Development of a Three-Stage Public Observation Service System Model with Logics for Observation/Assessment

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Abstract. We considered appropriate frameworks and functions for the public observation service system and created a 3-stage model for it with logics for observation to ensure the quality of required functions by reducing unintended omission and unevenness due to human characteristics. The study method and tool were used for all children belonging to an elementary school in X district. The public observation support service system based on the 3-stage model with a logic for observation, may facilitate the logical and efficient identification of problems, management of cause analysis results, and reasonable promotion of liaison among those involved in personalized support. This system to support the observation of children's growth and development provides a basis for creating a value of co-creation. This study provided a basis for maximizing the value of co-creation in public services, aiming to nurture human resources for the future.

Keywords: public service, observation service, system framework, problem solving, three-stage logic for observation

1 Introduction

When residents recognize their own need for support, they seek public/private support resources, and adopt actions to access them. However, if their abilities to: 1) recognize, 2) demand, 3) seek, 4) and obtain necessary support are insufficient, their conditions may deteriorate, and become serious, resulting in the development of social problems. In order to address this, it is necessary for local governments to provide 'observation services', through which they previously assess communities, households, and residents with an increased risk of such situations, and prevent it from further increasing while observing changes in negative factors.

Traditionally, in both urban and rural areas of Japan, systems that enable residents to participate, perform activities, and lead their daily lives in their communities had been established by the mechanism of 'mutual help and assistance'. However, with economic development, interpersonal relationships in households and communities have become poor, consequently weakening such a mechanism, and interfering with

the identification of residents requiring help and provision of support for them throughout Japan. This has brought unexpected results, such as 'lonely death', abuse, and crimes.

Under these circumstances, observation services provided by local governments may be crucial. Such services should aim to predict and prevent safety and other risks by observing the statuses of residents and communities. They should also be provided while sufficiently considering issues, such as the population and area of each community, service users and the diversity of their problems, and the cost performance of using public resources. Their provision as public services is difficult, unless systems to provide them with fairness, logicality, and efficiency are established.

2 Purpose

This study aims to consider appropriate frameworks and functions for the public observation service system; and create a 3-stage model for it with logics for observation to ensure the quality of such functions by reducing unintended omission and unevenness due to human characteristics.

We investigate a problem to be resolved for public service from the viewpoint of service science.

3 Target setting and procedure

A research project was performed, involving elementary school children as community residents whose abilities to: 1) recognize, 2) demand, 3) seek, 4) and obtain necessary support are insufficient, and appropriate systems to observe their growth and development were considered through collaboration with a local government (the Section of Educational Affairs and Board of Education), a medical association, and the Department of Pediatrics of a university hospital located in a district of the Tokyo Metropolitan area. The study procedure was implemented in 5 steps:

   Step 1: conducting a status survey on elementary school children's growth, and identifying related challenges from a medical viewpoint (short stature);
   Step 2: conducting a status survey on activities to support elementary school children's growth and development, and identifying related challenges;
   Step 3: designing a framework for the observation support system;
   Step 4: designing a 3-stage model with logics for observation to be used in public and private spaces; and
   Step 5: using it as a system to support the observation of elementary school children's growth and development

   We obtained agreement for this study from the board of education and medical association of District X, Pediatrics Laboratory in the Jikei University School of Medicine and Tsuru Laboratory in the University of Tokyo. District X has about 50

public elementary schools, and the living standard of this district is considered approximately the same as the national standard. The ethics committee of the Jikei University School of Medicine approved the study, and children's health data were anonymized. We are continuing this study from 2014.

4   Design and Development

4.1. A status survey on elementary school children's growth, and identifying related challenges from a medical viewpoint (short stature)

Health problems in children should be identified and treated promptly so that the condition does not hinder their development. In elementary school, school nurses are responsible for health management among the children. Growth disorder is an important health problem that should be detected by school nurses. Cotterill et al. show that body measurement made by them would be sufficiently reliable for screening of growth disorder [1]. The two symptoms of this are short stature and growth failure. Short stature is defined as a height value that is 2 standard deviations (SD) below the mean for age. In contrast, growth failure is difficult to define [2], and hence, various studies have defined it differently. For example, Jonathan [3] defined it as growth deceleration (falling across major percentiles on the growth curve). Growth disorder has many different causes [4], and therefore, it is not only a symptom of another disease, but also an environmental condition [5,6,7,8,9]. Furthermore, growth disorder may cause another problem. For example, younger and shorter children tend to be bullied in the classroom [10]. Hence, a focus on the height of the children may facilitate the detection and prevention of various health and social problems.

   However, each school has only one school nurse. The nurse's skills have to spread over several tasks that have to be done each day: treating children's injuries, investigating school hygiene, providing health guidance, and ensuring the children's mental health care. At present, they are unable to always detect children's health problems such as growth disorder because of a lack of knowledge, intuition, and time. In addition to early detection, early treatment is also important [11,12]. However, information available to the school nurse is not sufficient; accordingly, players involved in the children's health care such as their homes, schools, and hospitals have to share information. Cooperation between school nurses and these players will enable the analysis of the problems children have and the provision of appropriate treatment [13].

   Growth disorder is an important problem in child health. School nurses are responsible for child health management in elementary schools; although this task is important, it is also difficult. We aimed to develop a support system for school nurses performing this task [14]. First, we focused on the screening process for growth disorders, and developed a method to identify these conditions regardless of the differences of in their ability, by using height data of approximately 400 students from the fourth to sixth grades in elementary school. Second, we evaluated the

process of examining the condition in each child after screening. Finally, we developed a supporting tool that school nurses can use, in practice. This system could help school nurses in managing children health.

The information required to analyze the problem is dispersed among various players, so cooperation of the players is required. In this study, we developed a method where school nurses gather information about children, analyze it, and determine the appropriate intervention.

First, we designed the following narrowing process so that school nurses can analyze problems efficiently and effectively.

・Primary narrowing: They gather information such as medical history and allergies from medical checkups.

・Secondary narrowing: They ask homeroom teachers questions not only about health but also about lifestyle, home environment, and friendship.

・Tertiary narrowing: They ask people at home detailed questions to obtain information that could not be obtained in the previous phases.

4.2.   A status survey on activities to support elementary school children's growth and development, and identifying related challenges

Elementary school days are the most important period of children's growth process. Delays in the identification of growth-related problems may lead to the occurrence of intellectual, mental, or physical impairments. As children's self-care abilities are limited, it is necessary to mainly manage their health in their households, but the management capacity varies among households. Therefore, educational institutions play an important role in identifying growth-related problems in the early stages. In Japanese elementary schools, health examinations for all students are conducted 3 times annually, and data, such as somatometric values, necessary for screening are stored as records. In recent years, approximately 80% of all public schools throughout Japan have adopted the school affairs support system to manage information necessary to operate schools, including health-related data such as somatometric records. This facilitates the comprehensive management of all data regarding school activities, such as student lists, class attendance-related information, learning achievements, and events, in a single system. Using the system, it is possible to manage the results of health examinations at school, mainly somatometric records, as electronic data.

We examined the statuses of use of the school affairs support system and related data entry in a district of the Tokyo Metropolitan area. The system was initially adopted in all public elementary and junior high schools in FY 2011. However, the rate of entering health examination results, such as heights and weights, varied among schools, showing a mean of approximately 60%. Problematic issues, such as the situation in which the Board of Education had adopted a similar system, but they were unable to manage the status of data entry, were also revealed.

Furthermore, analytical support systems with algorithms to identify problems, represented by growth disorder, underweight, and obesity, incorporated were

unavailable, necessitating the school nurse at each school to perform this procedure manually, without sufficient quality. Thus, although a data management system was available, data entry was arbitrary, and the use of entered data was difficult. We noted this as an operational problem, and recognized the necessity of making data entry obligatory and offering data analysis support systems.

4.3. Design of a framework for the observation support system

This system consists of core, support, and management systems (Fig.1). Core system is processes associated directly with health management service from problem detection to daily observation. There are processes of problem detection, cause analysis, improvement activity, and daily observation in Core system. Support system including necessities for the core system such as human resources, tools, information technology and so on. Management system is a section for overall grasp and management. Core system is observation service support system.
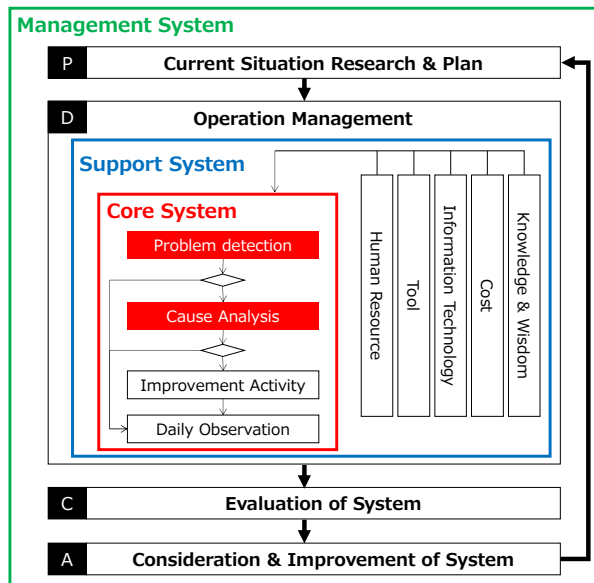
Fig. 1. Framework of the Public observation services System

Public observation services provided by the core system are expected to address the following challenges: 1) covering the entire population and area of each community; 2) considering the diversity of problems faced by targets; 3) using public resources efficiently; and 4) ensuring the appropriates of activities in both public and private spaces. Thus, the system should be designed with the following functions: 1) screening to process extensive data, and identify problems within a short time; 2) navigating to efficiently collect information needed to clarify the cause of each

problem; 3) selecting optimal intervention methods and observers to resolve each challenge; and 4) promoting liaison with observers.

4.4 Design of a three-stage model with logics for observation to be used in public and private spaces

In the observation system for services provided by local governments, observation targets are extracted through three-stages. Each stage is designed with a combination of functions related to 'data and information used' and 'narrowing down' (Fig.2).

In the first stage, targets with an increased risk are identified using data representing the statuses of communities and residents of the district. The reasonable management of extensive data and persons to extract problematic cases is an important viewpoint for this process. At this point, it is necessary to: 1) incorporate a reasonable logic to process extensive data within a short time; and 2) establish a system to provide support in accordance with each target's condition.

In the second stage, necessary information is collected from people around targets extracted through the first stage process to perform cause analysis. It is possible to efficiently perform such analysis by designing a process that navigates observers' thought process to extract important information.

Lastly, in the third stage, information is collected from people close to targets in consideration of their problems identified to determine optimal intervention methods and observers, in order to start problem-solving activities.

Thus, the observation system for services provided by local governments is a model consisting of three-stages: 1) identifying problems: the process of extracting targets, 2) analyzing causes: the process of examining targets, and 3) promoting liaison and starting intervention for targets.

Standard items needed for judgment in each stage are clarified, and their values are determined in consideration of the local situation. Logics for observation are developed through this process.

The logic for observation in each stage is expressed as follows:

    a)First stage

        If $X1<a1$ then inapplicable in first stage and not observe

        If $a1<X1<b1$ then applicable and observe in first stage

        If $b1<X1$ then inapplicable in first stage and transit to second stage

    b)Second stage

        If $X2<a2$ then inapplicable in second stage and transit to first stage

        If $a2<X2<b2$ then applicable and observe in second stage

        If $b2<X2$ then inapplicable in second stage and transit to third stage

    c)Third stage

        If $X3<a3$ then inapplicable in third stage and transit to second stage

        If $a3<X3<b3$ then applicable and observe in third stage

        If $b3<X3$ then choice of applicable intervention and provision it
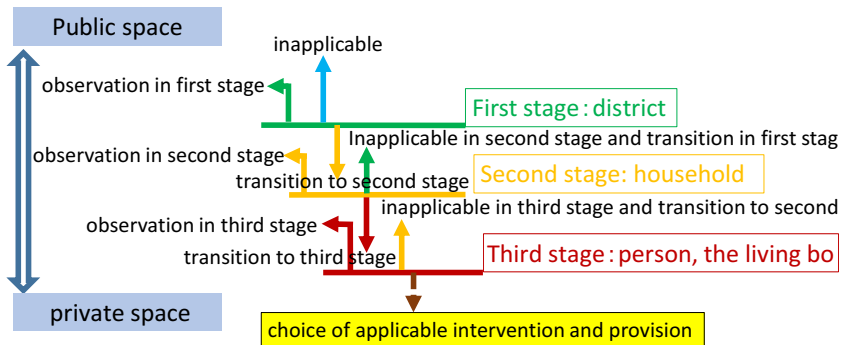
Fig. 2. A model consisting of three-stages

4.5. Use of the model as a system to support the observation of elementary school children's growth and development

We used the system model to elementary school, designed detail.

Core system has processes of problem detection, cause analysis, improvement activity, and daily observation for healthy child growth management. We took advantage of body measurement data from school health examinations to detect "growth problems" efficiently. The methodology for judging the presence or absence of abnormality was developed using indexes of height and weight.

"Growth problem" refers to not only defects that have already occurred but also every matter in need of some action considering both present and future. Therefore, "action" requires regional support such as improvement of lifestyle or living environment.

Next, a "cause" has to be specified in order to solve any problems. This includes not only direct but also indirect factors. We should clarify the relationship between a "growth problem" and its "cause" and decide what kind of intervention is needed. Therefore, we developed follows.

- visualization of process flowchart
- development of problem detecting Logic
- development of a support tool
- design of database structure for cause analysis

The state of children's growth is classified into "normally," "observation," and "cause analysis" through a combination of physical findings based on height and weight. The children classified into "normally" and "observation" transfer to the phase of observation. However, the management levels of the two are different. The

observers should watch the latter carefully. On the other hand, the other children shift to the "cause analysis" phase (Fig.3).
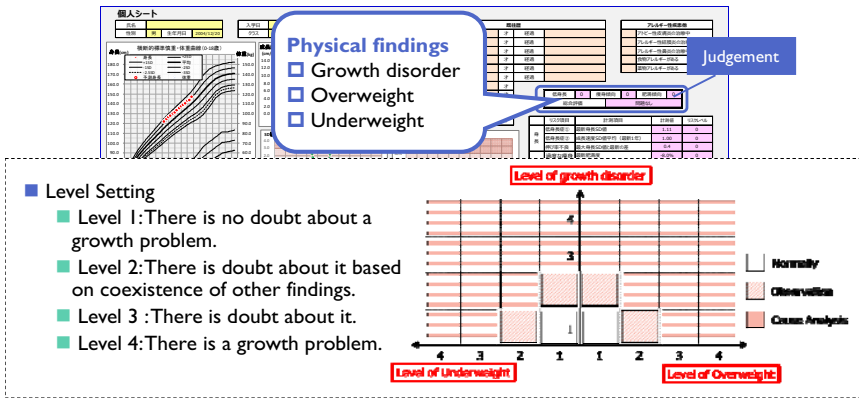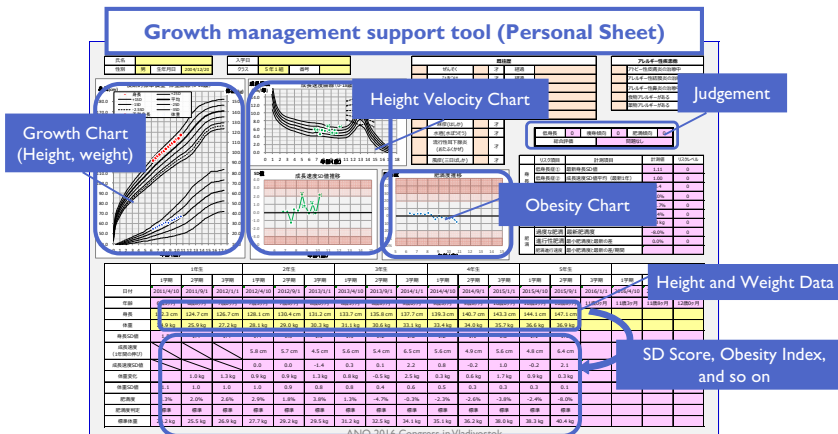

Fig. 3. Comprehensive Judgement

Fig. 4. The personal data sheet in support tool for growth management

We developed a support tool that can utilize the body measurement data efficiently and effectively and extract information necessary to analyze the growth problem [15]. This support is mainly for early detection, since the tool can calculate the SD score and obesity index and plot the growth curves of all children based on the data input into the school job support system. It can thereby diagnose growth problems automatically, using the previously mentioned rule. Height and weight data and the

growth chart for each child are output in a single sheet. When a child is suspected to have a growth disorder, the tool outputs a danger signal. Aside from the personal data sheet, this tool has functions to visualize the distribution of all school data and to search optional children in a collective data sheet (Fig.4).

As shown below, the processes of analyzing causes for children identified as those with problems are classified into 3 stages: 1) the process can be performed only by school nurses or other persons in charge of health management; 2) the process includes interviews with homeroom teachers to collect information related to the children; and 3) the process requires access to the children's households to collect further information.

Through these processes, optimal intervention methods to clarify the causes and improve the situation are determined. Such interventions address: lifestyle-related factors by improving diets, exercise habits, and sleep; environmental factors by improving school and home environments; and disorder-related factors by promoting consultation in medical institutions. When it is difficult to clarify the causes, the children are classified into: those requiring consultation in medical institutions; those requiring course observation; and those without problems, based on their physical findings (Fig.5).
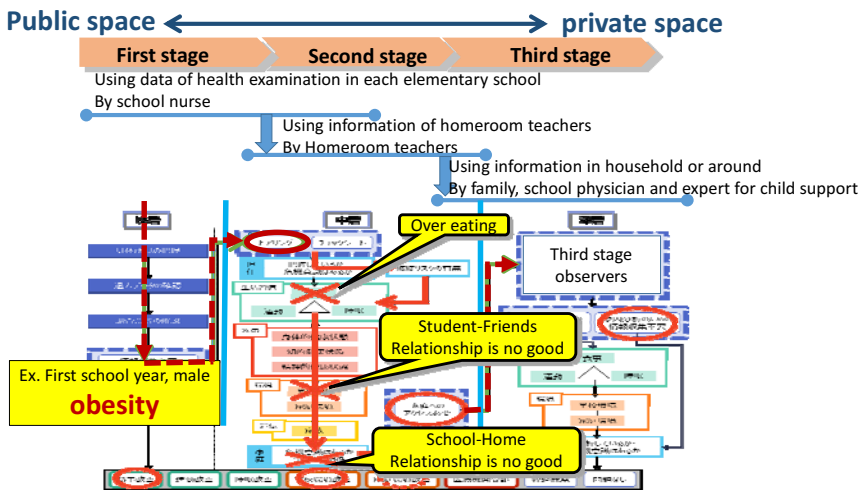

Fig. 5. Process of three stages in an elementary school children

5. Trial use of the study method

The study method and tool were used for all children belonging to an elementary school in X district. Their logical validity and usefulness were examined as follows:

The use of the tool we developed to identify problems made the creation of personal sheets and diagnosis for nearly 650 children within approximately 2 hours (approximately 10 seconds per person) feasible. It was confirmed that automatic diagnosis provided by the tool facilitates screening within such a short time frame. Based on their diagnostic results, less than 10% of children were shifted to the cause analysis unit.

Cause analyses were performed for the target children. Excluding those for whom data entry was clearly erroneous and those with whom interviews were not possible due to moving out of the district, 29 were managed through the second stage process. During this process, an interview with the homeroom teacher of each child was conducted, and the relevant cause analysis was completed. In all cases, in which the necessity of the third stage process and the causes of problems were clarified, actions to be adopted for improvement were advised.

Based on these results, interviews with the principle of the elementary school and medical association in the district were also conducted to examine the feasibility of the study system.

5.1. Logical validity and usefulness of the study method/tool

Originally, when specialists diagnose children, it is necessary for them to examine growth curves by calculating SDs and obesity levels based on data, such as the height and weight. In the present pilot study, diagnosis was performed by a specialist using the growth management tool to automatically create growth curves. The use of the tool was suggested to shorten the time needed to diagnose each child, which is generally estimated at 1 and a half minutes even for specialists, by approximately 90%. The specialist agreed with automatic judgment results based on the study logic. Furthermore, cause analyses revealed sex differences in the causes among children showing a tendency toward obesity, and this was consistent with the specialist's experience. Thus, the study method and tool were shown to have a sufficient logical validity and usefulness.

5.2. Feasibility

The study method and tool were also regarded as useful by the principle of the elementary school. On the other hand, as the necessity of an operational model and supporters was noted, we designed a navigation system to examine homeroom teachers' thought process, and collect information. The chairman of the Committee of Pediatrics of the local medical association also favorably evaluated the study method/tool, and recommended their use on a community-wide basis. By sharing data obtained using this growth management support tool with school doctors, it may also be possible to obtain support from doctors. The Section of Educational Affairs of X district made health examination data entry obligatory for elementary schools, and ensured a budget for past data entry. These outcomes also support the feasibility of the study method.

6   Discussion

6.1. Advantages of this system as a service system

Interactions between teachers as professionals and students are important to strengthen the value of co-creation in education services. In the case of children, it is necessary to provide education services while supporting their growth and development. This system to support the observation of children's growth and development provides a basis for creating a value of co-creation.

The system has 3 advantages: 1) logically and efficiently identifying children with health problems; 2) logically and efficiently supporting teachers who analyze the causes of such problems from the perspectives of daily life, diseases, and environments; and 3) providing players in charge of problem-solving intervention with information regarding corresponding children's developmental histories and the results of analysis. Advantage 1) reduces human errors related to judgment by shortening the time needed for screening and processing, with multiple logics for medical and epidemiological judgment; 2) reduces the energy and time needed for thoughts, as the system is designed to guide thoughts toward the clarification of causes through a process based on medical interviews; and 3) facilitates the efficient and effective use of the obtained information.

6.2. Remaining issues of the proposed system

The system may improve the quality of education services by: identifying problems related to children's growth and development; logically and efficiently supporting the process of analyzing the causes; creating time for players involved with education services; and reducing the energy needed for thoughts. It is also suggested to provide children without such problems with an enhanced value of co-creation. On the other hand, as a future perspective, it is necessary to design appropriate intervention for those with growth- and development-related problems, and develop functions to sup-port the efficient and effective implementation of such intervention. These approaches will facilitate the realization of a PDCA cycle that covers all children.

6.3. Challenging points and/or contribution of this study as service research

The present study provided a basis for maximizing the value of co-creation in public services, aiming to nurture human resources for the future. It also provided useful findings on the development of methodologies to ensure logicality necessary for the classification service users, as well as those for the efficient typification of individual cases.

6.4. Problem to be resolved for public service from the viewpoint of service science

As the majority of public services are provided by local governments, their quality depends on such governments' organizational abilities, and consequently varies among districts. Therefore, it is necessary to improve the quality of public services by visualizing them and organizing them as logics, while streamlining the process of providing them.

7   Conclusion

The public observation support service system based on the 3-stage model with a logic for observation, may facilitate the logical and efficient identification of problems, management of cause analysis results, and reasonable promotion of liaison among those involved in personalized support. As a future perspective, the system will be further used for elementary school children while developing such systems for other community residents.

Ackowledgement

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