

Development of Child-Teen Obesity Treatment Service Platform

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Objectives: This study aimed to develop an effective and efficient obesity treatment and management service platform for obese children/teenagers. **Methods:** The integrated smart platform was planned and established through cooperation with service providers such as hospitals and public health centers, obese children/teenagers who constitute the service's user base, and IT development and policy institutions and companies focusing on child-teen obesity management and treatment. **Results:** Based on guidelines on intervention strategies to manage child-teen obesity, we developed two patient/parent mobile applications, one web-monitoring service for medical staff, one mobile application for food-craving endurance, and one mobile application for medical examinations. **Conclusions:** The establishment of the integrated service platform was successfully completed; however, this study was restrictively to the hospital where the pilot program took place. The effectiveness of the proposed platform will be verified in the future in tests involving other organizations.

Keywords: Obesity, Pediatric Obesity, Delivery of Health Care, Mobile Applications, User-Computer Interface

I. Introduction

A considerable amount of attention has been directed toward health management issues, specifically in relation to the concepts of well-being, wellness and healthcare [1]. Despite these efforts, however, the child-teen obesity rate is persistently increasing. According to a 2015 survey by the Ministry of Health and Welfare, one of every five children/teenag-

ers under 19 years of age is obese, and this ratio has been increasing for the past 5 years [2]. Child-teen obesity causes various other physical and psychological issues throughout one's life, such as dyslipidemia, hypertension, cardiovascular disease, asthma, eating disorders, metabolic syndrome, depression, isolation and low self-esteem. Furthermore, the treatment cost for obesity has jumped by 82.9%, implying an expense of US \$117,349,702 to society as a whole [3]. For these reasons, we should no longer neglect the seriousness of child-teen Obesity and should strive to address this issue with guidance from the government or from social institutions [4,5].

Following recent improvements in network environments and the popularization of smartphones, mobile healthcare services are becoming popular [6-8]. Various mobile healthcare services have already been introduced in Korea. In line with this trend, integrated mobile services are becoming a new issue to increase the convenience of their users [6,8]. However, many potential services remain unrealized due to a lack of cooperation between governments, medical staff, dieticians, sports therapists and ICT (information and

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communication technology) developers. Government-led projects also result in unsatisfactory outcomes not only due

to the scale but to the lack of cooperation as well. For these reasons, establishing an integrated service platform is very

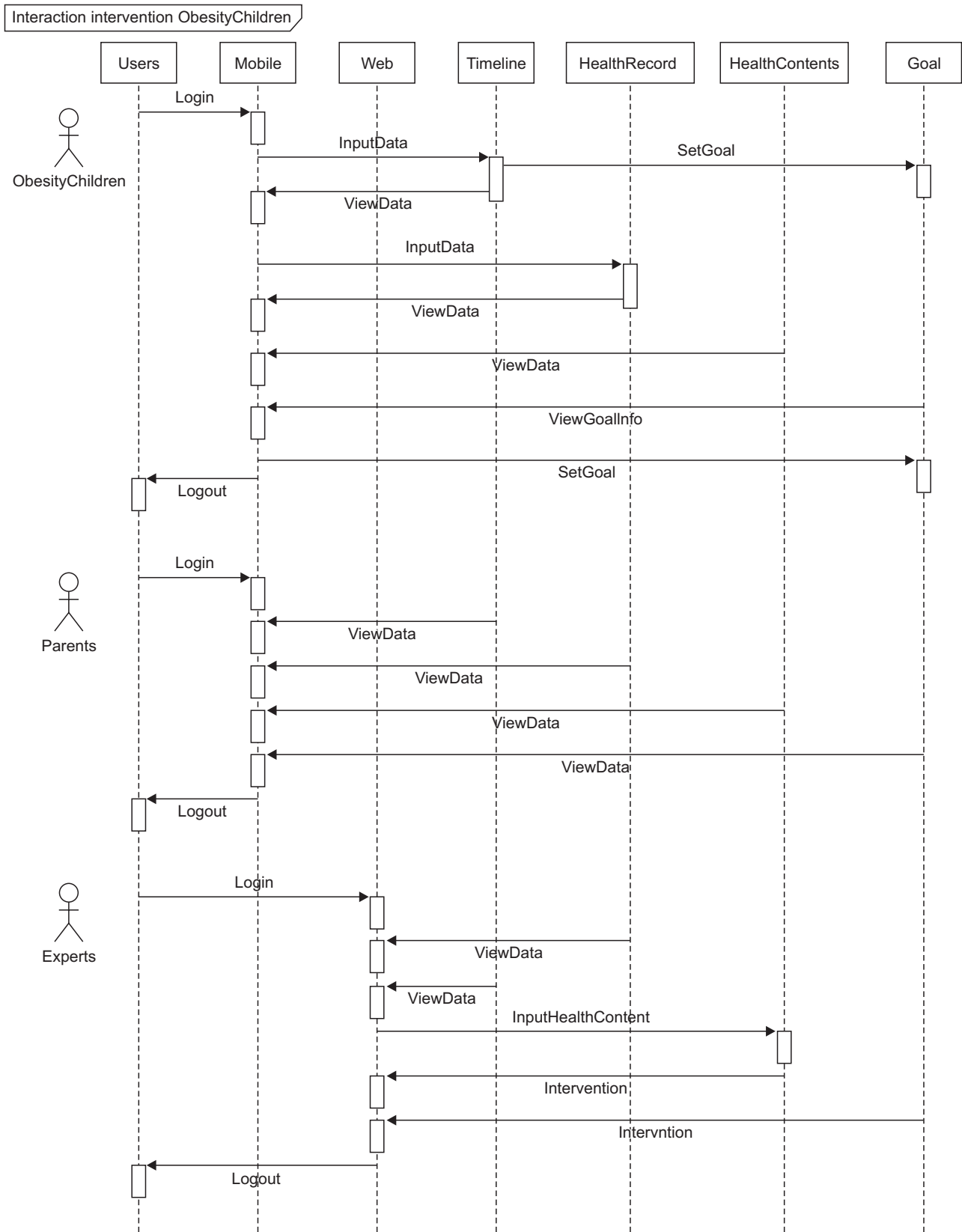


Figure 1. Diagram of the service platform for child-teen obesity treatment and management.

important and is the goal of this research.

The aim of this study is to establish a more effective and efficient mobile service platform for the treatment and management of child-teen obesity by combining ICT technologies into a medical service. Research was conducted with cooperation between companies and institutions in various fields, with participants including policy institutions, clinics, general hospitals, public health centers, sports facilities, training centers, local centers, ICT planning companies, and companies involved in IT development. This service is currently being piloted at a certain general hospital located in Seoul, while more extensive applications to various teenager training programs and local health centers are planned for the future [9,10].

II. Case Description

1. Scope of Research and Development

This service is based on an integrated smart platform pro-

viding content and services that are planned and established through cooperation with service providers such as hospitals



Figure 2. Mobile 5-minute appetite endurance service.

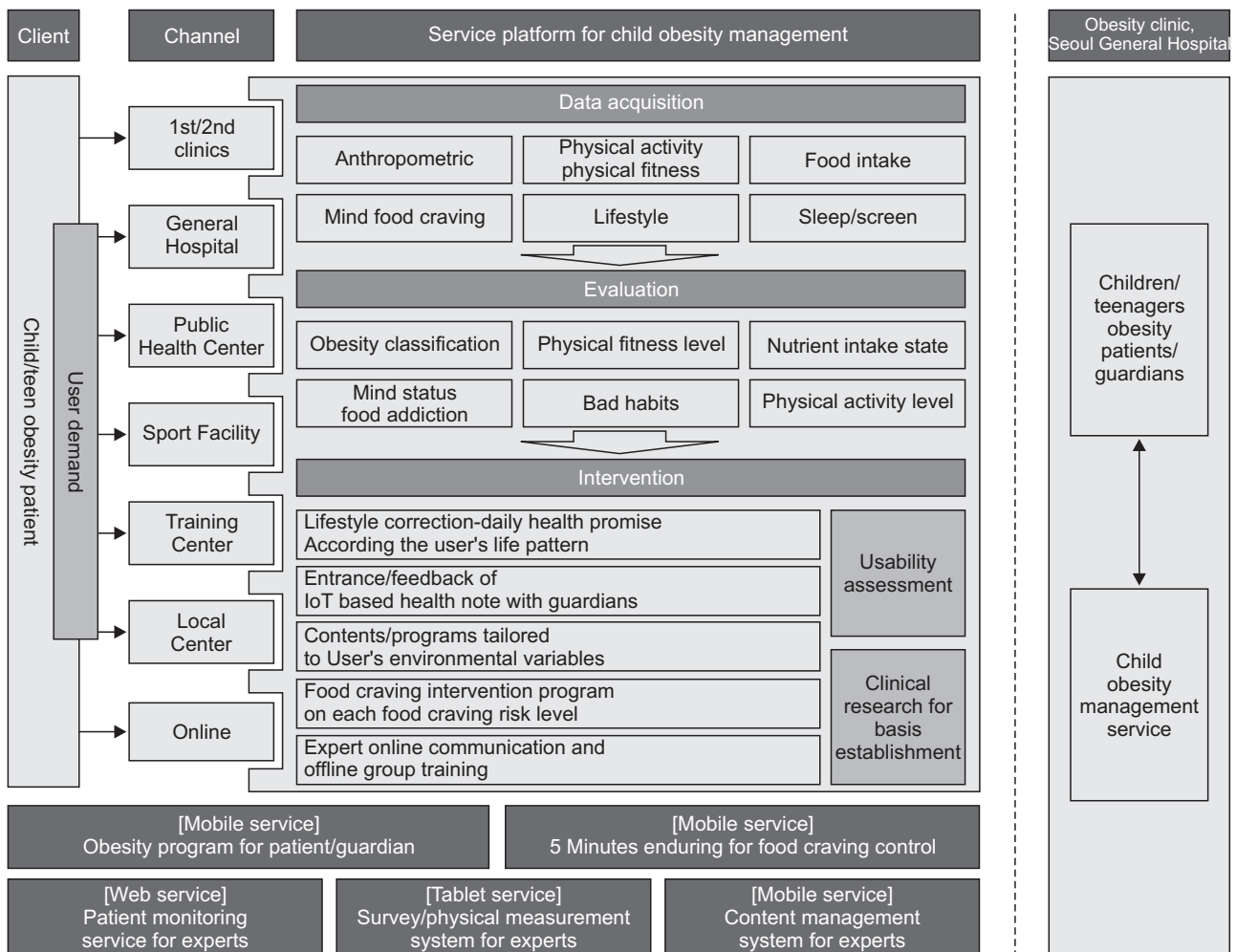


Figure 3. Service platform for child-teen obesity treatment and management.

and public health centers, obese children/teenagers who constitute the service's user base, and IT development and policy institutions and companies with a focus on child-teen obesity management and treatment (Figure 1).

Patients (obese children/teenagers) enter information about

their activity level, exercise and meals through the health tracker and are managed by experts (medical staff members) based on the entered information. Patients are also provided with various types of information related to nutrition and exercise and communicate with responsible experts to

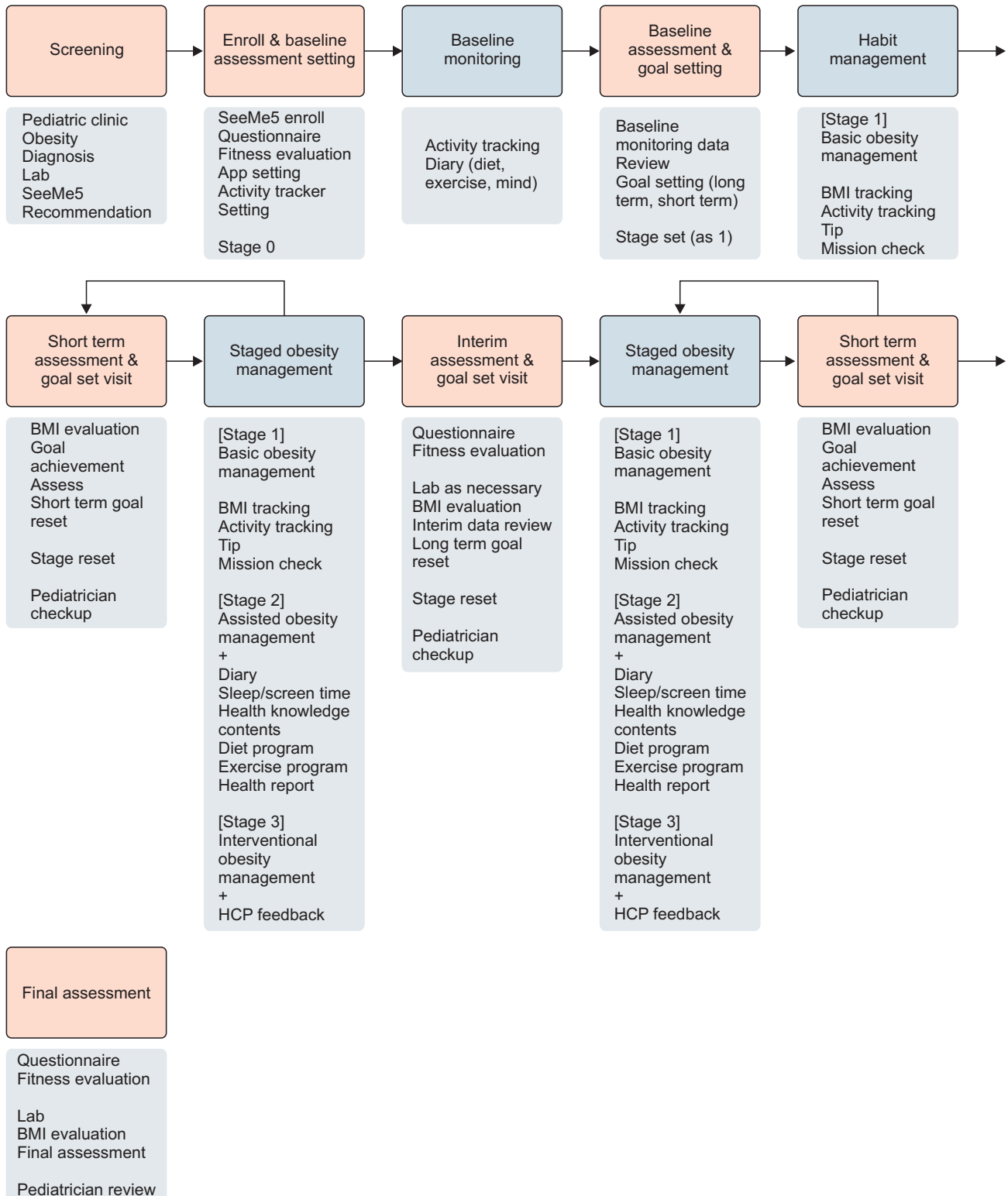


Figure 4. Child-teen obesity treatment and management processes.

correct improper aspects of their lifestyles that have been diagnosed through medical interviews and consultations. The parents of patients may check the information regarding their children's exercise, meals, treatment, management and other aspects of their progress through the mobile service. Experts monitor the patients in real-time based on the health information entered through the monitoring app service exclusively for that purpose and continuously communicate, providing information and interventions tailored to each patient.

Additionally, a service termed the 5-Minute Appetite Endurance Food Craving Service was planned and developed to help patients to suppress excessive impulse eating due to sudden appetite increases (Figure 2).

2. Service Platform for Child/Teen Obesity Treatment and Management

The target structure and a process map of this child-teen Obesity treatment service platform are summarized in Figure 3.

A child/teenager joins this service for obesity management and treatment by visiting a pediatrician for physical and body composition measurements. The expert registers the patient by entering the measurement information. The patient takes a physical fitness test consisting of various steps along with medical inquiries to detect poor health behavior and starts to wear an activity tracker. The expert provides consultations on nutrition and exercise and sets short- and long-term goals based on the test results. Later, the patient continuously uses the service by entering information about their emotions, meals and exercise. The expert then monitors this information and manages the patient's goal achievement status while the patient periodically visits the clinic for further physical measurements to check how far they have progressed toward their goal. All of the information is shared between the clinic, the patient and the parents, serving to increase the effects of the treatment.

3. Guideline for Intervention to Manage Child-Teen Obesity

The treatment and management program of this service is based on the principles of child-teen obesity management included in the guidelines of the American Academy of Pediatrics (AAP) for child/obesity treatment and management and the obesity treatment guidelines of the Korean Society for the Study of Obesity [3]. Interventions are classified from Stage 1 to Stage 4, with a total of four stages. Stage 4 is the most intense level of intervention (Figure 4).

4. Intervention Stage Classification and Management for Obese Children

Aspartate aminotransferase (AST), alanine aminotransferase (ALT), serum cholesterol, neutral fat, high-density lipoprotein (HDL) cholesterol, low-density lipoprotein (LDL) cholesterol, electrocardiogram, fasting blood glucose, hemoglobin A1c, urine and blood pressure are tested for any obese children/teenagers having a body mass index exceeding the 95th percentile for their gender and age. Lung function is tested for obese children/teenagers who are suspected of experiencing difficulty breathing during sleep. Tests for medical risks (past disease and treatment record, growth development, parents' obesity, family history, lab tests), behavioral risks (sedentary time, meal amounts, physical activity level) and attitude (interest and motivation levels for the family and the child) are conducted. The intensity and stage of intervention are set based on the results and include a mid-to-high intensity weight-control program which includes behavioral control, exercise and nutrition management aspects lasting at least one year.

The same factors are assessed for the overweight group with a body mass in the 85th–94th percentile and, if there is determined to be any health risk, a mid-to-high-intensity weight-control program including behavioral control, exercise and nutrition management is established and carried out for at least 1 year.

Management of specific groups of children/teenagers is performed by classifying the children/teenagers into four groups according to their obesity level and risk factors, as shown in Table 1.

All children/teenagers are managed from Stage 1 regardless of their group. Goal achievements are evaluated every 3 months for G1 and G2 and every month for G3. If the goal has been achieved, the stage is maintained. If the goal has

Table 1. Child-teen obesity management groups

Group G_R0	Overweight (85th–94th percentile) with no risk factors ^a
Group G1_R1	Overweight (85th–94th percentile) with some risk factors ^a
Group G2	Obese (BMI 95th–98th percentile)
Group G3	Morbidly obese (BMI ≥ 99th percentile)

BMI: body mass index.

^aRisk factors: (1) type 2 diabetes, obesity, hypertension and/or cardiovascular disease of any parent and/or family history of metabolic syndrome, (2) medical feedback: acanthosis nigricans, hirsutism, acne vulgaris, and others.

Table 2. Korean protocols for child-teen obesity treatment and management

Treatment stage	Components	Visit frequency	Concepts in SeeMe5 (key activities)
Stage 1 Prevention plus	<ul style="list-style-type: none"> - Leads to healthy habits - Vegetable and fruit diet, 1 hour or more of physical activity, 2 hours or less of TV viewing, meal skipping, fewer meals at restaurants 	Adjusted according to patient preparation condition	<ul style="list-style-type: none"> Leads to habit changes Habit record, activity level measurement and record
Stage 2 Structured weight management	<ul style="list-style-type: none"> - Diet training and prescription - Inducing healthy habits and parental monitoring (1 hour or less of TV viewing, physical activity monitoring) 	Monthly, adjusted according to the patient preparation condition	<ul style="list-style-type: none"> Habit monitoring and training by maintaining a journal Journal keeping, meals, exercise, program provisions
Stage 3 Comprehensive multidisciplinary intervention	<ul style="list-style-type: none"> - Frequent contact with experts - Contact following behavior change stage - Thorough monitoring and feedback - Thorough parent training 	Minimum 8-12 times, weekly, monthly	<ul style="list-style-type: none"> Habit monitoring and training through expert feedback Expert feedback
Stage 4 Tertiary care intervention	<ul style="list-style-type: none"> - Meal prescription, drugs, surgery 	-	<ul style="list-style-type: none"> Child obesity expert requested Drugs and/or surgery considered

not been achieved, the stage is upgraded to the next one. Stage 3 is maintained if the child has failed to achieve their goal. However, if the triglyceride glucose (TyG) index value is higher than the set point or if it is determined that an expert is required, the initial stage can be changed. Table 2 shows the intervention strategies used at each stage.

III. Discussion

Five services, i.e., a mobile service for patients/guardians, a monitoring web service for experts, a content management system for experts, a tablet using a survey/physical fitness measurement system for experts, and the “5-minute endurance” system for food craving control were planned and developed to establish a service platform for child-teen obesity treatment and management. The development of the platform was completed successfully. The program is currently being piloted at a general hospital located in Seoul. Thus far, the service is restricted to this hospital. Therefore, research on treatment protocols and service UI/UX (user interface/user experience) enhancements by acquiring more samples will be required to develop a better understanding of these subjects. This study is expected to contribute to the establishment of future mobile platforms for healthcare services which integrate healthcare and ICT.

Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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References

1. Lee NY, Yoo SH, Lee S, Kwon O. U-healthcare service for psychological wellbeing lifecare. DAEHAN Assoc Bus Adm 2012;25(8):3397-415.
2. Korea Ministry of Health and Welfare. A plan for child protection policy [Internet]. Sejong: Ministry of Health and Welfare; 2015 [cited at 2016 Mar 1]. Available from: http://www.mohw.go.kr/front_new/al/sal0301vw.jsp?PAR_MENU_ID=04&MENU_ID=0403&BOARD_ID=140&BOARD_FLAG=00&CONT_SEQ=322332&

- page=1.
3. Korean Society for the Study of Obesity. Clinical practice guidelines for overweight and obesity in Korea 2014 [Internet]. Seoul: Korean Society for the Study of Obesity; 2015 [cited 2016 Mar 1]. Available from: <http://www.kosso.or.kr/eng/>.
 4. Kim H, Cho J, Kim S, Kang Y. Child/teenager obesity prediction research [Internet]. Seoul: Korea Institute for Health and Social Affairs; 2015 [cited at 2016 Feb 20]. Available from: https://research.khealth.or.kr/hpResearch/rsfileTde.dia?method=reportfile&rs_idx=961&rs_code=1502001.
 5. Yu G, Park J. Types of studies on smart media contents for ubiquitous health service. *J Korea Des Knowl* 2013; 28:195-202.
 6. Jeon E, Park HA. Development of a smartphone application for clinical-guideline-based obesity management. *Healthc Inform Res* 2015;21(1):10-20.
 7. Jeon E, Park HA. Factors affecting acceptance of smartphone application for management of obesity. *Healthc Inform Res* 2015;21(2):74-82.
 8. Jeon E, Park HA, Min YH, Kim HY. Analysis of the information quality of Korean obesity-management smartphone applications. *Healthc Inform Res* 2014;20(1):23-9.
 9. SeeMe5 [Internet]. Seoul: SeeMe5; 2015 [cited at 2016 Feb 22]. Available from: <http://www.seeme5.org/>.
 10. National Health Information Portal. Childhood obesity [Internet]. Sejong; Ministry of Health and Welfare; 2015 [cited at 2016 Feb 12]. Available from: <http://health.mw.go.kr/HealthInfoArea/HealthInfo/View.do?idx=3450>.