgently need to develop new strategies to deal with chronic patients' needs.

This crisis can be an opportunity for the substantial growth in eHealth services, especially in telemedicine, which offer an efficient alternative way for non-COVID-19 populations to access healthcare. This can, in fact, lead to a fundamental transformation of healthcare systems. As we see, now both doctors and patients are much more inclined to use the eHealth tools, such as ePrescription, teleappointments, remote monitoring, etc.

The development of telemedicine is in line with another major trend of the recent years – the reduction in what we call 'hospital-centred care' and the rise of community-based care.

Another issue uncovered by the COVID-19 crisis is a lack of properly trained health workforce, especially for intensive care. I think countries have realised by now that they have this problem and need to invest into education and training to be prepared for the future.

The condition of healthcare workforce is yet another concern. In the countries affected the most, the impact on the mental health of healthcare workers will be tremendous. Although we weren't expecting this, it wasn't completely unpredictable.

Interestingly enough, we can see a change in a concept that has gained popularity in recent years, namely a view that our health is a result of our individual decisions. For example, if you exercise and eat properly, your health is better. What we have seen during this crisis, however, is that our health depends on others. This is a major implication to the way societies are functioning and how healthcare should be organised.

Healthcare Economies

When we talk about healthcare expenditure, the lion's share of it goes to care and not prevention, and this might change as a result of the pandemic. I want to hope that we'll see an overall increase in spending on healthcare, on telehealth, on prevention measures. But being realistic, I am not that sure this will happen. If we look at the financial and economic crisis of 2008, back then everyone was relying on public funding to restart their economic activities. As we know, the countries had exited that crisis with very high public debt levels. Even today, the restrictions on public expenditure in the EU continue to be quite severe encouraging countries to reduce their public debts. Therefore, I don't know if countries have the capacity to invest in public health when this crisis ends.

Economic Impact on Our Hospital

Unlike our revenues, the operation costs have inevitably increased. We expect to have them covered by the government, to at least balance the impact on our budget. On the other hand, the way the COVID-19 crisis is affecting our activities is much more profound. For example, we had to postpone most of the elective surgeries, and we are a 1,800- bed hospital that carries out over 60,000 surgeries per year – so the reduction is very high. We also have personnel who are infected or quarantined with suspected infection, so our shift schedule had to be adjusted to allow those workers to safely stay at home and at least try and reduce the risk of the infection spread. There is, of course, the increased need of PPE and ventilators and their constant shortage. A major part of our facilities, such as operating and recovery rooms, had to be transformed to increase our ICU capacity. Our need for trained nurses, intensivists, anaesthesiologists, etc has risen dramatically, and we had to train our personnel to provide intensive care.

All this means enormous changes in care provision and the hospital's configuration. When the crisis is under control, we will start moving in the opposite direction. We still have to see what happens next, but it is already clear that returning to our cruise velocity will be quite hard. With all this in mind, we rely on our highly qualified and committed staff, who are making a tremendous effort at the moment, and on the community to help us to provide the best service possible to the COVID-19 patients, but also to other patients.

Hospital Bed Capacity

The number of beds always depend on the hospital's needs and practices. Take Portugal, for example. We are one of the countries that has lower number of acute beds. 80% of our surgeries are same-day surgeries, and that's a good thing. Other countries, like Germany, have high number of beds, but they continue to hospitalise patients for diagnostic purposes, for routine surgeries – and this is not good for both the patients and the system.

One problem that is common for all countries, including Portugal, is the need to deal with what we call 'bed

blockers,' the patients who are continued to be hospitalised without the clinical need. We are struggling to develop community services to care for them, which is probably the only approach that could integrate social and health services to deal with this kind of cases.

According to the early mathematical, epidemiological models, we would need four, five times more beds than we have – that's absurd! A healthcare system shouldn't be always prepared for something that might happen once in a lifetime, this would be excessive in all senses.

With the exception of Italy and Spain that were relatively late in implementing the suppression measures, the healthcare systems in Europe have been flexible enough to adjust their ICU capacity. Another example here would be an increase in the European production of mechanical ventilators – we have seen this in Spain, for example, where Volks-wagen started to produce this equipment.

Testing Policies and Capacities

Across the EU there are different policies on testing, eg Sweden is only testing patients who need to be hospitalised while Germany has a much broader approach. But this depends directly on the availability of tests. At the European level there is a shortage of tests, so universal testing is simply not possible. Germany, together with some others, is an industrial country, and it could implement its broader policy because it was capable of producing enough tests. Other countries do not have such capabilities.

Besides the tests, there are shortages of PPE and ventilators across Europe. Some EU countries, eg Germany and France, even stopped exporting these kinds of equipment to other countries of the bloc until they had their own needs covered.

Thus, this is not an issue of policies but of the industrial capacity in Europe. The EU should have developed some mechanisms not to allow this, eg create incentives for the European industry to produce enough equipment. But it failed to do so.

WHO, Its Efforts and Independence

At this point and considering the circumstances, WHO has done everything in its power. Most of the Western countries, especially those in Southern Europe, like Italy or Spain, weren't prepared for a pandemic of such magnitude. But I believe that the awareness has been raised on the global level, and not only by WHO but also the UN who put a lot of effort into convincing the policymakers the pandemic is serious. In this sense they all have done a great job. Previous pandemics, like H1N1 or SARS, had left everyone a little disappointed, in a positive sense, because the outbreaks ended up to be not as dramatic as predicted. This time the tremendous efforts by the international agencies match the circumstances. The ultimate response, however, always depends on the member states and their own contingency plans, and no one was prepared for the infection of this magnitude.

Regarding the influence big companies have on the UN system – I personally think this is a conspiracy theory that one can entertain as they like. I don't believe in it. The funding mostly comes from the member states or private foundations that earn nothing from this. With COVID-19 we don't see any gain for either pharma industry or any of the big donors of the UN system. Specifically for this disease there's no cure.

The existing medicines are being tested, eg chloroquine, and others are under development. But none of those will be available on the global scale. We hope, of course, that there will be a vaccine and/or cure, but in any case this is a joint effort by international organisations and the scientific community.

Is COVID-19 a Hype?

I completely disagree. As I have already said, if no measures had been put in place, the number of deaths from COVID-19 would have been much higher than during the 191 pandemic. All the data point to that. Also, the economic and social impacts of those deaths would have been tremendous, and here's what I mean by this.

In the European health systems, we believe in the universal health coverage and in 'not leaving anyone behind.' This is the core value of our society. Therefore, we cannot just allow a huge proportion of our population to die from one disease in a short period of time – and without the interventions thi would've happened in less than a month's time. We cannot allow people to die without clinical care because all the hospitals are overloaded. Waiting for care and not getting it at this scale would be equal to a war scene.

So, no, I don't think this is a 'media hype.' On the contrary, I think that, fortunately, we didn't – and I hope never will – see the full impact of this pandemic. We have seen only a small fraction of it – in northern Italy, in Lombardy, one of the richest areas of Europe with one of the best healthcare systems in Europe, with the highest number of intensive care beds per population in Europe. So we must be grateful that there has been only one example of what could have happened on a global level.

interviewee: **Alexandre Lourenço**

EXEC Editor-in-Chief | HealthManagement.org

President, Portuguese Association of Hospital Managers

Hospital Administrator, Coimbra University and Hospital Centre | Coimbra | Portugal

al@healthmanagement.org | apah.pt | @alexlourenco | @LourencoAlex

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Going 'Liquid'

Digital Transformation and Big Data Strategy in SJD Children's Hospital

Summary: An innovation expert talks about the challenging transformation journey of a hospital in Spain, triggered by the economic crisis and the growing digitalisation of the modern world. While realised mainly through introduction of technology, this journey is, first, about organisational innovation and change.

Sant Joan de Déu (SJD) Barcelona Children's Hospital is a private non-profit institution. Founded in 1867, it is the biggest monographic paediatric hospital in Spain and one of the biggest in Europe – there are over 300 beds and 12 operating rooms with almost 2,000 professionals attending to around 350,000 patients every year.

SJD Hospital is a member of the Hospitaller Order of the Brothers Hospitallers of St. John of God, a non-profit organisation with more than 300 hospitals around the world in 50 countries. In 1973, the hospital was concerted by the public health service and since 1983 has been providing public healthcare services through an agreement with the Catalan Health Service (CatSalut).

It is also a teaching hospital, linked to the University of Barcelona and specialising in the fields of paediatrics, gynaecology and obstetrics.

Almost all of the hospital's activity is public but being private gives it some management capacity and freedom to have private and international patients. Furthermore, the CEO and governing board have been leading the hospital for 15 years, which allows for continued strategy and gives stability and vision to hospital projects.

World Goes Data Driven

Disruptive digital technologies have become indispensable elements in our daily lives. A good example is a smartphone, with over 5 billion unique mobile users in the world (67% of the world population). In Spain, users spend an average of 5h 18m per day online (Kemp 2019). We are undergoing an exponential disruption in the habits of the population and the provision of services that challenges the healthcare status quo.

"If 2000s saw the introduction of digital life-style devices, the 2010s will be known as the era of digital medical devices" (Topol 2010) and personalised treatments, and the 2020s will probably be the decade of automation and data driven care (Topol 2019).

Care is becoming ubiquitous and 'liquid,' moving from the hospital-centric diagnosis and treatment to a continuum that moves with the patient. 90% of healthcare will happen outside the hospital walls, in the daily life of each person. This thesis is in line with the statements of Singularity University at the World Economic Forum, that by 2030 health would move from hospital to home-spital, or even phone-spital (Walker 2016). This is particularly evident in a hospital like ours. Most of our patients are young parents and kids. They are tech-savvy and expect to be able to interact with the hospital through digital channels.

Meanwhile, in 2000s society underwent major demographic and lifestyle changes. Advances in research and medicine lead to increased life expectancy – and with it to the prevalence of chronic diseases and rising healthcare costs. Thus, care processes, especially for patients with chronic or complex pathologies, which are the most expensive for the healthcare system, must become more efficient, ie "the best patient outcome at the lowest cost" (Porter and Tiesberg 2006).

The available technologies are plenty. The problem is to implement them to solve the real needs. Today we see many pilots and trials, but the main challenge is the organisational change necessary for their adoption. It is especially true in demanding and fragmented systems like ours – public, private and international.

The business model must also be adjusted to demonstrate the value of the impact and outcomes and be less activity-centred, ie more value-based.

Crisis as Innovation Driver

In 2008, the financial crisis began in Spain. Also known as the Great Recession (Bentolila et al. 2012), it had a devastating impact on the public revenue with a 15% decrease between 2008 and 2014. There was a decrease in births as well, which also affected the hospital's economy. At the same time, complexity was growing (46.3% from 2004 to 2013). In response to these developments, the hospital introduced an adjustment plan: salaries were cut by 12.5%, the number of professionals by 5% and the number of beds by 10%.

However, these initiatives couldn't work in the long run if complexity and activity were to be maintained. As

a strategy of survival, the hospital decided to focus on maintaining quality care and accessibility, offsetting the drop in revenue by developing the private and international directions. The hospital needed to adapt to these new circumstances, and the accompanying strategy, the 'Liquid Hospital' (LH) was launched in 2010.

Strategic Perspective

The journey of digital transformation has been underpinned by several strategic plans, 'Paidhos,' renewed every five years.

The first 'Paidhos' (2004-2008) reflected the need to position the hospital as a local paediatrics reference centre. During the next stage (2008-2014) the hospital was converted into a national centre of reference through specialisation in care. Due to the deteriorating economic conditions, this plan was revised in 2010 towards more international activity and alternative sources of funding. The latest plan (2020) is focused on becoming an international reference hospital.

In 2009 the hospital – first in Spain – created the Innovation Department, an outlet for its professionals' various innovative ideas. Over 150 innovation projects have been analysed since then and more than 50 carried out, with 44 patents generated as well as 5 start-ups and 11 licences for use.

The Liquid Hospital (H2O)

The LH was created to move care beyond the hospital building, leveraging innovation to advance healthcare. Its main objective was to provide services and offer health contents to patients, families and professionals to improve clinical outcomes and patient and professional experience via collaboration and knowledge exchange. If in the 20th century the medicine was paternalistic, hospital-centred, one-size-fits-all, reactive and siloed, in 2010 the objective was to make it more participatory and virtual. The plan was to create a virtual space for the patients to interact with the hospital and actively engage in their health with new digital tools.

The concept of the LH draws from 'Liquid Society' (Bauman 2000) suggesting that healthcare can happen anytime anywhere. LH strategy had four pillars.

E-Health segment includes online care and telemedicine services with online consultations, telerehabilitation, telemonitoring, second opinions, patient portal (integrated with the 'La Meva Salut' public healthcare system portal and other external platforms) and services for home care (see Box 1).

E-learning was designed to promote knowledge exchange among professionals through online platforms for continued training.

Online communities, where patients interact with professionals, focus on chronic diseases and promotion of health. One example is 'Faros,' a web portal dedicated to health promotion (10 million visits in 2019). It is connected with KidsHealth.org and collaborated with the American Academy of Pediatrics. It informs parents on first aid, child's education, importance of sports in health, and more.

In terms of **social media**, SJD Hospital has been the first European hospital, both for children and adults, and one of the first in the world, to define and publish a Social Media Policy. The hospital followed a multiplatform strategy focused on:

- Promoting a new model of care delivery, in which a patient is more responsible for their health.
- Getting feedback, listening to patient needs, and interaction.
- Increase brand value (building hospital brand).

Challenges for Clinical Teams

The adoption of these new digital formats has created a challenge for the clinical teams, who are willing to make a change but struggling under workload. Analysis

Box 1. E-Health: Practical Examples

PrevenGo: a programme to prevent childhood obesity

Problem: The data indicate that 31% of child population in Spain have an overweight and obesity problem (as compared to 34% in the U.S.), and obese children have a 5.4-time higher risk than non-obese ones of developing type 2 diabetes mellitus in the future (Ludwig et al. 2011).

SJD Hospital is treating more than 500 patients for obesity. The data indicated that 40% would not come back following the first visit, since socially obesity is not viewed as a disease.

Solution: PrevenGo is a hybrid health programme (technology + professionals) that aims to increase children's adherence to treatment (diet and exercise). Each family is given two monitoring devices (fitness trackers), one for the child and the other for the parents. This is accompanied by the help of a specialist (nutritionist, expert in lifestyle changes) who supports and motivates children and their families throughout the programme.

With PrevenGo, not only patients but also their family members become active and involved through lifestyle changes, monitoring and professional help. In addition, it is an efficient way to prevent type 2 diabetes and cardiovascular complications.

Current status: Study conducted in 2013-2016 with 40 children participating. Now active, running a new study.

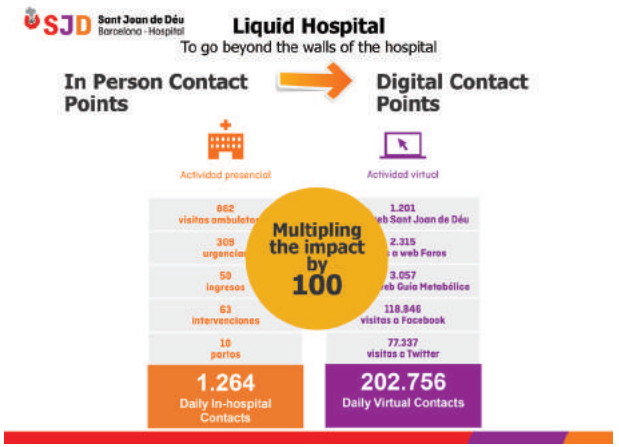

Figure 1. The Number of Daily Personal and Virtual Contacts, 2014.

of the data coming from digital sources needs time, so clinicians have to adjust their schedules accordingly. Currently, the public service doesn't cover the cost of these services, and health is still measured by activity and not by result.

To solve this challenge the hospital decided to include telemedicine service in clinicians' schedules equalling it to 'traditional' visits. In some cases, a health coach was allocated to help with services' adoption. However, we still need to find a way of paying for such treatments. The biggest challenge is not technology, but the organisational change. Yet, while technologies help drive innovations and automate processes, human factor keeps inhibiting breakthroughs. The co-creation of requirements and processes as well as behavioural change are key to implementation.

At the early stages, for clinicians, except for certain champions who were involved in the project, going digital wasn't easy. Aside from the scheduling issues, clinicians also need training to handle the digital tools. The way they interact with a patient is different. The collection of data they need from digital sources is also challenging. Basically, the very way of how services are provided to patients on a daily basis is changing. However, gradually their attitude is becoming more positive as they start to see the potential benefits of digitalisation – both for patients, themselves and the hospital.

Outcomes and Conclusions

In 2014, the first LH (H2O) was completed. The analysis of the 20 comprising projects led to the following conclusions:

- Digital services and content to support patients and families had been created helping them to play a more active role in their health, and paving the way for a new, more collaborative model of healthcare.

- The success of several projects resulted in new technological and organisational challenges.

- The evolution of the main projects required further development of service provision.

- New communication channels were created: hospital-patient, patient-patient and professional-professional, which had to be organised and managed.

- The H2O helped the 'Paidhos' strategy in terms of brand development, digitalisation, knowledge and internationalisation.

Two main outcomes of LH were:

• **Virtual visits.** In 2014, virtual clinical visits (patient portal, scheduled and unscheduled telephone visits, virtual interconsultations, etc) accounted for 2.5% of all visits. By May 2017 this share grew to 12.5%, and – leaping ahead – by May 2019 reached 16.1%, which means 42.000 visits a year! COVID-19 has added over 950 daily virtual visits.

• **Brand and daily contacts.** The four social networks created (Faros, Share4rare, Rarecommons, Metabolic Guide, Diabetes Guide) had more than 10,000,000 annual visits in 2019, with a large share coming from Latin America. Thus, if the total number of in-person daily contacts at the hospital is approximately 1,264, the number of virtual contacts is more than 200,000, multiplying the hospital impact by 100 (Figure 1).

Patient Experience and Services Stratification

Moving towards patient-centred care is a must. Solutions and services should be co-designed following real patient and professional needs if we want innovations to be implemented and used. It is important to consult patients and professionals for any new solution, as they can educate the hospital about the services they need.

Moreover, each patient is different and so are their needs. There are some who are not used to digital technologies. In such cases, their clinical reference specialists – nurses and physicians – can help them to understand what they need to do. However, not all the services fit all the patients, so depending on a patient's profile we would have to adapt treatment, benefitting from digital solutions those who are tech-savvy while providing the rest with more traditional care.

Building Upon Experience

Having completed the first LH, we saw that we did go 'beyond the walls' of the hospital, but in the process created a complex ecosystem, with numerous points of contact. At the same time, the sources of data have been multiplied with data in silos, coming from inside and outside of the hospital. Simplification and order were needed.

On the one hand, with the increase of information sources and the ease of access to them, patients have become actively involved in their treatment, whether by seeking online consultations, participating in online

communities or using wearables and apps. Moreover, the ability to store and collect large volumes of data from multiple sources is, and will increasingly be, an essential element in enabling healthcare providers to have a holistic, real-time view of patient health and wellbeing with a 'Digital Twin' of each patient. This comprehensive vision will allow for more informed decisions improving both treatment and outcomes and facilitating the emergence of new non-face-to-face health services.

With all this in mind, we aimed to progress from the participatory model of the previous LH (H2O) to a more collaborative model with predictive, preventive, personalised and connected medicine. This became the basis for the Liquid Hospital 4.0 (2016-2019) – as in the 4th industrial revolution.

The Liquid Hospital 4.0: Going Data-Driven

The new LH (LH4.0) was co-funded by the EU through the European Regional Development Fund (ERDF) with the support of the Government of Catalonia through the Public Procurement of Innovation in Health programme.

It had two major areas of work and four main projects:

1) Create a model of attention and provision of services that ensures the multichannel approach. We aimed to transition from a reactive model based on receiving and managing calls, direct contacts or emails on a disaggregated basis, to a more efficient model of proactive and informed health management. The main idea was to route several channels (phone, email, social networks and other digital channels) into the same system to provide the same experience to everyone.

At the 'front office' we wanted to change the model of communication and service provision with the following main projects:

- The COACH (Centre of Operations and Administration of Community Health), which includes a customer relationship management (CRM) system and the Contact Centre to connect with patients and the environment through multiple channels.

- The Contact Centre is the 'front door' to the hospital for certain services. This system uses the data and information captured and analysed by the CRM to monitor patients' status and offer them personalised information. This has led to redefinition of the internal contact processes helping to move to a more efficient structure. The Contact Centre is focused on offering medical consultation and telecare services and deals with relatively easy cases. Health professionals respond to patients and, if the case is complicated, remotely refer them to physicians.

- The new patient portal is a digital channel that promotes communication and training and is equipped with self-management tools to provide patients with access to personal information (via a website or an app).

- Health Literacy is focused on communicating medical information and clinical results to patients and families in a clear and efficient way enabling informed decision-making.

2) Create healthcare value from data. The goal was to identify, prepare and gather all the relevant health data from inside and outside of the hospital – both those already existing in the EHR and hospital silos (clinical data, genomics results, biomedical, laboratories or other hospital systems), as well as those generated by patients through online health communities, mHealth or patient portal – and exploit them to support clinical decision-making, operations and research.

To that end, a data lake, Health Data Management (HDM), was created to complement the Business

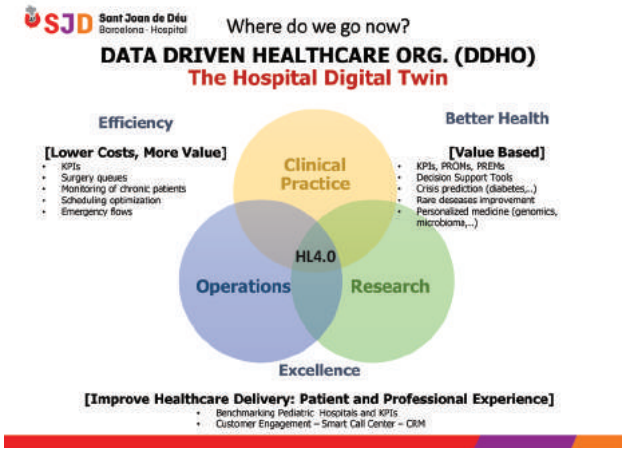

Figure 2. The Concept of the Data Driven Healthcare Organisation.

Intelligence Warehouse (BIW) and other information systems of the hospital. Its main focus is to improve clinical assistance through clinical decision support systems, data analysis and exploration. HDM allows us to have, in a single place and in an organised way, integrated information from different sources that are currently fragmented, which will open the door to a lot of possibilities for secondary use of data for research. The solution is based on a number of standards (HL7 – FHIR, ICD10, ICD9, ORPHA, etc). We piloted its use with external data coming from wearables in the PrevenGo project (see Box 1) to improve the follow-up treatment. The second pilot conducted is on type 1 diabetes.

The LH4.0 was a big step towards the 'Triple (now Quadruple) Aim' (Berwick et al. 2018), ie improvement of the patient experience, improvement of the reference population's health,reduction of the cost per capita of the provision of health services, and improvement of professional wellbeing (Bodenheimer and Sinsky 2014).

Next Steps

The current data elements are the following:

- Digital tools at the front line: patient portal and app, online communities and wearables.
- The COACH in the middle where different types of interactions with the hospital are brought together.
- The HDM, BIW and other data tools at the back office, with all the relevant data, knowledge and intelligence of the hospital.

Our next goal is to create an AI-driven holistic command centre for consolidation and intelligent use of data as well as better access to relevant information for decision-making in real time. This will be the 'brain' of the hospital to help in operations, to have all the decision-makers at the same place with the same information, enabled to answer and adapt to changes as quickly as possible. In other words, we want to be a data-driven healthcare organisation effectively utilising our data to improve the provision of services and the model of care (Figure 2).

Challenges, of course, persist. The hospital has achieved some success in changing the organisation, but we are still at the beginning of this long journey to make medicine collaborative and adaptable to each patient's needs, with the patients being well-informed and taking part in the decision-making process. Governance, finance and polices must be adjusted and, to succeed, healthcare has to aim and evolve towards an outcome-based and value-based model.

Author: **Arnau Valls Esteve**

Innovation Engineer and Project Manager, Innovation Department | SJD Barcelona Children's Hospital | Barcelona | **Spain**

avallse@sjdhospitalbarcelona.org | www.sjdhospitalbarcelona.org

@ArnauVallsEstev | @arnau-valls-esteve-99924071

Author: **Jaume Perez Payarols**

Director of Research, Innovation and Education | SJD Barcelona Children's Hospital | Barcelona | **Spain**

jperezpayarols@sjdhospitalbarcelona.org |

www.sjdhospitalbarcelona.org

@payarols | @jaime-perez-payarols-16881753

Key Points

- The world is going digital, and we must adapt. The main challenge here is the organisational change.
- 90% of healthcare happens outside of a hospital, so we need to go 'beyond the hospital walls' becoming liquid and adjusting our business model accordingly.
- The first step was to move from paternalistic and hospital-centred medicine to participatory and virtual one.
- With five-year strategic plans the hospital defined the direction and started implementing innovative solutions.
- Transferring some services to digital platforms is challenging for most of clinicians. Solutions must be found for issues like scheduling, professional digital training and payment for the services delivered online.
- At the next phase the digital ecosystem had to be simplified and the data utilised more efficiently.
- We now aim to a more collaborative model with predictive, preventive, personalised and connected medicine, moving towards a data-driven organisation. Our next step is creating a holistic command centre to support decision-making in real time.

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How to Support a National Network for COVID-19 Identification in Medical Imaging Studies?

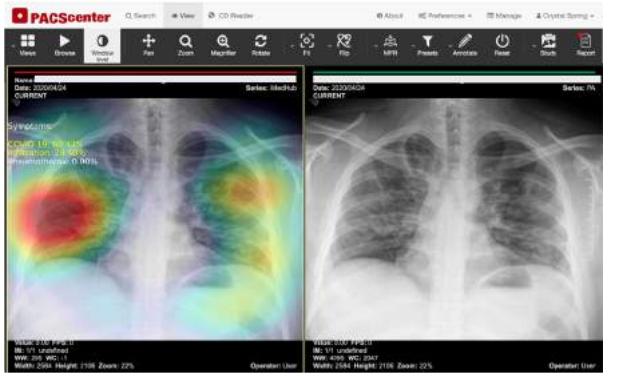
The current COVID-19 pandemic has reinforced the need for more agile technical solutions that can quickly support researchers and clinical practitioners in diagnostics and treatments. Sharing data and knowledge is the key driver that can dramatically change the efficiency of political and health care decisions. Chest x-ray has been the main imaging method to diagnose the COVID-19 infection, but the sharing of these images can be hindered by the absence of vendor-neutral archives and web viewers.

Given the severity of the current situation and the awareness of the importance of medical imaging within the COVID-19 pathology, BMD Software (www.bmd-software.com) is partnering with hospitals and research institutions to bring together anonymized medical imaging repositories within this pathology, with the aim of creating research studies that may lead to the development of discoveries and support the diagnostic process. Using a Web-browser, radiologists are able to submit and annotate the images, with the studies being automatically anonymized by the platform. Researchers are then able to view, search and export data to train the automatic diagnostic solution.

To support this scenario, the PACScenter platform uses the latest web technology (zero-footprint) to transform a common web browser (Chrome, Safari, Firefox, etc.) into a professional workstation with a similar performance as when compared to desktop solutions. It supports the breast cancer screening program in Portugal and several regions of Germany, and an installation for academy in the leading European teleradiology services. Moreover, it has already been accessed from users of about one hundred countries.

The most recent application of a teleradiology platform that is supported by PACScenter, is currently in place in Kazakhstan and it is being used for COVID-19 identification in medical imaging studies (Figure 1). The platform was easily integrated with iMedHub (imedhub.org), a decision support system that provides national services for hospitals and doctors helping the remote diagnosis of lung diseases. Anyone can upload an x-ray of the lungs and get a neural network diagnostic result in a few seconds. During the fight against coronavirus, this tool was integrated with the PACScenter platform and it is being used in the largest coronavirus control hospitals in Almaty, Kazakhstan (The State Clinical Infectious Diseases Hospital).

The acquired x-ray images are transferred to the PACScenter, after which they are automatically analyzed by the neural network, and the result is stored back into the PACS in the form of a new DICOM study with a heat map and the detected symptoms. This process is completely transparent for the physicians, who are able to compare the original image and the diagnostic result, simplifying the diagnosis and the dynamics of the disease. On the third day of using the solution, all the hospital's doctors confirmed that the diagnostic process is many times faster, which, in the current situation of physical lack of time, is a lifeline for them. At the moment, the service can detect 14 symptoms of lung diseases and differentiate COVID-19-specific pneumonia.



Clearly, the world wide population must learn to live in a different way. In the next few years, we believe that technology, a wider digitization, and paper/film free solutions will play a more significant role in the context of healthcare services. Telemedicine solutions will not only provide remote consultancies and diagnostics but also help to promote data sharing for research.

This article was prepared in close collaboration with CrystalSpring in the scope of the iMedHub project.

Author: Luís Bastião Silva

CTO | BMD Software| Portugal

info@bmd-software.com | bmd-software.com | @bmd_software

Upcoming Issue

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1.Data on file and from public sources, 2017. 2. Results from Friedewald, SM, et al. "Breast cancer screening using tomosynthesis in combination with digital mammography." JAMA 311.24 (2014): 2499-2507; a multi-site (13), non-randomized, historical control study of 454,000 screening mammograms investigating the initial impact of the introduction of the Hologic Selenia® Dimensions® on screening outcomes. Individual results may vary. The study found an average 41% increase and that 1.2 (95% CI: 0.8-1.6) additional invasive breast cancers per 1000 screening exams were found in women receiving combined 2D FFDM and 3D™ mammograms acquired with the Hologic 3D™ Mammography System versus women receiving 2D FFDM mammograms only. 3. In an internal study comparing Hologic's standard compression technology to the SmartCurve™ system (18 x 24cm).

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