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**Review**

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## Chemiless Town and Town of Public Health (TOP) Projects based on Sustainable Health Science

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### Abstract

In modern society, people enjoy healthy and convenient life styles thanks to advanced technologies. On the other hand, rapid economic growth based on mass production, mass consumption and mass disposal has caused global environmental problems and health disorders originating in the environment. If humans continue their current life styles, future generations may be unable to enjoy the life that people do today. It is therefore crucial to establish a new science, Sustainable Health Science, improve the society focusing on future generations. The measurement to make the science practical is named as Environmental Preventive Medicine, in which the environment is improved so that possible adverse health effects will be prevented. This paper discusses the concept of sustainable health science and the education system required to achieve it. Finally, the future direction of sustainable health science and our projects named “Chemiless Town Project” and “Town of Public Health (TOP) Project” will be introduced from the viewpoint of town planning from the perspective of preventive medicine.

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《Key words》 Chemiless Town Project, Sustainable Health Science, Town of Public Health (TOP) Project, Environmental Preventive Medicine, future generations

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### I. Introduction

In the field of medical science, whereas the 20<sup>th</sup> century was considered the era of early diagnosis and treatment, the 21<sup>st</sup> century is expected to be the era of preventive medicine. The definition of preventive medicine is: “the branch of medical science concerned with the prevention of disease and with promotion of physical and mental health, through study of the etiology and epidemiology of disease proc-

esses”<sup>1)</sup>. There are three steps in preventive medicine. The first step is to inform people of diseases. The second is to let people know the risks they face, meaning their susceptibility to specific diseases. And the third step is to urge people at higher risk to take action to prevent the disease. Preventive medicine can be applied to life-style related diseases such as hypertension and diabetes, which means that once people know the risk, they take action and make a

personal effort, which eventually results in preventing the disease to some extent. However, there are diseases and sicknesses that cannot be prevented by one's own efforts.

Unlike acute poisoning by localized severe contamination of water, such as Minamata Disease<sup>2,3)</sup>, small amounts of chronic pollution of the multiple environmental contaminants cause sicknesses to a smaller population who are more susceptible than others. In such cases, society should take action to prevent diseases. Among the human population, children and fetuses are especially susceptible to environmental factors<sup>3~5)</sup>. Currently, governments and local municipalities typically take measures for environmental contamination assuming "a physically mature adult weighing 50kg". However, to prevent adverse effects on the health of children, the target population should be children who are at greater risk, not adults. Therefore, to protect susceptible people, society should recognize that environmental regulations should be based on possible health risks to children. To generate awareness of this concept in academia, medical science should seek to prevent possible adverse health effects on future generations. This is "Sustainable Health Science"<sup>3~5)</sup>.

In modern society, people enjoy healthy and convenient life styles thanks to advanced technologies, and especially in developed countries, there are very few people who do not benefit. On the other hand, rapid economic growth based on mass production, mass consumption and mass disposal has caused global environmental problems and health disorders originating in the environment<sup>6~9)</sup>. If humans continue their current life styles, future generations may be unable to enjoy the life that people do today. It is therefore crucial to study the relationship between the environment and

children's health<sup>3,10~12)</sup>, and to improve the environment to protect the health of children and future generations. This measurement, improving the environment and prevent possible adverse health effect is named as Environmental Preventive Medicine. Improving the environment requires not only the efforts of medical scientists; rather, several fields of science should gather and focus on the health of future generations. The importance of establishing sustainable health science has already been reported<sup>3,5)</sup>. This paper discusses the concept of sustainable health science and the education system required to achieve it. Finally, the future direction of sustainable health science and our ongoing projects named "Chemiless Town Project" and "Town of Public Health (TOP) Project" will be introduced from the viewpoint of town planning from the perspective of environmental preventive medicine.

## II. The concept of sustainable health science

Japan learnt an important lesson in recent history that localized severe contamination may cause serious environmental diseases in a large population, as exemplified by the case of "Minamata Disease"<sup>2,3,5)</sup>. In the process of economic development, adverse health effects caused by environmental contamination from industry affected few people initially; in fact, before the disease appeared in the human population, it was found in wildlife such as fish, cats and birds. However, both the local and national governments considered only the economic benefits from the industry and did not consider the small but important phenomena. The number of victims increased and the cause became clear, but still the national government tried to deny it to protect economic interests. Eventually, the area of contamination spread widely and when the national government fi-

nally admitted the cause, the number of victims had increased to several thousands. Yet even 50 years after the first victims were reported, the problem has not been resolved completely<sup>3, 5)</sup>.

It is most unfortunate that the first small phenomenon was ignored. If the “precautionary principle”<sup>13)</sup> had been adopted earlier, Minamata Disease perhaps would not have existed and the health of most people would have been protected. In studies on Minamata Disease<sup>2, 3)</sup>, it became clear that fetuses were especially susceptible to environmental contaminants. To protect the health of the fetus, the mother’s womb should be clean and safe<sup>3, 5)</sup>.

Environmental regulations for chemicals are currently based on the standard population of “a physically mature adult weighing 50 kg”. However, mature adults are generally at the strongest stage of their life. If the standard population on which chemical regulations are based consists of adults, the health of adolescents, children and fetuses may not be protected. The standard population when drawing up environmental regulations for chemicals should be the most susceptible population, namely fetuses<sup>3~5)</sup>. It is a fact that the proportion of children with allergies such as atopic dermatitis and asthma has increased rapidly in the past few decades<sup>14, 15)</sup>. Genetic profiles cannot have changed in just a few decades, so some environmental factors must have dramatically changed recently<sup>3, 5)</sup>.

Thus, whole the society should change the focus of public health from the current generation to future generations. A new science of sustainable health science should be applied to this problem<sup>3, 5)</sup>.

There are three key points in sustainable health science. First, the focus is on future generations. If the standard population for sci-

ence is people alive today, the health of fetuses or future generations may not be protected. Second, the “precautionary principle” should be applied<sup>13)</sup>. When a small problem appears, society should take action before the effect becomes obviously large. The third is that it should be a transdisciplinary science<sup>16)</sup>. To protect the health of future generations, it is necessary to make society as a whole healthy. To do this, many scientific fields in addition to medical science need to jointly consider the common concept of “for future generations”<sup>3, 5)</sup>.

In modern society, people are exposed to innumerable chemicals<sup>3, 4, 9, 17)</sup>, yet the health effects on humans of only a small percentage of whole chemicals are evaluated. In fact, almost nothing is known about the relationship between multiple chemical exposure and human health, especially the effects on children and fetuses<sup>3, 4, 10~12, 17)</sup>. Our previous studies revealed that fetuses are contaminated by multiple chemicals that are transferred through the umbilical cord from the mother<sup>3, 4, 17~19)</sup>. Most of the chemicals that are detected in the umbilical cords of newborn babies did not exist just 100 years ago, and there is no scientific evidence that the health risk of exposure to such mixtures of chemicals is negligibly small.

We have studied the health effects of environmental chemicals and have tried to find a fundamental solution<sup>3, 4, 17~19)</sup>. We have suggested that chemicals in the environment should be decreased to prevent possible adverse health effects<sup>3, 20~25)</sup>. Sustainable health science is a new science that aims to keep society healthy for future generations<sup>3, 5)</sup>.

### III. Education program for sustainable health science

Sustainable health science is not merely traditional preventive medicine or public health.

It is necessary to understand not only basic public health and preventive medicine, but also possible adverse health effects from the environment. To learn these topics, knowledge of past environmental problems and the current human environment, such as the air, soil and water pollution, is necessary. Furthermore, knowledge of the modern human surrounding environment such as dwellings and indoor air is needed when considering human health today because our surrounding environment has changed dramatically in recent years<sup>3, 5)</sup>.

To spread the concept of sustainable health science and protect the health of future generations, it is vital to educate young people and train leaders who understand the problems clearly, and to educate graduate students.

Intensive graduate course on sustainable health science have been run in Chiba University since 2008. This course consists of lectures such as basic public health, the history of the relationship between the environment and human health, a modern study of the interaction between human genes and the environment, the fetal origin of adult diseases, and a tour of Chemiless-Town<sup>26, 27)</sup>. The graduate students gather and discuss the current and future of the relationship between the environment and human health.

Additional specific subjects such as the health risks of environmental contamination, modern architecture, town planning focusing on human health, sociology, economics and environmental problems need to be included to make the course more practical.

#### **IV. Practical studies of sustainable health science using health examination for chemical exposure and Chemiless Town**

Since the health effects of environmental contamination are not easy to recognize, people

need to know their own contamination level to make them realize that every single person in the world is actually contaminated. People will then understand the real importance of sustainable health science<sup>3, 5)</sup>. To inform people, a chemical contamination check system using blood samples was developed<sup>3, 5)</sup>.

Also, a model of a sustainable health town, Chemiless Town<sup>26, 27)</sup>, was built in Chiba University and is used to make students understand and feel the possibility of future town planning based on public health<sup>3, 26, 27)</sup>.

##### **1. Chemical contamination health check system to understand human contamination from the environment**

In public health, it is very important that people know their own susceptibility to specific diseases. For example, to prevent life-style related diseases such as diabetes or hypertension<sup>3, 28, 29)</sup>, people undergo health examinations and they know their blood pressure, heart status, blood sugar level and so on. Without knowing their own data, people usually do not take action. Of course, even if they know their health status, many people will not change their lifestyle and often their health deteriorates as a result. Therefore, it is important that medical and co-medical staff intervene in the lives of high-risk people, and urge them to take action such as starting to do exercise or improving their diet.

In environmental preventive medicine, people need to know their own level of contamination by multiple chemicals to make them realize that all human beings are contaminated without exception<sup>3, 5)</sup>. However, at present there are no clinics or hospitals where people can go to receive such chemical contamination health checks. In Chemiless Town<sup>3, 26, 27)</sup>, there is a Clinic for Environmental Medicine, and people can undergo a chemical contamination health



**Fig. 1 Chemiless Town: An example of town planning for future generations based on the concept of sustainable health science.**

check by blood sampling.

In this system, PCBs are used as representative chemicals to show the concentration of persistent chemicals since many organic chlorinated chemicals and dioxins show strong correlation with PCBs<sup>3,30)</sup>. If the contamination level is high, lifestyle intervention is practiced such as advising the person to avoid eating fish guts and large species such as tuna and bonito. If the contamination level is extremely high, medications can be administered to decrease PCBs and dioxins<sup>3,21~25)</sup>.

## 2. Chemiless Town Project<sup>3,26,27)</sup>: An example of town planning for future generations based on the concept of environmental preventive medicine

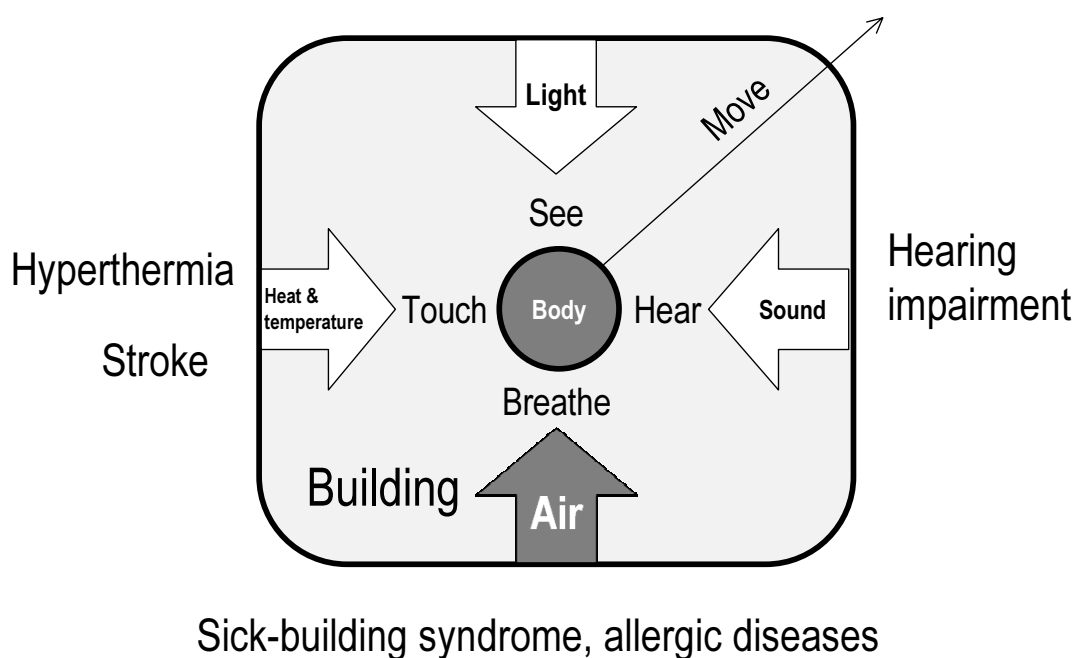
Chemiless Town is a model town of environmental preventive medicine in Chiba University Campus<sup>3,26,27,31)</sup>. The town has laboratory houses and buildings, which are built with materials

containing as few chemicals as possible aiming people would not diagnosed as “sick-building syndrome”<sup>3,26,27)</sup> (Figure 1). Sick-building syndrome includes symptoms such as headache, sore throat, and eye irritation caused by volatile organic compounds (VOCs)<sup>3,32)</sup>. Sick-building syndrome can be prevented if the level of VOCs in indoor air is low enough, but once a person is diagnosed, serious long-term health problems may result. The purpose of the Chemiless Town Project is to create a society in which people do not suffer from preventable sicknesses or diseases, and so the houses and buildings in the model town have been improved<sup>3,26,27)</sup>. The goal of the project is to spread the town throughout Japan as a practical example of environmental preventive medicine<sup>3,5,26,27)</sup>.

Today, we spend most of our daily lives inside buildings, such as our homes, schools, and

workplaces. On the other hand, a range of health hazards arise within buildings, including hyperthermia and stroke from dramatic change of temperature, hearing impairment by big sound or noise, “sick-building syndrome”, allergic diseases induced by VOCs and dusts, mites or pets’ hairs in indoor air exposed through breathing<sup>3, 26, 27</sup> (Figure 2). Ideally, a building acts as a shelter mitigating the effects of the elements outside. With advances in technology allowing us to control the indoor environment, it is now relatively easy to shut out or reduce health risks related to heat, light, and sound. In contrast, the cause of the “sick-building syndrome” is air, and because the sources of the pollution are wide-ranging, from building materials to household furniture and commodities, it is difficult to pinpoint the sources<sup>3, 5, 26, 27</sup>. To understand the seasonal changes in the concentrations of chemical substances within the atmosphere, we measure 4

times a year according to the seasonal change. Generally, the temperature and the humidity have a substantial effect on the volatility of chemical substances. During summer, as temperature and humidity rise, the volatility of chemical substances increases. During winter, on the other hand, the concentrations of chemical substances do not rise as much as during summer. With the addition of furniture and daily commodities after the completion of the building, moreover, the occupant is constantly and in many ways changing the state of the indoor atmosphere<sup>3, 5, 26, 27</sup>. In other words, the concentrations of chemical substances within a building are influenced by the seasons and how the building is used. Therefore, accurate assessment of the quality of air and planning of an environment with reduced chemical substances requires not only inspection and documentation at the time the construction of a building is completed, but also “recording and



**Fig. 2** Schema of environmental factors and human health disorders in house environment.

evaluation”

Chemiless Town<sup>3, 26, 27, 31)</sup> is used in the sustainable health science course of graduate program as an example of a practice of environmental preventive medicine. Students attend lectures in the town’s lecture room, and compare its air quality with that of other ordinarily constructed rooms. Students learn about the sick building syndrome and the importance of environmental preventive medicine<sup>3, 5)</sup> to maintain the health of present and future generations.

## V. Future direction of sustainable health science: “Town of Public Health (TOP) Project”

The original definition of “public health” is “the *science* and *art* of promoting health, preventing disease and prolonging life through organized efforts of society. The goal of public health is to transform research, education, and outreach into public health impact: to prevent disease, and to protect, restore and promote health, well-being, security and safety.” According to the definition and goal of public health, it is important to carry out strategic projects to solve the current health issues caused by environmental factors<sup>3, 5)</sup>.

We therefore propose a new form of town planning that focuses on both current and future generations, and call it the “TOP (Town of Public Health) Project”.

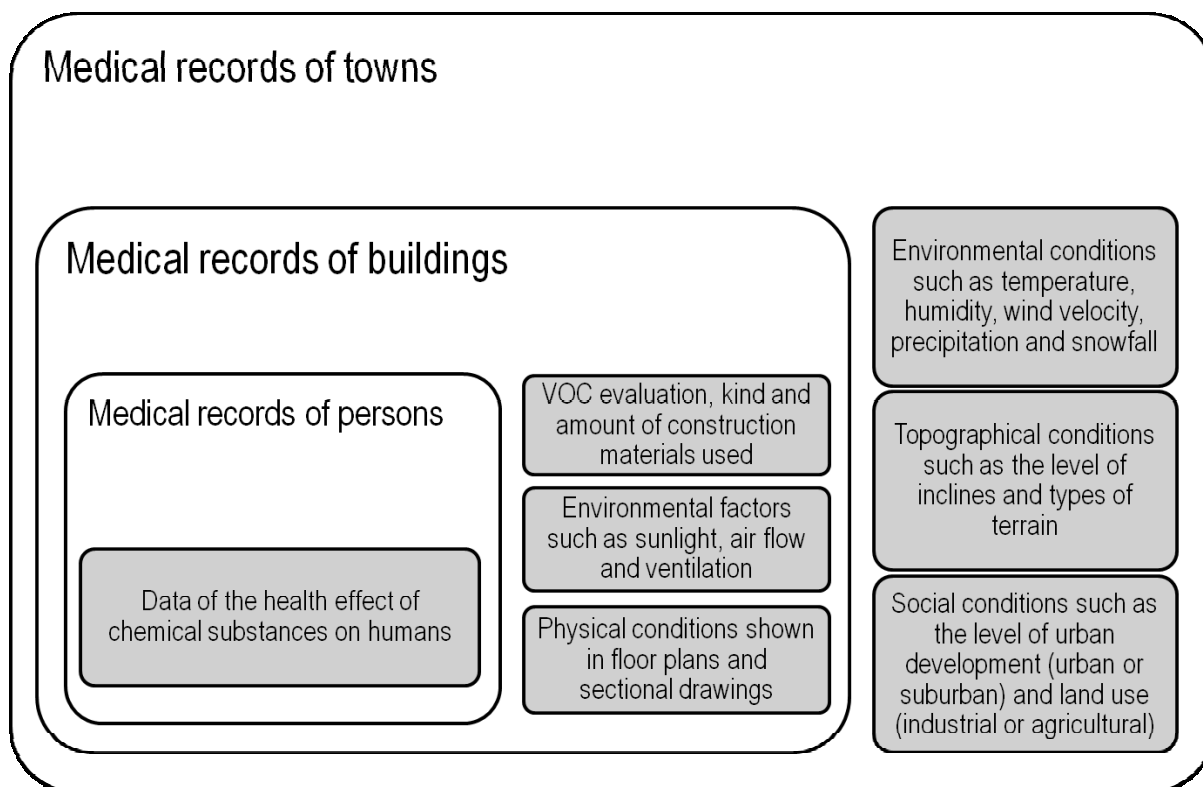
In TOP Project, we also propose preventive medicine in town planning by focusing on “recording and evaluation” using the “medical records” of persons, buildings, and towns (Figure 3). Japan’s Medical Practitioners Act, Article 24, obligates medical doctors to promptly “record” after diagnosing or treating a patient. With the team approach to medicine an indispensable part of today’s healthcare, the importance of medical records, as a means to

sharing basic information among team members in addressing a problem, is rising. Medical records also provide the basis for forming a comprehensive range of strategies, such as treatment and nursing strategies, following diagnosis or hospitalization.

In TOP Project, we substitute for the patient in the healthcare setting persons, buildings, and towns, and propose creating “medical records” for each as a way to introduce preventive medicine in urban planning. The medical records of an individual keep track of data on the effect of chemical substances on people’s health. The medical records of buildings contain data on the kind and amount of construction materials used in the building, evaluation of VOCs, environmental factors such as sunlight, air flow, and ventilation, and physical conditions shown in floor plans and sectional drawings. And the medical records of towns include regional environmental conditions such as temperature, humidity, wind velocity, precipitation and snowfall, topographical conditions such as the level of inclines and types of terrain and social conditions such as the level of urban development (urban or suburban) and land use (industrial or agricultural). By gaining perspective from all three medical records, we attempt to introduce preventive medicine at all levels, from people’s health to urban planning.

## VI. Conclusion

This paper introduced the concept of sustainable health science and our current activities on establishing an education system for environmental preventive medicine and sustainable health science. We hope that society will recognize the importance of forming a sustainable society for future generations. We also described new town planning based on the



**Fig. 3** Town planning by focusing on “recording and evaluation” using the “Medical records of persons”, “Medical records of buildings” and “Medical records of towns”.

concept of sustainable health science, called the TOP Project. Some of the activities such as the chemical contamination health check system and Chemiless Town Project have already started in the TOP Project.

In Japan, there are many old towns that are being abandoned and their populations are decreasing. On the other hand, there are many plans to create new towns. Furthermore, people today are becoming increasingly concerned about the future due to the destruction of the natural environment, environmental contamination, aging of society, increase of health problems, etc. When new towns are planned or old towns are planned to rebuild, the concept of sustainable health science and TOP Project should be considered. Towns will thus become more attractive because “health”

and “environment” are key words in the 21<sup>st</sup> century.

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