

Impact Objectives

- Develop an effective methodology to build and operate temporary PCR test systems for pandemic response
- Analyse the experiences of multiple medical schools and hospitals, and present the data in a universal format

A collaborative approach to pandemic response

Drs Junna Oba, Masako Toriya and Koichi Matsuo outline their work on systems engineering-based analysis of agile building for versatile test systems to provide key information supporting professional responses to pandemics



Dr Junna Oba



Dr Masako Toriya



Dr Koichi Matsuo

Your project is aimed at increasing diagnostic testing capacity during a pandemic. Can you talk about the importance of this project?

JO: Our focus has been to promote collaborations between hospital staff and scientists at medical schools, generate a supportive architecture by basic scientists during the health crisis and document these efforts.

KM: We aim to provide useful knowledge, insight and know-how to those responding to future pandemics by analysing the experiences of multiple medical schools and hospitals and presenting the key points considered in the process of test system building in an applicable framework.

MT: We use the systems engineering method, which allows us to build a highly urgent and flexible inspection system that can be launched quickly, functions for a constrained time frame and can be resolved

when no longer required. Key information, such as functional and material flows among stakeholders and role allocation, needs to be visualised quickly and shared with relevant parties to gain swift consensus without discrepancies.

What made you decide to take this angle for your research?

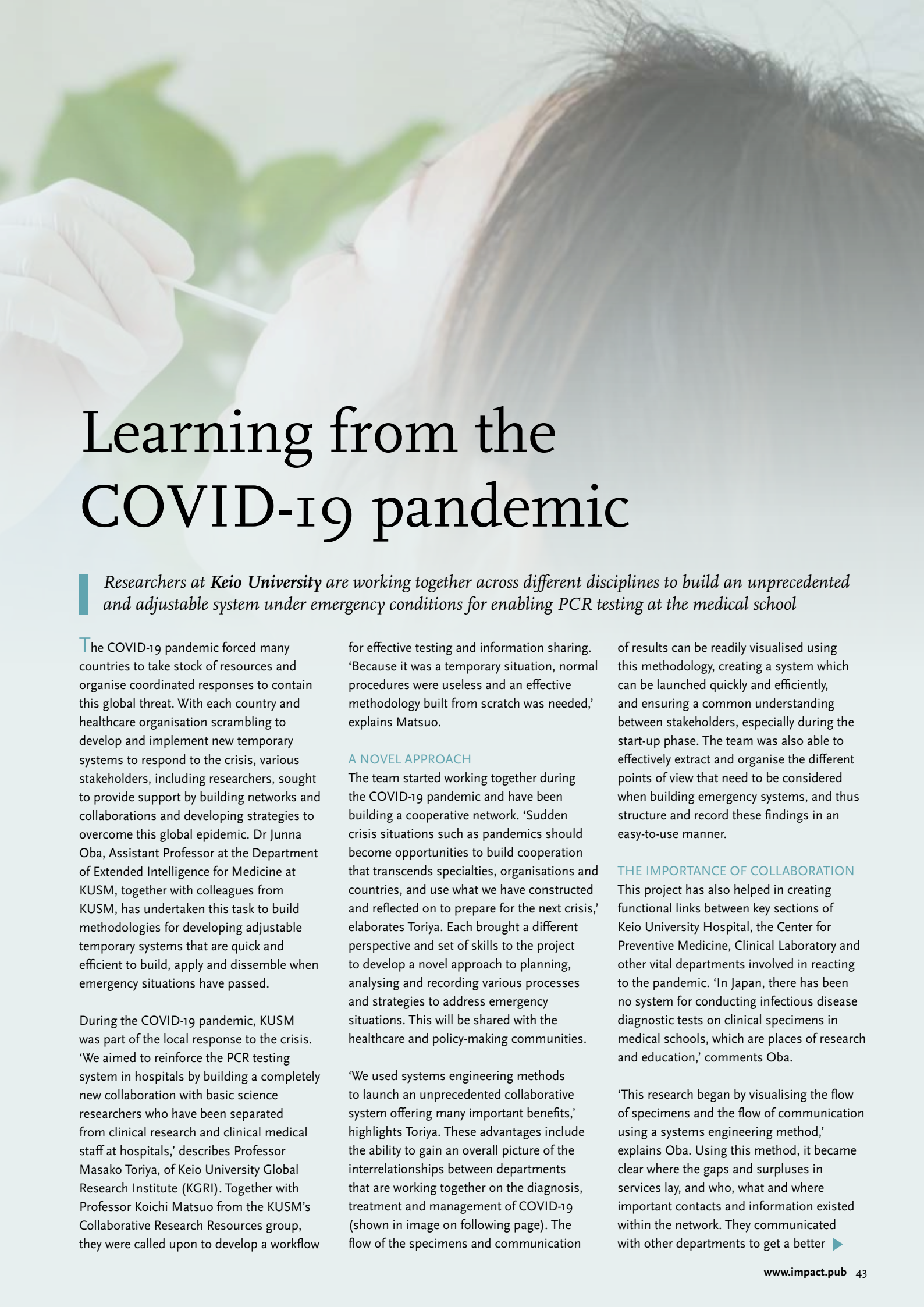
JO: During the early stages of the spread of the SARS-CoV-2 infection, there was concern that the clinical examination systems of hospitals would be under pressure, and that the conventional in-hospital examination structure alone would not be able to handle the situation. We wanted to address these issues.

MT: Medical school researchers proposed the creation of various systems to support PCR testing at hospitals by utilising human and material resources available at medical schools to reinforce the pandemic response. Our research group believed that by recording and verifying the process and structure of building a flexible examination system at Keio University School of Medicine (KUSM), we would be able to respond quickly and efficiently to the next health crisis. We are confident that using the concepts and diagrams of systems engineering would enable us to initiate

the system efficiently and quickly, foster a common understanding between the parties involved, and keep organised records of the process.

How important is it to combine the expertise of a multidisciplinary team effort for this research?

MT: Our research started from Professor Koichi Matsuo, who is responsible for a joint use laboratory that handles the research equipment, registered the joint use laboratory as an external clinical laboratory (ECL), provided a place to build an inspection system at KUSM, and called us for joint research. Dr Junna Oba is a doctor who specialises in analysing medical information and who provided an academic framework for this activity through the acquisition of research funds. I specialise in system design and contribute in terms of visualisation and structuring of system building. With these expertise, design drawings using systems engineering can be utilised for actual system construction and operation. Moreover, we were able to redesign the system in line with on-site circumstances and structure the records of the process, which means that they could be used not only in rapid start-ups but also while reconstructing and looking back at the system. ●

A close-up photograph of a person's face, slightly tilted back, as a white cotton swab is inserted into their nostril. The person has dark hair and is wearing a light-colored garment. The background is blurred, showing green foliage. The overall tone is clinical and focused.

Learning from the COVID-19 pandemic

Researchers at Keio University are working together across different disciplines to build an unprecedented and adjustable system under emergency conditions for enabling PCR testing at the medical school

The COVID-19 pandemic forced many countries to take stock of resources and organise coordinated responses to contain this global threat. With each country and healthcare organisation scrambling to develop and implement new temporary systems to respond to the crisis, various stakeholders, including researchers, sought to provide support by building networks and collaborations and developing strategies to overcome this global epidemic. Dr Junna Oba, Assistant Professor at the Department of Extended Intelligence for Medicine at KUSM, together with colleagues from KUSM, has undertaken this task to build methodologies for developing adjustable temporary systems that are quick and efficient to build, apply and disassemble when emergency situations have passed.

During the COVID-19 pandemic, KUSM was part of the local response to the crisis. 'We aimed to reinforce the PCR testing system in hospitals by building a completely new collaboration with basic science researchers who have been separated from clinical research and clinical medical staff at hospitals,' describes Professor Masako Toriya, of Keio University Global Research Institute (KGRI). Together with Professor Koichi Matsuo from the KUSM's Collaborative Research Resources group, they were called upon to develop a workflow

for effective testing and information sharing. 'Because it was a temporary situation, normal procedures were useless and an effective methodology built from scratch was needed,' explains Matsuo.

A NOVEL APPROACH

The team started working together during the COVID-19 pandemic and have been building a cooperative network. 'Sudden crisis situations such as pandemics should become opportunities to build cooperation that transcends specialties, organisations and countries, and use what we have constructed and reflected on to prepare for the next crisis,' elaborates Toriya. Each brought a different perspective and set of skills to the project to develop a novel approach to planning, analysing and recording various processes and strategies to address emergency situations. This will be shared with the healthcare and policy-making communities.

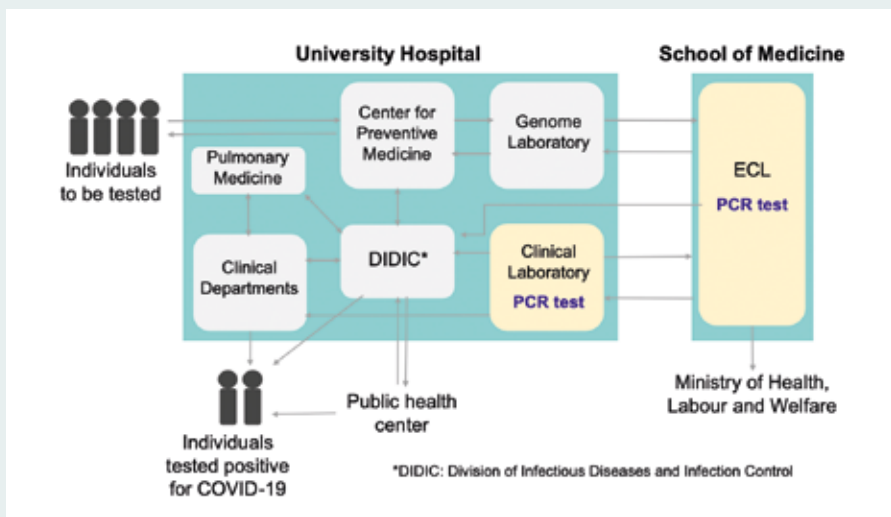
'We used systems engineering methods to launch an unprecedented collaborative system offering many important benefits,' highlights Toriya. These advantages include the ability to gain an overall picture of the interrelationships between departments that are working together on the diagnosis, treatment and management of COVID-19 (shown in image on following page). The flow of the specimens and communication

of results can be readily visualised using this methodology, creating a system which can be launched quickly and efficiently, and ensuring a common understanding between stakeholders, especially during the start-up phase. The team was also able to effectively extract and organise the different points of view that need to be considered when building emergency systems, and thus structure and record these findings in an easy-to-use manner.

THE IMPORTANCE OF COLLABORATION

This project has also helped in creating functional links between key sections of Keio University Hospital, the Center for Preventive Medicine, Clinical Laboratory and other vital departments involved in reacting to the pandemic. 'In Japan, there has been no system for conducting infectious disease diagnostic tests on clinical specimens in medical schools, which are places of research and education,' comments Oba.

'This research began by visualising the flow of specimens and the flow of communication using a systems engineering method,' explains Oba. Using this method, it became clear where the gaps and surpluses in services lay, and who, what and where important contacts and information existed within the network. They communicated with other departments to get a better



understanding of how various individuals, groups and resources best fit within the system. The group recognises the importance of collaborating with other institutions outside KUSM and have been exchanging information and learnings with other groups. They constantly seek networking opportunities to find new partners to work with.

LEARNING FROM CHALLENGES

The team developed a new organisational architecture of the system for expanding SARS-CoV-2 PCR testing by registering Collaborative Research Resources as an ECL, recruiting volunteer researchers and enhancing collaborations between basic researchers and clinicians. Initially, KUSM ECL was slated to handle the PCR testing for

company to conduct voluntary questionnaire surveys at universities with medical schools nationwide,' says Oba. In pushing to gather more information in areas that proved challenging, the team were able to get what they needed to organise and present this data in a useful format. 'The organisation, visualisation, recording and sharing of particularly important viewpoints, as well as methods of building a system that can flexibly respond to changes, should be encouraged so that it can be utilised even in institutions with different situations,' Matsuo states. This helped them create a blueprint to demonstrate the critical functions of different groups, allowing users to gain a better understanding of the organisational, human and physical resources available to them. This established a useful overall perspective

We propose measures to keep records of emergency responses that will be phased out eventually and promote the need for more networked information gathering across organisations

overflow samples from the hospital's main clinical laboratory. 'We were able to build a system that prepares for the overflow while also capturing the needs of the screening tests from within the hospital and obtaining opportunities for implementation,' describes Toriya.

They also examined similarities and differences of hastily-built architectures at other universities and institutions during the pandemic and experienced difficulties in gathering information from other organisations. 'In order to obtain information, we conducted interview surveys through personal connections (both domestically and internationally) and commissioned a questionnaire survey

of the division of roles, flow of activities and greatly simplified the task of understanding resource constraints, legal regulations and organisational policy-making.

INSIGHTS OFFERED

With over a year of the project completed, Oba, Matsuo and Toriya have already gained great insights into how organisations in Japan responded to the COVID-19 pandemic. 'It turned out that a number of domestic medical schools, hospitals and research institutions were constructing systems in unique and divergent ways,' says Matsuo. They found that each organisation built a customised structure to suit their own circumstances, considering their available resources and organisational policies.

Examining these systems enabled the team to develop a method to systematically account for the differences in the structure of each institution. 'As a result of our findings, we propose measures to keep records of emergency responses that will be eventually phased out and promote the need for more networked information gathering across organisations,' reveals Toriya.

Throughout this project, each member of the team came to appreciate the usefulness of the systems engineering approach to comprehend the whole picture of complex relationships and develop new systems. Matsuo hopes to apply the systems engineering method using flow diagrams to the field of biology, which is his area of expertise. Toriya plans to design and implement social systems to encourage healthy behaviours to aid in disease prevention, and Oba seeks to work on the digitisation of medical and health data and developing an analysis platform for Keio and its partner organisations to enhance digitalisation and standardisation in healthcare. ●

Project Insights

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