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Japanese Healthcare Facilities in the Post Covid-19 Society

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Prologue

The spread of the new coronavirus (COVID-19) has changed daily life and caused many problems in medical and healthcare / welfare facilities [1]. Fortunately enough, during the weekend staying safely and quietly in my house located at the center of the Tokyo Mega city, where the Japanese government warns us not to go out except essential and urgent works, the author is convinced that our society will change very drastically after pandemic of COVID-19. According to an old saying; "Good chance will come at the worst occasion", it will be better to utilize this occasion to think and discuss on what kind of direction we will forward in order to cope with the changes inevitably caused by unfortunate COVID-19 pandemic.

It goes without saying that the spread of viruses is the result of effective traffic and transporting system of people and goods to the global scale which had been developed for these 100 years mainly in 20th century. The speed was very quick as it took only several months for taking over whole world.

The author started to think about the historical developing of architecture in terms of building and engineering as well as urban and rural environment. Because the phenomena of spreading COVID-19 seems to closely connect with these situations.

Building asset in our society

From "Dwellings" to "Facilities"

In old days most of the events during our daily life happened in and around our dwelling / homes. Eating in dining rooms, cooking in kitchens, working in house or outside field around the house, meeting with friends in guest rooms, reading on desks and chairs in living room, sleeping in bedrooms, washing in bath and WC rooms etc. Even funeral and wedding ceremonies were carried out in a large room in the house of ourselves or neighbor's affordable to do. However, currently these daily activities are carried out in specialized type buildings. We educate our children in school buildings, working in office buildings, eating in restaurants, libraries for reading, friends meet in tea/coffee shops, funeral in rental funeral hall wedding in city hotels or wedding ceremony company buildings. These are the result of pursuing effectiveness, economical and functional efficiency of our daily life.

General tendency of current society in urban area is that people is living their lives not only in dwellings but also in many other social and private facilities. Undoubtedly many people would like to get together in these specialized functional buildings [2]. This time Japanese government defined three risky situations of infection are staying in air-tight space, clouded space and in close human physical distance. Generally speaking, contemporary urban environment contains very difficult places to avoid the COVID-19 infection.

Places for the sick

Let's briefly review the history of place for the sick, because the present is the stump of the past and the entrance of the future. Historically everywhere in the world, when somebody get sick, he/she was resting in a bedroom cared by family members and, if necessary, medical doctors are asked to visit the patient. Medieval hospitals were the place of accommodating sick people who could not be cared for or cured in their own home. Dwellings are considered the first place of caring and curing [3].

Especially in the case of infected people, they were isolated in hospitals which were eventually converted from other existing private and public buildings, e.g. noble family's mansions, palaces and prisons. However, most of them died finally before their discharge because of poor provision of medical and nursing services as well as extremely deteriorated physical environment. In other words, the way of isolating people with doubtful to be infected is the only way at that time to protect their society from diseases.

Modern technologies

Medical and hygiene technology

The end of the 19th century and the early part of the 20th century saw the continued development of remarkable discoveries in science such as X-rays for medical diagnosis, the introduction of anesthesia. Particularly, related with infection control, discovery of various infectious bacteria and viruses, antibiotics to control tuberculosis and other similar diseases, sterilization techniques to eradicating infectious bacteria and protecting ourselves, e.g. simple "wash hands" procedure (Ignaz Semmelweiz,1818 ~ 1865), antiseptic method in surgeries (Lord Joseph Lister, 1827 ~ 1912), vaccination treatment (Edward Jenner, 174 ~ 1823) and bacteriology (Louis Pasteur, 1822 ~ 1895) and so forth [4].

That were all crucial to changing our understanding of the causes of sickness and disease and / or their treatment, all of which fueled the development of increasingly sophisticated western medical technologies up until now.

In the 19th century, various improvement of deteriorated urban environment had been in success, after experience of pandemic diseases in past. The concept of public health brought the various development of urban asset management including hygiene technologies, e.g. drinking water provision, sewage system etc. into the cities concentrated with congested roads and buildings. Thereafter due to the establishment of public health and the effective medical care that

made rapid progress in the latter half of the 20th century, we can enjoy happy days without the fear of infectious diseases which often thought the diseases in the past as long as unexpected pandemic occurs.

Hospital planning technology

The exponential development of technology progressed in the 20th century continues in the 21st century and is increasingly affecting our lives. One area in which advanced technology is seen as being fully utilized is modern hospital buildings. This stems from the administrative policy of "centralization". Specialized departments with new architectural requirements such as Diagnosis/Therapeutic (D/T) departments containing new functional units such as radiology departments, path-labs, operating theaters, and Supply / Logistic (S/L) department began to appear in hospitals. They functioned to improve the economic efficiency of sophisticated medical equipment and material handling to make full use of the scarce professional human resources such as physicians, nurses, radiologists, and clinical laboratory technicians, available to hospitals [5].

Hospital building and engineering technology

The "International Style" which appeared in the 20th century using glass, steel and reinforced concrete as building materials dominated hospital construction, as the building type was seen as more appealing on account of its functional utility. At the same time, the development of building-technologies has enabled us to work or stay in completely artificial environments for many hours each day. Such artificial environments were easily accepted into the new centralized departments of modern hospitals.

The centralization of hospital functions also created activity of the movement of people across departments during working hours. Inpatients had to walk long distances from their wards each day, while outpatients especially in Japan were forced to visit various D/T departments and wait in each such department for hours.

One target of hospital design in Japan at the end of 20th century has been the pursuit of compact building shape with reduced external wall-to-floor ratio, mainly because of saving construction and maintenance cost. The aim was also to shorten the walking distances [6] between relevant departments and to find more economical solutions to material handling. The tall buildings are common utilizing rapid vertical lift through a number of floors. As the result, modern hospitals do not look like so much like dwellings as much as petrochemical plants or car production factory buildings.

The compact building shapes are suited situations in Japan where ample site areas are not available. Anyway, the aim of designing the 20th century hospitals is the first priority is survival and longevity of patient life, ironically the hospitals became the places where patients were unable to dye easily, whether or not patients like to live longer with very severe physical/mental situation including his/her family and friends.

Patient accommodation area in terms of infection control

Nightingale ward for infection control

In the 19th century, Florence Nightingale made an effort to establish better environments for the sick by providing natural sunlight, outside fresh air and appropriate room temperature. As many bacteria and virus were discovered since the latter half of 19th centuries, she did not have scientific medical knowledge about cause of infection at the time. She tested and verified that the proximity of various wards was a key factor in the spread of disease and the rates of recovery and death. She proposed a pavilion-type hospital consisting of two-story-high "Nightingale Wards" and specified high ceiling heights, providing spacious air volume i.e. 40 cubic meters (2.4m width × 306m long × 4.8m height) to each bed, and the layout of wards with greater spacing on a large site.

This building type is what we now know as the Nightingale Hospital. This decentralized configuration of wards and buildings was the state-of-arts designing hospital at that time and disseminated across the world including in North America as the template for a typical hospital, which dominated the period beginning with Florence Nightingale's works in 1860 and ending with World War II (WW II) [7].

Patients' room

In the 19th century hospitals, 90% of the total floor space was occupied by wards. At present, outpatient, D/T, management, and S/L departments have been expanded, and the proportion of wards has reached only to 30-40% of the total floor area. However, environmental settings around beds are still the basis of hospital architectural design.

Looking historically at the patient rooms in Japan, before and just after WWII, wards consist of "big general rooms with bay corners" containing many beds inside. Then the number of beds in one room became mostly 6 at the maximum. Reflecting the opinion that each bed should have its own corner, 4 bed room became common. In order to solve the disadvantage that the environment around corridor side bed were worse than window side, the design policy of "multi-bed-room with private windows provided to each bed" appeared in Nishi-Kobe Medical Center in 1994 for the first time in Japan. Even now, various hospital rooms that utilize this idea are being designed and constructed.

One advantage of multi-bedrooms is said to allow patients sharing a room helping each other to facilitate nursing care and observation. Recently, however, cubicle curtains have always been drawn, and a multi-bed room looks like a kind of combined private rooms separated with curtain. For Japanese young generations who grew up in their own private rooms from an early age, ensuring privacy would be a matter to be considered. As a result of the policy to shorten hospitalization period, there was only short period now for interaction among patients in a room [8].

Single bed room

This time in Japan, it goes without saying that one of the risks of hospital based cross infections increased due to a lack of private (single-bed) rooms in hospitals. The advantages of a private room are not only infection control but also privacy protection, provision of a comfortable medical treatment environment, and improvement of convenience/healing environment and safety of medical and nursing activities.

Single room was designed in old days for high class inpatients. Up until now, private rooms are regarded as "luxury beds" which inpatients are required to pay extra money on the top of the ordinary room charge which is covered by Japanese National Insurance System. After the introduction of Care Insurance System in 2000, all private room design became a prerequisite to get the license/permission when

someone was going to build skilled nursing homes for the elderly in Japan. Comparably, medical architectural field is delayed in this issue and now this tendency is going to be flourishing [8].

Case study of all-single bed hospitals in Japan

St. Luke's International Hospital, Tokyo, reconstructed in 1992 in light of the US hospital design policy and constructed all private rooms wards for the first time in Japan. Ashikaga Red Cross Hospital equipped with 555 beds was relocated and rebuilt in 2011. Five years after opening the hospital, the hospital got the International Building award 2016 at the Congress of International Federation of Hospital Engineering (IFHE) held in the Netherlands. It is the first experience in the field of hospital design. It is also all single bed room is the first case among the Japanese Red Cross Hospital group.

In a super-aged society like Japan number of aging inpatients is growing. The need of hospitalization of increasing. Since any patient can be admitted if one bed is empty, the occupancy rate is 100% or more and the length of stay became shorter. The increased frequency of family visits making it easier to monitor inpatients leaving from bed and exercise in rehabilitation center.

Since the time of St. Luke's project, the ratio of these private bed eligible to ask extra charge was raised to 50% of total beds in hospitals. When the hospital income was calculated at the planning stage, it was found that the differential income could be supplemented by an increased charge of newly admitted hospitalized patients by 2-3 persons per day/per year. It is also proved to increase the turnover rate of the hospital bed, performing medical treatment without moving the bed to one room to the other, and shorten the hospital stay.

As the advantages of the private room are, above all, privacy, prevention of nosocomial infection, and ease and safety of medical and nursing activities, it will be worthwhile to consider designing all single hospital wards in Japanese hospital project. Actually, there has been several new public hospitals equipped with all private rooms without any requirement of paying extra room charge.

Discussion

Several key points of discussion were identified as above, the author would like to discuss with the readers about crucial items related to future Post COVID-19 Society.

Roles of hospitals/dwellings in regional healthcare planning

Centralization concept is seen inside each hospital but also in regional strategies of healthcare planning. First of all, hospital is one of the various healthcare facilities, e.g. local clinics, health center, halfway houses, nursing homes etc. The role of each hospital in one region is defined in the hierarchy of primary, secondary and tertiary depended on the grade of medical services each hospital can provide. This often means patients and families have to move great distance to access sophisticated medical services.

One wonders what has happened, in contemporary hospital system, to the primary purpose that ought to be the better serving of patients. This is exactly the same feeling when author visited to developing countries as a short-term consultant for WHO in the 1980s / 1990s [9]. It was found that the construction of a high-performance hospital to which concentrates medical functions and professional human resources, resulted in lowering the level of medical services in the surrounding area and influence healthcare economy in the entire region. For instance, most of these cases found that 90% physicians of the nation worked in a central hospital located in the capital city and serving only for 10% of total population. Patient families have to carry seriously ill patient to the central hospital taking for a week.

Success in emergence ambulance system involving local authority (fire brigades) is an exceptional case in Japanese medical provision system. Since the last decade of 20th century, regional health care planning has been in attention to support people with sick and aged through efficient use of limited resources.

Considering the social system available in the future, e.g. electrical patients record system, self-monitoring tools, etc. , while hospital beds are centralized as ICU beds for seriously ill/injured people, in the case of mild cases, his/her specimen are self-sampled in the bathroom/toilet while recovering in the bedroom of the house, and the specimen collected are transported to the hospital by courier, then the test results can be transformed to his/her mobile phone without any need of hospital visit. In this sense, dwellings will be more important places in medical service provision.

From "facilities" to "dwellings"

This time there are quite a number of persons who are not express any symptom of COVID-19. They are asked to stay in their own homes or move to city hotel bedroom under the observation of medical and nursing staff in order to reserved hospital beds for people in more serious cases. This imply that many buildings can be served as a part of medical function. that is, a return from facilities to dwelling. In fact, this time, it was important to observe the patient at home to prevent infection or care for people with mild infection.

In the urban context, compact building shape of hospital is favored in urban context with limited construction sites. And people seeking an efficient social daily life accepting such an arrangement. In order to accommodate a growing urban population, many housing complexes have been planned and even in these dwelling-type buildings, compact tall building shapes are adopted. Like contemporary hospital buildings these urban buildings have proven expensive to construct and operate and are vulnerable in disasters and difficult to alter with changing need.

There are many problems in local communities. One often occurring problems is the weakening of established human relationship, as a product, the inhabitants' ability or will to control their housing community is challenged [10]. The results often in the deterioration of the quality of the living environment. It follows that where people have little contact with neighbors the possibility of criminal activities is greater.

From now on it is a signal to put pay more attention to people's dwellings than facilities designed for specialized function, keeping in mind to have good neighboring atmosphere.

New type of ICU design

In quite a number of nations, the shortage of ICU beds accommodating COVID-19 serious cases is observed. Although in the condition of supplying enough private rooms in hospitals are common, in order to cope with the lack of beds in ICU, AAR (Acuity Adaptable Rooms), which allows almost all medical examinations/treatment can be carried out in a private room during hospitalization, will be one solution.

AAR concept has already become common in the United States.

Another good example is seen in patient bed arrangement in Kaiser Permanent Foundation system. All the private rooms with WC have a direct access door and direct observation window from nursing staff corridor (one staff desk is located every two rooms, and patients monitoring set in on the desk) on one side, and direct family communication window on the other side of nursing corridor. This arrangement with AAR will be ideal to keep good medical/nursing procedures as well as good communications with family/visitors even in the COVID-19 patients.

Further example is found in a prototype plastic capsule for patient care developed in New York by an architect, Willium N. Breger in 1970. "The module, which looked like space capsule and was influenced by the work being done at NASA, was designed for short-term intensive care. The self-propelled capsule ware to move about the hospital on a monorail track" [11]. He also said it will be an advantage to protect hospital cross infection

Supporting technologies in post COVID-19 society

As mentioned above, hospital function in the 21st century will be decentralized. Hospital beds must be centralized bearing ICU beds function, ordinary illnesses will be treated in the dwellings, where bed for resting, a bathroom / toilet for specimen collection etc. resulted in decreasing their hospital visit as an outpatient. Here is an era in which patients do not need to move but can be provided various care services.

The necessity and possibility of realization of ICT, IOT, and AI medical treatment that patients can obtain at home.

For future society sophisticated data sensor technology with AI will be one of the best technologies that contributes to decrease the chance of infection caused by direct contact to people in surroundings. In the case of essential contact with people is needed, e.g. home care staff to older people, it can be appropriately utilizing various ICT, IOT and AL technology. This situation will also cover the disadvantage of shortcoming of caring staff.

Renovation and innovation of existing building assets

Compared to the past cases, e.g. the famous Bubonic plague occurred in Crimea peninsula and Constantinople in 1346 spread in Mediterranean and Europe lasting for 7 years, COVID-19 influence will be diseased much shorter period, thanks to the modern medicine. Contemporary globalization still implies that the therapeutic and vaccination technology against COVID-19 will be invented and disseminated around the world in a short period of time. However, the protection of Infectious disease looks like similar, because they will come periodically again and again.

Fighting to COVID-19 reveals current weak characteristics of hospital centered medical services. Large centralized facilities become inefficient and costly. Networks of smaller facilities become more efficient and created the concept of rationalization. As it was clearly shown that there are differences in the way of spreading COVID-19 infection depending on the individual climate, customs, and culture of each nation / region. This rationalization will add a system permitting of human element which can be adapted more to the surrounding culture of areas/regions.

In this context, existing building resources will be one of the targets of solving the problem. In future, multi-purpose use of existing buildings will be considered, e.g." School buildings are not the only places for educational environments, while school buildings will not be limited to educational functions" and "Hospital buildings are not the only places for medical environments, while Hospital buildings will not be limited to medical functions."

Renovation/conversion of existing buildings become more important, e.g. as a successful example, a 19th century old opera house is converted into bookshop in Buenos Aires, utilizing huge volume of interior space. Flexible space inside buildings is the key to alternate of any functional buildings including hospital buildings.

Introducing building high technology, we should recall the fact that without enough consideration, artificial environment technologies were applied to areas used as healing places for patients. Instead of providing natural sunlight, fresh air circulation, and optimum room temperature as recommended by Florence Nightingale, artificial illumination, mechanical ventilation, and electrical heating and cooling systems were adopted. In the case of no mechanical air conditioning, if each bed has a window facing directly outside will be better solution to the environment of long-term patients with slight illness. Should the building be naturally ventilated and oriented to the prevailing breezes, because there is little need of sophisticated maintenance to preserve certain level of environment.

Generally speaking, Buildings in old days ware designed on the basis of "Style-ism". In the 20th century, of "Functional-ism", and in the 22nd century, of "Space-ism".

Epilogue

When specializing facilities such as hospitals were established for the first time, specialized function being owned by dwellings were disappeared, and the function is concentrated to the facilities. However, based on the experience of several decades of designing centralized hospitals, there exists some doubt about the trend of compact shapes in terms of operating expenses, difficulties in growth and change after operation and occupation, and vulnerability in natural disasters like fire and earthquakes as well as human originated disasters such as cross infection and hazards of radioactivity and medical gases.

At the same time improvement in medical equipment has provided some compact lightweight and inexpensive instruments that can sometimes be used by non-trained persons. One of the major advantages for centralization is already disappearing. Instead, informatics, patient records, ICT, IoT and AL technologies will be fully introduced. It is also following current tendency of medical services from impatient care to ambulatory care, then to community care and home care.

Japanese COVID-19 infection started on the cruise ship became a hot topic, and the ship was regarded as a villain. However the other day when the author had a chance to visited an US hospital ship with a total length of 272m, the author found it a truly moving hospital that is equipped with X-rays (4 rooms), CT, Angiology, 10 surgery operating rooms and can accommodate a total of 1000 beds including observation beds, ICU, and temporary beds. Sufficient infection control on board is a prerequisite, but it can be used to secure beds for the isolation of people with infectious diseases and also will be carrying people for inspecting COVID-19 infection during 2 weeks

cruising. The author also felt that it would definitely help rescue the coastal victims from the sea especially good for island country like Japan after the great earthquake on 11th March 2011. it is necessary to consider positively using hospital ships in the future, in other words, future hospital will be non-site-specific architecture not just as a machine of providing health services but having beautiful life in itself.

At the end, the author would like to quote the following suggestion in November 2001 by an architect late Mr. Shoji Hayashi, commented on 9.11 disaster in Manhattan, New York city. Because both Jet-plane and sky scraper are regarded as one of the top symbols of 20th century civilization. His warning is suite to consider current situation related to COVID-19 pandemic;

---This incident will be memorized clearly some day during 21st century as "an implication of the starting point of end of the 20th century civilization".---We 'd better to start right now to change the 20th century lifestyle which had been developed and completed for 100 years, looking for towards something like completely new life style of the 22nd century's utilizing this available 100 years of 21st century. This is our very heavy tasks to carrying out [12].

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