

Using ICT to Transform Emergency Healthcare in Provincial Japan

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1. Introduction

What comes to mind when you see the term “Regional Healthcare × ICT”?

In this article, I will introduce an example of an ICT application in the arena of emergency healthcare. Emergency healthcare is a battle against time, where matters of minutes or even seconds can mean the difference between life and death. This area of healthcare is perhaps the one where workers in the field are exposed to the harshest conditions. I thought perhaps these workers could be using ordinary common-or-garden terminal devices such as smart phones and tablet PCs.

In this article, I'd like to describe how Saga became the first prefecture in Japan to start working on the use of ICT in the emergency medical field in April 2011. The sharing of information is an essential requirement in many different fields, including emergency healthcare. I hope this article about what we are doing here in Saga prefecture helps to raise awareness not only in the field of emergency healthcare but also in other fields and other industries.

2. Background to the introduction of ICT in the emergency healthcare field

Back in 2010 when I first became responsible for emergency healthcare, it was commonplace ambulance crews in Saga prefecture to phone around several hospitals in order to find a hospital able to accept a patient. Sometimes this turned out to be quite difficult, and patients would be sent on from one hospital to the next. This had become a major social issue not just in Saga prefecture but all over Japan. (Appendix 1)

With no prior knowledge of emergency healthcare, I found myself facing these dangerous circumstances, and felt that the first thing I needed to do was experience for myself the issues faced by actual ambulance crews. Otherwise I would be unable to

formulate effective policies. A hands-on approach is an important element of human resource development in Saga's prefectural government, and it is the approach I take when starting any new job.

I therefore took this valuable opportunity to ride along with ambulance crews during their actual work shifts, listen directly to the doctors that save lives in the emergency medical centers to which these ambulances bring their patients, and observe the actual flow of patients through the ambulance system. By witnessing the front line of emergency healthcare, I got to see how ambulance crews use their mobile phones when making urgent decisions about where to take patients, and how doctors are beset by a continuous succession of calls from hotlines asking them to accept patients arriving by ambulance. Typical tasks they have to perform include finding out which hospital is currently able to accept a patient, finding out how many ambulances have been called out, and where they have been called out to, and finding out how many patients have been accepted by which hospitals. To get this information, they have to make calls from their mobile phones inside the ambulance while the medical institutions respond on their dedicated hotlines, while all the time doing their best to keep the patient alive. I felt that information was not being adequately shared between ambulance crews and medical institutions. If we can make it possible to visualize the scene of an emergency, then this could help to improve the current situation. I saw for myself how medical institutions continue to reject phone calls asking for emergency patients to be admitted, and the difficult conditions of ambulance crews who have to continue desperately making calls to medical institutions, and felt strongly that ICT could provide technology to change this situation.

We constructed a system funded by a grant from the Ministry of Internal Affairs and Communications for ICT-related human resource development and business applications aimed at promoting healthcare in provincial regions. The system design, screen layout and the like were arrived at through a series of meetings with a committee of fire department workers and ambulance center directors. The development proceeded at a rapid pace through a hands-on approach aimed at developing a system that would be useful to people working on the front line of emergency care.

■ Document 1: The current difficulties of Japan's emergency healthcare

- (1) Number of patients transported by ambulance
 (All Japan) 2000: 3.997 million ⇒ 2013: 5.340 million (highest ever)
 (Saga prefecture) 2000: 220,000 ⇒ 2013: 320,000 (highest ever)

- (2) Time taken for patient to reach hospital after dialing the emergency number (119)
 (All Japan) 1999: 27.1 minutes ⇒ 2013: 39.3 minutes (highest ever)
 (Saga prefecture) 1999: 27.8 minutes ⇒ 2013: 36.1 minutes (highest ever)

(Source: “The current state of emergency and rescue services”, Fire and Disaster Management Agency, Ministry of Internal Affairs and Communications)

3. Details of the emergency healthcare information network system

In April 2011, we deployed tablet devices in every ambulance in Saga prefecture and started up an information network system connecting these devices. This constituted the Saga prefecture emergency healthcare information system, which is called “99 Saga Net” (Figure 1).

In this system, ambulance crews are able to operate the tablet terminals inside their ambulances to obtain information that would previously have to be collected by phoning around multiple medical institutions.

Twice a day, in the morning and evening, the medical institutions use PCs or the like to enter information such as the availability of specialist doctors into the system. Using their tablet devices, the ambulance crews can access this information to find out what sort of medical specialists are available at each medical institution. Although it may be generally possible to ascertain the admission capabilities of medical institutions within an ambulance’s own service area, this system makes it possible for anyone to obtain information about medical institutions even outside the ambulance’s service area with a proficiency at least matching that of veteran ambulance crew members. (Figure 2)

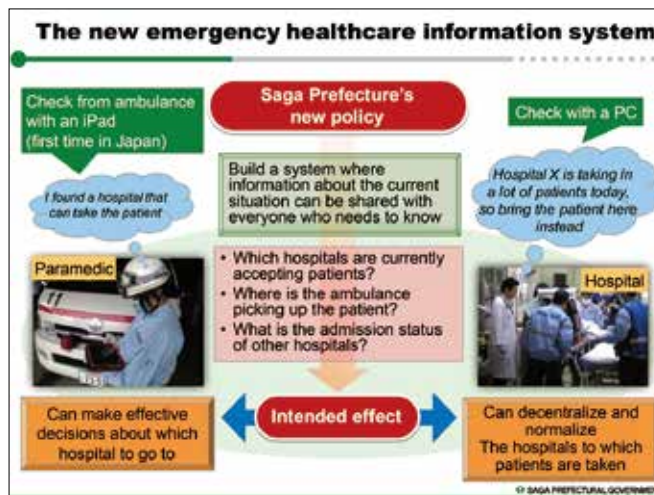
Also, each ambulance crew can use its tablet device to record details about the patients they have carried, such as the time of the journey, where the patient was taken, and the nature of their medical emergency. This allows them to check in real time on a map showing how many ambulances have been accepted by each medical institution, and how many have been turned away. (Figure 3, Figure 4)

In addition to this sort of specialized function for use by related individuals when transporting emergency patients, the system also provides services to local residents such as a “my home” registration service that allows them to search for medical institutions in their neighborhood.

4. Effects of introducing the system

Since they have hitherto not known about the circumstances of medical institutions, ambulance crews have spent a lot of time in unnecessary exchanges with these institutions. However, the use

Figure 1: Overview of the “99 Saga Net” system



of ICT has made it possible to share information such as which specialist doctors are available at which medical institutions, and how many ambulances each medical institution is able to accept, allowing both sides to understand the situation.

As a result, Saga prefecture was able to reduce its average ambulance transport times for the first time, while transport times continued to increase throughout the rest of Japan. It was also possible to spread around the ambulance destinations by allowing ambulance crews and medical institutions to check for concentrations of ambulance patients at particular medical institutions on the same screen.

It has also become possible to use the tablet devices to convey information that was previously communicated verbally, such as the patient’s condition, the amount of blood lost, or the circumstances of a traffic accident, allowing the ambulance crew to visually display the current situation to doctors. This is very useful for making the communication between ambulance crews and doctors go more smoothly.

Regarding issues related to the budget, we reconfigured the existing emergency healthcare information system that had not been used much, and we introduced a cloud service, through

Figure 2: Making the essential information accessible to anyone according to the situation out in the field.

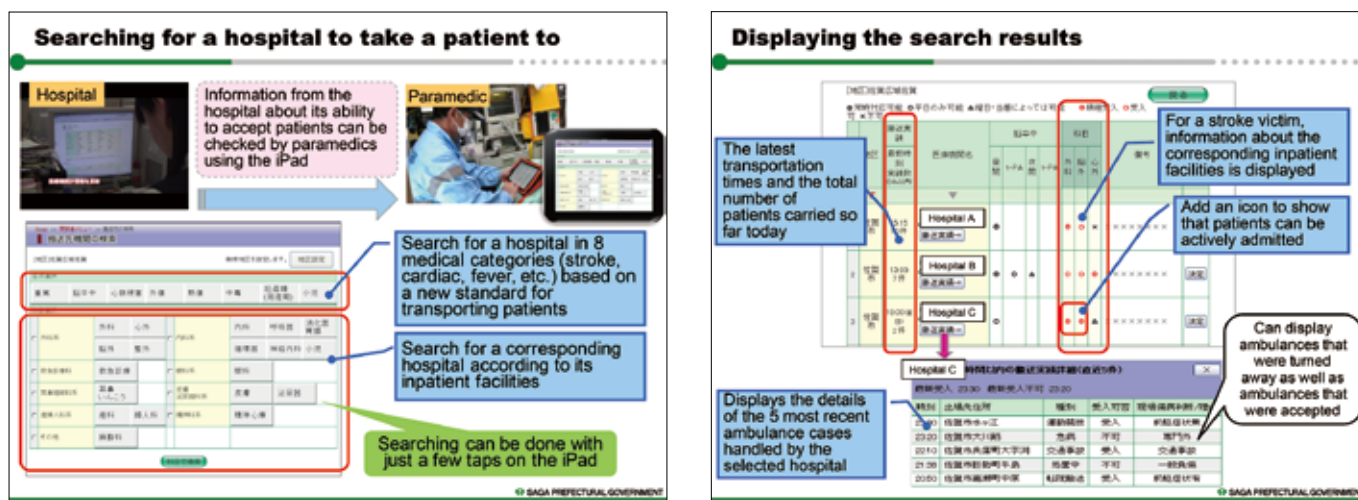


Figure 3: Ambulance transport records can be easily entered using touch operations

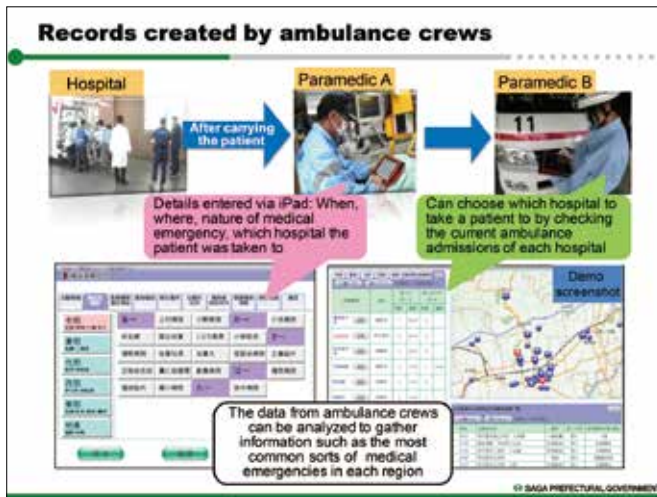
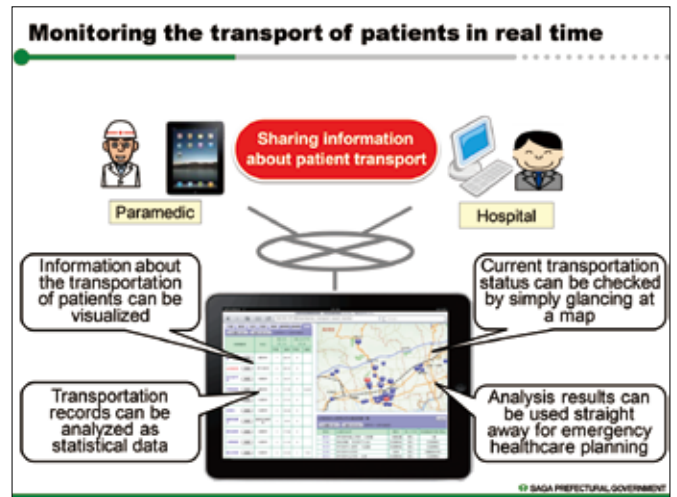


Figure 4: Ascertaining the current transportation situation at a glance by sharing transportation records



which we were able to reduce costs significantly. As a result, despite deploying tablet devices in a total of 50 ambulances, we were able to achieve a reduction in running costs of ¥40 million per year. (Appendix 2)

Also, by introducing a framework called MDM whereby it is possible to check on the status of tablet device applications and the like, we made it possible for ambulance crews to have some degree of freedom to install their own applications. Although it is of course necessary to give due consideration to the handling of personal information, the ambulance crews were also able to use applications by themselves in order to resolve issues when out in the field. We also saw a spread in the voluntary use of ICT in the field whereby ambulance crews searched for and used applications to help with their work. These included an application that searches for information about medicines, a translation application to help when transporting foreign patients, and a written communication application to facilitate communication with hard-of-hearing patients. There were also changes in the way ambulance crews worked.

Since we achieved definite results in Saga prefecture, we wanted to expand this use of ICT in emergency healthcare across the whole country, so we have been actively accepting lecture requests from other organizations and publishing media resources, to introduce and describe our work. This project has had a far-reaching impact, and not only won the 2012 MCPC Grand Prix Award but was also awarded the Advanced Governance Award for the best policy at a conference on advanced policy creation held by the National Governors' Association.

In the wake of these awards, Saga has been visited by over a hundred fact-finding groups from organizations such as local councils, regional bodies and medical associations.

Currently, the use of smart devices in ambulances is showing signs of spreading, and as of April 2015, devices for the use of ICT are now being issued as

standard equipment in all the ambulances of 10 prefectures. In Gunma and Saitama prefectures, they have even started cooperating by sharing information at the prefectural level across government boundaries.

5. Changing emergency healthcare through data visualization

In particular, since this system was first put into operation, we have collected diverse data related to emergency healthcare, and by analyzing this data, we have been able to visualize issues and aspects of the current situation that have not been apparent before.

Photos: An ambulance crew using a tablet device to find out where to take a patient



Document 2: The effects of the new emergency healthcare information network

(1) High rate of access to the system			
(Fire) 10,000 accesses	→	110,000 accesses	(11-fold increase)
(Medical) 25,000 accesses	→	200,000 accesses	(8-fold increase)
(Residents) 146,000 accesses	→	1,413,000 accesses	(10-fold increase)
(2) One-minute reduction of transportation times			
34.3 minutes	→	33.3 minutes	(* First 6 months after system's introduction)
(3) Decentralization of medical institutions selected as destinations			
2010: 32.7%	→	2011: 29.6%	(Percentage transported to critical care centers)
(4) Operating costs			
Approx. ¥67 million per year	→	approx. 27 million per year	(Including cost of cloud system and tablet devices)

For example, when we analyzed each stage of the time elapsed between a 119 emergency call and the arrival of the patient at hospital, we found that the time between the departure of the ambulance from the scene of the emergency and its arrival at the hospital varied greatly between districts. When this was analyzed in greater detail, we found that the medical institutions were biased towards urban locations, and that one of the challenges of emergency healthcare in Saga prefecture is the large number of cases where the arrival of patients at hospital is delayed in regions without local medical institutions.

Therefore, to improve the quality of emergency healthcare, we started operating an air ambulance in Saga prefecture in January 2014. By using ICT at the site of an emergency to analyze the data from each region, we created a system that supports visualization of the data of each issue and the sharing of this data with related individuals. We are also creating knowledge through a process of cooperative contributions. This has led to major improvements. When we used the air ambulance services of neighboring prefectures, the number of call-outs per year was about 40, but this has now increased to 388 call-outs per year, which has helped to save many lives.

Although there is unfortunately no magic bullet that can solve all of the problems currently facing emergency healthcare, I think we can gradually overcome these problems by creating environments and spaces where it is possible to cooperate with related individuals in the same region so we can find our own solutions.

6. Future prospects – wearable devices, medical treatment

The era of big data is going to bring further changes to the emergency healthcare field. People say that all innovations start to become obsolete from the moment they are made, so we should strive to continue innovating to keep up with the constant changes in the social environment. We will certainly try to do so in Saga prefecture.

Although we achieved a temporary reduction in our emergency transport times through the use of ICT, they started increasing again in the following year. I think this is partly due to the number of emergency patients increasing at a rate that outweighs the benefits of using ICT, and partly due to changes in the reasons why patients are transported by ambulance.

Due to Japan's ageing population, there has been a major shift from patients with external injuries to patients with internal illnesses. It is difficult for ambulance crews to care for such patients without their medical records. This is an unknown social issue that has not been experienced before in any Western developed nation, and since there is no model for us to follow, we have no choice but to figure out a solution for ourselves.

I think that ICT will be more useful than ever in helping us to adapt to these changes in emergency healthcare. Although it is of course important to guard against the leakage and misuse of information, I am concerned that emergency healthcare systems could be liable to collapse if ambulance crews and doctors are expected to carry on making on-the-spot decisions without all the necessary information.

I am still searching around in the hope of finding new forms

of medical care in the future.

Accidents and injuries cannot be predicted, but diseases have various indicators. These are things that people may not notice themselves, but it might be possible to detect them in advance by using wearable health management equipment or the like to monitor the patient's pulse rate, breathing rate, blood oxygen concentration and the like. We can visualize the signs of serious illness by combining information about the patient's current condition and prior medical records with medical information derived from big data. If, for example, we could predict that in a certain state of health we will have a heart attack in the next 48 hours with 80% probability, then we would be likely to visit a medical institution ourselves as soon as possible. If remedial steps can be taken before patients fall ill, then they may not require ambulances, and may also avoid the need for surgery and aftercare.

I believe that the utilization of diverse technologies and the cooperation/exchange of human resources across the boundaries between different fields and residential areas will result in beneficial changes to society. In the future, I hope to continue doing whatever I can to improve our future wellbeing.

7. Conclusion

Emergency healthcare in Saga prefecture starts with the observations of individual workers with no prior knowledge of the patient, but extends across the whole prefecture and is even showing signs of spreading across the whole country. We have also received many responses from people all over Japan via social networking services, and we have been told by paramedics and ambulance crew members that they are delighted with the attention that Saga prefecture's emergency healthcare system has been receiving as a result of this initiative. Following the introduction of ICT, we saw an increase in the number of full-time paramedics at each emergency healthcare center as well as an increase in the number of air ambulance operations as mentioned above, and in just four years the emergency healthcare environment in Saga prefecture has been gradually changing.

Perhaps the most important lesson we have learned from our experience in Saga prefecture is that there is no need to accept the status quo if you think there are things that should be changed. Just have a go by yourself and see where it takes you. If people working in the field come up with just one initiative for doing things in a better way, then it could result in the whole of society changing for the better. Rather than referencing specific success stories or businesses, local creation gives people a sense of ownership that encourages them to tackle social issues. But they need the right tools to do this. I think ICT is an effective tool for overcoming social issues.

Reference URLs

The Saga prefecture emergency healthcare information system ("99 Saga Net")
<http://www.qq.pref.saga.jp/>
"Using ICT to shape the future of emergency healthcare in Saga prefecture"
<http://youtu.be/pqK-wNFtgcQ>
"Starting a revolution to save lives – Yusuke Enjoji at TEDxFukuoka"
<http://youtu.be/PaboSgRcAjg>