

DESCRIPTION

Title of Invention

CARE PLAN CREATION ASSISTANCE SYSTEM, STORAGE MEDIUM, CARE PLAN
CREATION ASSISTANCE METHOD, AND CARE PLAN CREATION ASSISTANCE
5 PROGRAM

Technical Field

[0001] The present invention relates to a care-plan creation support system, a recording
medium, a care-plan creation support method, and a care-plan creation support program.

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Background Art

[0002] Plans for providing care to people who receive care or support from others in their
daily lives including bathing, excretion, and taking meals (hereinafter, such people may be
collectively referred to as "care receivers") are called care plans. These care plans each
15 include the contents of a specific care service as well as a service plan schedule defining
the date and time at which the above-mentioned care service is provided.

[0003] Such a care plan is usually created by a care manager in consideration of a care
benefit defined according to the level of needed care which is to be certified based on a
situation of the care receiver (hereinafter, may be referred to as "care receiver situation").

20 When a person to be certified for the level of needed care files an application, a care
insurer receiving the application causes a certification investigator of a certification
investigative organization to conduct a survey on a physical condition and/or the like of the
applicant. This survey is conducted by a method in which to make a choice that matches
a situation of the applicant from two or more options for predetermined items or to make
25 text input for items. The results of this survey are entered into a computer and/or the like
and used for the primary judgement of the level of needed care using a predetermined

calculation method. The care insurer requests committee for certification of care, an organization established by the care insurer, to certify the level of needed care for the applicant based on the primary judgement and/or special instructions of the care receiver and a written opinion of a primary doctor other than the primary judgment, for example.

5 Accordingly, the maximum of the care benefit to the care receiver is determined by the certified level of needed care.

[0004] After the maximum of the care benefit is determined, a care manager creates a care plan suitable for the care receiver in consideration of the care benefit. At this time, the care manager or a subcontractor of the care manager newly makes assessment on the
10 care receiver situation at the time of creating the care plan (hereinafter, may be simply referred to as "assessment"). The care manager then creates the care plan based on the assessed current situation of the care receiver (hereinafter, may be simply referred to as "assessment result").

[0005] PTLs (Patent Literature) 1 to 6 propose a method for supporting creation of care
15 plans from the results of assessment and also propose a system for implementing the method, for the purpose of increasing the efficiency of creating care plans and/or averaging the quality of care plans to be provided, by suppressing degradation of the quality of care plans attributable to the competencies of care managers.

[0006] Meanwhile, the number of care receivers tends to increase for the reasons of
20 declining birthrate and a growing population of elderly people (longevity), which make further progress in recent years. In addition, there are very few cases where the levels of needed care are improved by care, so that the number of care receivers with high levels of needed care also increases as the number of care receivers increases. Although part of funds required for care benefits is covered by a care benefit expense which is a type of
25 social security cost, the higher the level of needed care, the higher the care benefit expense per care receiver will be. For this reason, the care benefit expense has been increasing

every year due to an increase in the number of care receivers and an increase in the number of care receivers with high levels of needed care corresponding thereto. While the population of so called elderly people aged 65 and over in Japan is, for example, about 34 million in 2015 (1 in a population of 3.7 people), the population of the elderly people is
5 expected to increase to about 36.5 million (1 in a population of 3.3 people) in 2025, and the care benefit expense is expected to increase to 21 trillion yen in 2025 from 10.1 trillion yen in 2015.

[0007] Furthermore, the increase in the number of care receivers and the increase in the number of care receivers with high levels of needed care have a large social impact.
10 There have been problems, for example, including one so called care unemployment that requires a person to leave a job for providing an immediate family member with care. These problems reduce the quality of lives of care receivers and/or people related to the care receivers, and/or reduce the labor force, which possibly causes a social loss.

15 Citation List

Patent Literature

[0008]

PTL 1

Japanese Patent Application Laid-Open No. H11-149499

20 PTL 2

Japanese Patent Application Laid-Open No. 2000-003404

PTL 3

Japanese Patent Application Laid-Open No. 2000-003391

PTL 4

25 Japanese Patent Application Laid-Open No. 2001-101279

PTL 5

5 Summary of Invention

Technical Problem

[0009] As mentioned above, the increase in the number of care receivers increases a financial and social burden, and such a burden needs to be suppressed. In particular, the higher the levels of needed care, the larger the amount of care benefit expense as well as
10 the larger the amount of social burden will be. For this reason, it is desirable to suppress the increase in the number of care receivers with high levels of needed care. An effective method of reducing the number of care receivers with high levels of needed care is not established yet, however.

[0010] Improving the levels of needed care for care receivers by designing care plans
15 well, for example, supposedly makes it possible to suppress the increase in the number of care receivers with high levels of needed care. There are, however, only few examples of care plans that have successfully improved the levels of needed care, and even when these examples are applied to other care receivers of different situations, improvement of the levels of needed care in the same way cannot be necessarily expected.

20 [0011] In order to carry out the well-designing of care plans, increasing the efficiency of creating care plans and/or averaging the quality of created care plans is considered to be important. In this respect, PTLs 1 to 6 mention that the objects including increasing the efficiency of creating care plans and/or averaging the quality of created care plans are achieved by causing a computer to support creation of care plans (hereinafter, a system that
25 supports creation of care plans may be simply referred to as "care-plan creation support system." As long as the care-plan creation support system is a system capable of

outputting information useful in creating a care plan by a care manager, the care-plan creation support system may have only a function to output only a care service to be included in the care plan or may also have a function to output simultaneously a service plan schedule defining the date and time at which the the care service is provided). PTLs 1 to 6, however, take into consideration nothing about creation of care plans that can improve the levels of needed care.

[0012] The present invention has been made in consideration of the problems mentioned above, and aims to provide a care-plan creation support system capable of supporting creation of a care plan by outputting, in accordance with a situation of each care receiver, a recommended care plan with which improvement of the level of needed care can be expected. Moreover, the present invention also aims to provide: a recording medium usable in the above-mentioned system; a care-plan creation support method that can be implemented using the system; and a care-plan creation support program capable of executing the method.

Solution to Problem

[0013] An aspect of the present invention for solving the problems relates to a care-plan creation support system including: a care-plan outputting section that obtains, for each care plan, using a care-plan output support model, a probability of improving a level of needed care of a care receiver for input of a care receiver situation, and outputs, as a recommended care plan, a care plan for which the obtained probability is higher, the care-plan output support model outputting, for each care plan, the probability of improving the level of needed care for the input of the care receiver situation; a determination section that determines whether or not the level of needed care of the care receiver after provision of care using the outputted care plan to the care receiver has improved; a probability calculation section that newly calculates, using a result of the determination by the

determination section, the probability of improving the level of needed care of the care receiver when the care is provided according to the outputted care plan; and a processing changing section that changes the care-plan output support model such that a probability to be obtained for the outputted care plan for input of the care receiver situation becomes
5 close to the calculated probability.

[0014] Another aspect of the present invention for solving the problems relates to a recording medium connectable to the care-plan creation support system, in which the recoding medium stores therein a record associated with: information for identifying a care receiver; a care receiver situation of the care receiver; a care plan used for the care
10 receiver; and a level of needed care of the care receiver after provision of care using the care plan, or a change of the level of needed care as a result of the provision of the care using the care plan.

[0015] Still another aspect of the present invention for solving the problems relates to a care-plan creation support method including: obtaining, for each care plan, using a
15 care-plan output support model, a probability of improving a level of needed care of a care receiver for input of a care receiver situation of the care receiver, and outputting, as a recommended care plan, a care plan for which the obtained probability is higher, the care-plan output support model outputting, for each care plan, the probability of improving the level of needed care for the input of the care receiver situation; determining whether or
20 not the level of needed care of the care receiver after provision of the outputted care plan to the care receiver has improved; newly calculating, using a result of the determining, the probability of improving the level of needed care of the care receiver by the provision of the outputted care plan; and changing the care-plan output support model such that a probability to be obtained for the outputted care plan for input of the care receiver situation
25 becomes close to the calculated probability.

[0016] Yet another aspect of the present invention for solving the problems relates to a

care-plan creation support program causing a computer to execute processing including:
obtaining, for each care plan, using a care-plan output support model, a probability of
improving a level of needed care of a care receiver for input of a care receiver situation of
the care receiver, and outputting, as a recommended care plan, a care plan for which the
5 obtained probability is higher, the care-plan output support model outputting, for each care
plan, the probability of improving the level of needed care for the input of the care receiver
situation; determining whether or not the level of needed care of the care receiver after
provision of the outputted care plan to the care receiver has improved; newly calculating,
using a result of the determining, the probability of improving the level of needed care of
10 the care receiver by the provision of the outputted care plan; and changing the care-plan
output support model such that a probability to be obtained for the outputted care plan for
input of the care receiver situation becomes close to the calculated probability.

Advantageous Effects of Invention

15 [0017] According to the present invention, a care-plan creation support system is
provided, which is capable of supporting creation of a care plan by outputting, in
accordance with a situation of each care receiver, a recommended care plan with which
improvement of the level of needed care can be expected. Moreover, according to the
present invention, a recording medium usable in the above-mentioned system; a care-plan
20 creation support method that can be implemented using the system; and a care-plan
creation support program capable of executing the method are provided.

Brief Description of Drawings

[0018]

25 FIG. 1 is a block diagram illustrating a configuration example of a care-plan creation
support system according to an embodiment of the present invention;

FIG. 2 is a flowchart illustrating an example of processing performed by the care-plan creation support system;

FIG. 3 is a flowchart illustrating specific processing included in outputting of a care plan (step S100);

5 FIG. 4 is a schematic diagram illustrating a configuration of a middle unit in a first embodiment;

FIG. 5 is a flowchart illustrating specific processing included in learning processing (step S200);

FIG. 6 is a block diagram illustrating a configuration of a care-plan creation support
10 system according to another embodiment of the present invention;

FIG. 7 is a block diagram illustrating a configuration of a care-plan creation support system according to still another embodiment of the present invention; and

FIG. 8 is a block diagram illustrating a configuration of a care-plan creation support system according to yet another embodiment of the present invention.

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Description of Embodiments

[First Embodiment]

[0019] FIG. 1 is a block diagram illustrating a configuration example of care-plan creation support system 100 according to an embodiment of the present invention.

20 Care-plan creation support system 100 according to this embodiment includes: care-plan outputting section 110, determination section 120, probability calculating section 130, and processing changing section 140, each serving as a processing section, and storage section 150 serving as a storage medium, display section 160, and input section 170.

[0020] Note that, care-plan creation support system 100, for example, includes: a central
25 processing unit (CPU) as a processor; a storage medium such as a read only memory (ROM) storing therein a control program; a working memory such as a random access

memory (RAM); and a communication circuit although these components are not illustrated. In this case, the functions of the processing sections are implemented by executing a control program (which corresponds to the "care-plan creation support program" of the present invention) by the CPU. At least part of a program for executing
5 processing by the care-plan outputting section, the determination section, the probability calculating section, and the processing changing section is saved in a server, but at least part of the program may be saved in a cloud server as in a fourth embodiment to be described, hereinafter.

[0021] Care-plan outputting section 110 is a processing section that obtains, for each
10 predetermined care plan, the probability of improving the level of needed care of a care receiver when care is provided to the care receiver (hereinafter, may be simply referred to as "provision of care"), using a predetermined care plan (hereinafter, may be simply referred to as "care plan is provided" or "provision of care"), and outputs, as a recommended care plan, a care plan for which the obtained probability is higher.

15 Care-plan outputting section 110 obtains the probability of improving the level of needed care of a care receiver when a predetermined care plan is provided by, for example, inputting a care receiver situation of the inputted care receiver to a probabilistic inference model (hereinafter, simply referred to as "care-plan output support model"). Note that, the probabilistic inference model is an inference model that outputs an inference value
20 (probability of improving the level of needed care in this embodiment) for each predetermined attribute (care plan type in this embodiment) by performing a predetermined arithmetic operation for an input value. Care-plan outputting section 110 is a processing section which then selects a care plan with a higher probability of improving the level of needed care, for example, with reference to the probabilities of improving the level of
25 needed care outputted for the respective care plans, and outputs a care plan recommended to the care receiver.

[0022] Determination section 120 is a processing section which determines whether or not the current level of needed care of the care receiver has improved as compared with the level of needed care of the the care receiver in the past. Determination section 120, for example, determines whether or not the level of needed care of the care receiver after
5 provision of the care to the care receiver, using the care plan outputted from care-plan outputting section 110 has improved. Note that, determination section 120 may determine whether or not the level of needed care of the care receiver after provision of care to the care receiver, using a care plan created by a care manager separately, has improved.

[0023] Probability calculating section 130 is a processing section that newly calculates
10 the probability of improving the level of needed care of a care receiver when care is provided according to the predetermined care plan (particularly, care plan outputted from care-plan outputting section 110) using the result of determination made by determination section 120. Probability calculating section 130, for example, calculates, from among records stored in storage section 150, a total number of records having the same care
15 receiver situation and the same care plan used for care, and the number of records which are included in the records and which indicate that it is determined that the level of needed care has improved, then calculates the ratio of the number of records indicating that it is determined that the level of needed care has improved with respect to the total number of records, and thereby sets the calculated ratio to be the probability of improving the level of
20 needed care of the care receiver.

[0024] Processing changing section 140 is a processing section that changes the care-plan output support model by using, as training data, a combination of the past care receiver situation, the care plan created based on the past care receiver situation and then provided to the care receiver in the past, and the result of determination made by determination
25 section 120. Specifically, processing changing section 140 changes the care-plan output support model such that the probability to be obtained for a certain care plan when a care

receiver situation is inputted to care-plan outputting section 110 becomes close to the probability calculated by probability calculating section 130 for a combination of the same care receiver situation and the same care plan.

[0025] The processing performed by these processing sections will be described in detail,
5 hereinafter.

[0026] Care-plan creation support system 100 is partly characterized in that the system changes the care-plan output support model by learning processing. According to the learning processing, the care-plan output support model can be changed such that a feature included in the past data is mechanically extracted and a similar result is outputted to the
10 input having a similar feature. For this reason, whether or not the level of needed care has improved is determined for each care plan provided for a certain care receiver situation, and the learning processing is performed using these pieces of data (care receiver situation, care plans, and the result of determination for each of the care plans). Thus, the care-plan output support model can be changed in order that a care plan with a high probability of
15 improving the level of needed care can be outputted for a situation having a similar feature. Accordingly, care-plan creation support system 100 can output, as a recommended care plan, a care plan with a higher probability of improving the level of needed care for each of individual care receivers having various situations, according to a feature of the care receiver situation. In addition, repeating the learning processing while preparing a large
20 number of pieces of such data increases the capability of accurately outputting a care plan with a higher probability of improving the level of needed care for a given care receiver situation.

[0027] Storage section 150 is a readable and writable recording medium.

[0028] Storage section 150 can be used as a recording medium such as a database.

25 Storage section 150 stores therein records associated with information on a care receiver (hereinafter, may be simply referred to as "care receiver information"), date or date and

time, a care receiver situation, a care plan, the level of needed care of the care receiver, and the level of needed care after provision of care using the care plan or a change of the level of needed care as a result of the provision of the care plan. The records may be each provided with a unique record number.

- 5 [0029] The above-mentioned date or date and time is the date or date and time at which assessment is made on the care receiver.

[0030] The care receiver information is information for uniquely identifying the care receiver who receives care and can contain an ID number unique to the care receiver, the full name, sex, and birth date of the care receiver, for example.

- 10 [0031] The care receiver situation can be the result of assessment obtained by assessment made on the care receiver by a care manager or a subcontractor of the care manager. As the care receiver situation, a survey result of an overview survey related to service usages and/or special instructions, and/or the contents in a written opinion of a primary doctor such as such as the name of a disease may be used.

- 15 [0032] The care plan described above is a care plan created by a care manager based on the care receiver situation and provided to the care receiver.

[0033] The level of needed care of a care receiver is the level of needed care of the care receiver that is certified by the Care Needs Certification Board when the care plan is created.

- 20 [0034] The level of needed care after provision of care using the care plan is the level of needed care of the care receiver that is recertified by the Care Needs Certification Board after provision of a care plan to the same care receiver.

- [0035] The change of the level of needed care is a data piece that is determined by determination section 120 and can be aggregated. For a record including a care plan that
25 has been determined as having improved the level of needed care is given "1," while a record including a care plan that has been determined as having not improved the level of

needed care is given "0," for example.

[0036] At the time of initial setting, the records in number that allows probability calculating section 130 to calculate the probability are prepared in advance and stored in storage section 150.

5 [0037] Display section 160 is a display device such as a smartphone carried around by a care manager, or a PC or TV, and displays a recommended care plan in accordance with a display control signal inputted from care-plan outputting section 110. Display section 160 can be used by a care manager who sees the displayed care plan to create the care plan to be provided to the care receiver.

10 [0038] Input section 170 includes various operation keys, such as a numeric keypad and a start key, an audio receiving section, and/or a video receiving section such as a camera, for example, and receives various input operations made by a user, generates input data, and outputs the generated input data to care-plan outputting section 110 and determination section 120. Input section 170 may be a receiver for various signals, such as a receiving
15 connector, which is configured to receive the input data electrically outputted from another medium and to be capable of outputting the input data to care-plan outputting section 110 and determination section 120. The input data outputted from input section 170 is outputted to care-plan outputting section 110 and then used for outputting of a care plan and is also outputted to determination section 120 and then used for changing a care-plan
20 output support model by probability calculating section 130 and processing changing section 140.

[0039] FIG. 2 is a flowchart illustrating an example of processing performed by care-plan creation support system 100. Upon reception of input of data about a care receiver situation, care-plan creation support system 100 outputs a care plan recommended to the
25 care receiver based on a predetermined probabilistic inference model (step S100). Care-plan creation support system 100 performs learning processing for changing the

probabilistic inference model so as to be capable of outputting a care plan having a higher probability of improving the level of needed care of the care receiver (step S200).

[0040] Note that, FIG. 2 illustrates a mode in which the learning processing (step S200) is performed after the outputting of a care plan (step S100), but the outputting of a care plan (step S100) may be performed after the learning processing (step S200), or the outputting of a care plan (step S100) and the learning processing (step S200) may be performed simultaneously in parallel.

[0041] Hereinafter, a description will be first given of input data used in the processing performed by care-plan creation support system 100, and then more specific processing included in the outputting of a care plan (step S100) and the learning processing (step S200) will be described.

[0042] (Input Data)

The input data is information relating to the assessment made on a care receiver in order to newly create a care plan and includes the care receiver information, the date or date and time of the assessment made on the care receiver, the care receiver situation, and the level of needed care of the care receiver as of the date or date and time of the assessment. Although it is preferable that the care receiver information included in the input data and the care receiver information stored in storage section 150 consist of the same items, as long as determination section 120 can make the same determination of a care receiver, only some of the items may overlap each other.

[0043] The care receiver situation can be a result of selecting an option that most matches the care receiver situation from among two options (Yes (Y) and No (N)), or three or more options for multiple survey items. These multiple survey items and options are not limited to any particular type and are optionally determinable, and for example, the survey items and options determined for use in certifying the levels of need care can be used. Although the survey in certifying the levels of needed care include an overview survey and

basic survey, either one or both of them may be used, or only the items and options of the base survey (74 items as of July 2015) may be used. In this case, it is preferable that the survey items and options be changeable accordingly when the certification standard of the levels of needed care is changed. Moreover, the care receiver situation may be entered by
5 text input of the result of the overview survey and/or the contents of a written opinion of a primary doctor, for example.

[0044] The survey items used in certifying the levels of needed care as of July 2015, for example, consist of 74 items such as: items relating to physical functions and/or daily life behavior of a care receiver, such as "left-upper extremity paralysis (select from "Yes" and
10 "No")," and "roll-over (select from "capable of roll-over without holding anything," "capable of roll-over with something to hold" and "cannot roll over");" items relating to vital functions of a care receiver, such as "moving (select from "capable of moving without any care," "needs watch over or the like," "needs partial care," and "needs complete care");" items relating to cognitive ability of a care receiver, such as "communication (select from
15 "survey respondent can communicate with others," "can communicate with others sometimes," "can barely communicate with others," and "cannot communicate with others"), and "survey respondent can tell his or her birth date and age (select from "Yes" and "No");" items relating to mental and behavioral disorder of a care receiver, such as "falling into victim mentality such as insisting that something is stolen (select from "No,"
20 "sometimes," and "Yes");" items relating to adaptation to social life, such as "money management (select from "not released," "partially released," and "completely released")" and "daily-life decision-making (select from "Yes (including special cases)," "Yes, except for special cases," "difficult on a daily basis," and "No");" and items relating to medical treatment in the last 14 days, such as "dialysis (select from "Yes" and "No")." These
25 items may be used without any change, or may be selectively used, or another item may be optionally registered and used.

[0045] Note that, from a viewpoint of saving the time and effort of input, the number of items for a care receiver situation can be set between 5 and 20 (both inclusive) or even between 5 and 15 (both inclusive). It is preferable that the care receiver situation at this time be composed of survey items used in assessment (monitoring) of activities of daily living (ADL) or instrumental activities of daily living (IADL) made on the care receiver. As the survey items used in assessment of the ADL, for example, survey items used in assessment methods such as Barthel Index, performance statuses defined by Eastern Cooperative Oncology Group (ECOG), and Functional Independence Measure (FIM) can be used, for example.

10 [0046](Step S100: Outputting of Care Plan)

In the outputting of a care plan (step S100), care-plan outputting section 110 inputs the inputted care receiver situation to a care-plan output support model and obtains the probability of improving the level of needed care for each care plan. Care-plan outputting section 110 then outputs a care plan recommend to the care receiver based on the probability of the level of needed care outputted for each care plan and displays the care plan on display section 160.

[0047] The care plan mentioned above includes at least a care service. The care service is the specific contents of a care service provided to a care receiver. The care service may be selected from services that can be provided by a care service provider. Note that, the care plan may include, other than the specific contents of a care service, a service plan schedule defining the date and time at which the care service is provided.

[0048] FIG. 3 is a flowchart illustrating specific processing included in the outputting of a care plan (step S100).

[0049] First, care-plan outputting section 110 inputs a care receiver situation to a care-plan output support model and obtains the probability of improving the level of needed care for each care plan (step S310). Care-plan outputting section 110 then outputs,

as a recommended care plan, one or more care plans having a high probability of improving the level of needed care (step S320). Care-plan outputting section 110 outputs, for example, a care plan for which the outputted probability is high (e.g., such as a care plan with the highest probability or care plans corresponding to output units of the top ten probabilities) as a recommended care plan.

[0050] Care-plan outputting section 110 then outputs the outputted care plan as a display control signal to display section 160 and causes the care plan to be displayed on display section 160 (step S330). In a case where the care plan is changed at this time as in a third embodiment to be described, hereinafter, the processing returns to step S310, and care-plan outputting section 110 causes the corrected care plan to be displayed on display section 160.

[0051] Finally, care-plan outputting section 110 registers, as a new record, to storage section 150, the care receiver information, the date or date and time, the care receiver situation, and the level of needed care included in the input data, as well as the outputted or changed care plan (step S340).

[0052] The care-plan output support model is a probabilistic inference model which outputs a constant inference value with respect to the input of a care receiver situation for predetermined each type of care plan, and is configured to be changeable by processing changing section 140. The inference value is the probability of improving the level of needed care of the care receiver when each care plan is provided to the care receiver having the inputted situation. The care-plan output support model includes, for example, a neural network, a Boltzmann machine, a decision tree, and/or the like.

[0053] Hereinafter, the configuration of a care-plan output support model of a case where the care-plan output support model includes a neural network is exemplified.

[0054] The above-mentioned neural network (hereinafter, may be simply referred to as a "plan output network") includes: an input layer including multiple input units; one or more

middle layers each including multiple middle units; and an output layer including multiple output units. The plan output network is a multi-layered neural network having N layers including multiple middle layers from an input layer side to an output layer side, and a middle unit included in each of the middle layers outputs information received from one or more middle units (or input units) included in a middle layer at the previous layer position to one or more middle units (or output units) included in a middle layer at the next layer position. The number (N) of layers included in the plan output network is at least three and can be optionally determined in accordance with the number of assessment items, for example. The number (N) of layers can be, for example, at least three but not more than 25, and preferably between 5 and 20 (both inclusive), and even more preferably, between 8 and 16 (both inclusive).

[0055] The input layer ($N=1$) includes the same number of the input units as the number of survey items included for a care receiver situation. The input units each correspond to any of the survey items and output an input value corresponding to one or more options included in the survey item to one or more middle units without any change.

[0056] The middle layers ($N=k(1 < k < N)$) each include an optional number of the middle units. The middle unit receives output from one or more middle units included in the middle layer (or one or more input units included in the input layer) at the previous layer position and outputs the output to any or multiple middle units included in the middle layer (or output unit included in the output layer) at the next layer position. The middle layer can be a fully connected layer in which the middle unit included in the middle layer is connected to all the middle units (or input units) at the previous layer position, or can be a convolutional layer in which the middle unit included in the middle layer is connected to only some of the middle units (or input units) at the previous layer position.

[0057] At this time, as illustrated in FIG. 4, middle unit Z of the k-th layer receives outputs w_1 , w_2 , w_3 , and w_4 from the middle units (four units in FIG. 4) of the $k-1$ th layer.

Middle unit Z then calculates value u_1 by adding predetermined bias b to a total value obtained by multiplying the outputs by predetermined weights y_1 , y_2 , y_3 , and y_4 , respectively, as expressed in Equation 1. Note that, the weights and bias are changeable by processing changing section 140.

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$$u_1 = w_1 \times y_1 + w_2 \times y_2 + w_3 \times y_3 + w_4 \times y_4 + b \dots \text{(Equation 1)}$$

[0058] The middle unit further outputs, to the middle unit (or output unit) of the $k+1$ th layer, value z_1 obtained by applying predetermined activating function f to u_1 . Activating function f is not limited to any particular type, and a sigmoid function, a logistic function, and Rectified Linear Unit (ReLU), and a soft-max function can be used, for example.

10 Among these functions, ReLU is preferable in that activating function f included in the middle unit increases the processing speed while increasing the output accuracy.

[0059] The output layer ($N=N$) includes the same number of the output units as the number of predetermined care plans that can be outputted. The output units each receive output from one or $N-1$ middle units and output a value obtained by performing processing

15 similar to the processing of the middle unit, as an inference value (the probability of improving the level of needed care) for the care receiver situation which has been inputted to the input layer. Note that, for activating function f included in the output unit at this time, a soft-max function is preferable because the sum of inference values outputted from all the output units becomes 1, and the outputted inference values can be used as
20 probability distribution without additional processing.

[0060] In this case, the output units are set to correspond to the predetermined care plans that can be outputted by care-plan outputting section 110, respectively, in one to one correspondence. The inference values outputted respectively from the output units are regarded as the probabilities of improving the level of needed care of a care receiver having
25 the situation when the respective care plans are provided. For this reason, care-plan outputting section 110 can select a care plan corresponding to the output unit in which the

outputted inference value is higher and outputs the care plan as a care plan recommended to the care receiver having the situation.

[0061] It is preferable that the weights and bias of the units in the middle layer and the output layer be predetermined at the time of initial setting by the learning processing performed by processing changing section 140 using, as training data, a combination of the care receiver situation and the care plan selected for the care receiver by a care manager in the past.

[0062] (Step S200: Learning Processing)

In learning processing (step S200), determination section 120, probability calculating section 130, and processing changing section 140 change the care-plan output support model mentioned above by the learning processing. More specifically, determination section 120 determines whether or not the level of needed care included in the input data has improved from the past level of needed care of the same care receiver, which is registered to storage section 150. Probability calculating section 130 then calculates, for an optional combination of the care receiver situation and a care plan included in storage section 150, the probability of improving the level of needed care when the care plan is provided to the care receiver having the care receiver situation forming the combination. Processing changing section 140 then changes the care-plan output support model by using, as training data, the care receiver situation and the care plan which form the combination and the probability of improving the level of needed care for the combination. Processing changing section 140, for example, changes the values of the weights and bias of the middle units and output units such that, when the care receiver situation is inputted to the neural network, the inference value outputted from each of the output units becomes close to the value calculated as the probability of improving the level of needed care when the care plan corresponding to the output unit is provided.

[0063] Note that, the past level of needed care as well as the past care receiver situation

and the past care plan to be described hereinafter are the level of needed care, the care receiver situation, and the care plan included in a record at a point of time as far back as a predetermined period from the date or date and time of the input data from among the records of the same care receiver which have been registered to storage section 150.

5 More specifically, the items included in a record whose registered date or date and time correspond to the date or date and time of assessment in the abovementioned record, i.e., the time point as far back as a predetermined period from the date or date and time of assessment included in the input data are set to the the past level of needed care, the past care plan, and the past care receiver situation. The predetermined period can be set to a
10 period from creation of a care plan to creation of a care plan again and can be set to six months, for example.

[0064] FIG. 5 is a flowchart illustrating specific processing included in the learning processing (step S200). Determination section 120 compares care receiver information included in input data with care receiver information registered to storage section 150, and
15 determines whether or not a record of the same care receiver as that of the input data is registered to storage section 150 (step S510).

[0065] In a case where the record of the same care receiver is registered, as the result of determination (step S510: YES), determination section 120 assesses a change (whether or not the level of needed care has improved) of the level of needed care of the care receiver
20 after provision of care to the care receiver, using the past care plan (step S520). More specifically, determination section 120 compares the level of needed care (the current level of needed care) of the care receiver, which is included in the input data, with the level of needed care included in the past record of the same care receiver, which is registered to storage section 150, and determines whether or not the current level of needed care has
25 improved (lowered) from the past level of needed care. Note that, when no record of the same care receiver is registered (step S510: NO), the processing in FIG. 5 ends because the

input data cannot be used for the learning processing.

[0066] As of July, 2016, the levels of needed care in Japan consist of seven levels, which are "need support 1" "need support 2" "need care 1" "need care 2" "need care 3" "need care 4" and "need care 5," and the levels mentioned earlier are determined to be lower levels of
5 needed care while the levels mentioned later are determined to be higher levels of needed care. Therefore, when the level of needed care shifts to the earlier mentioned category from the later mentioned category; for example, when the past level of needed care of a certain care receiver is "need care 3," while the level of needed care included in input data is "need care 2," it is determined that the level of needed care of the care receiver has
10 improved.

[0067] This result of determination is registered as a value of the item "change of the level of needed care" in a record including the past care receiver situation and the past care plan which are used in this assessment among records of the same care receiver included in storage section 150 (step S530).

15 [0068] Then, probability calculating section 130 counts the number of the records in which the value of the item "change of the level of needed care" has been newly registered to storage section 150 (step S540). As a result, when it is determined that at least a predetermined number of data pieces have been newly registered (step S540: YES), probability calculating section 130 obtains the probability of improving the level of needed
20 care of the care receiver (step S550). Probability calculating section 130, for example, obtains, from among records stored in storage section 150, a total number of records having the same care receiver situation and the same care plan used for care, and the number of records which are included in the records and which indicate that it is determined that the level of needed care has improved, then calculates the ratio of the
25 number of records indicating that it is determined that the level of needed care has improved with respect to the total number of records. When it is not determined that at

least a predetermined number of data pieces have been newly registered (step S540: NO), the processing in FIG. 5 ends.

[0069] Processing changing section 140 then performs the learning processing and changes the care-plan output support model (step S560).

5 [0070] Processing changing section 140, for example, changes the plan output network such that, when the care receiver situation is inputted to the plan output network, the inference value outputted from the output unit corresponding to the care plan becomes the ratio obtained by the calculation.

[0071] More specifically, processing changing section 140 obtains a difference (error)
10 between the inference value outputted from the plan output network when the care receiver situation is inputted and the ratio obtained by the calculation. Next, processing changing section 140 changes one or more values of the weights and bias (y_1 , y_2 , y_3 , y_4 , and b in the example of FIG. 4) included in any of the middle units and output units of the plan output network such that the error becomes small.

15 [0072] The method of changing an assessment network and a plan output network is not particularly limited, and a publicly known method such as a gradient descent method using an error backpropagation method can be used. In addition, an error function used in expressing the error in the gradient descent method is not limited to any particular type, and a publicly known formula such as mean square error and cross entropy can be used.

20 [0073] With this configuration, the care plan outputted from care-plan outputting section 110 by processing including execution of the care-plan output support model including the plan output network has a high probability of improving the level of needed care of a care receiver. Particularly, performing the learning processing a large number of times while inputting a large number of input data pieces enables selecting a care plan forming the
25 combination with which the probability of improving the level of needed care is high, for a care receiver having any care receiver situation, and then providing the care plan to the

care receiver.

[0074] Moreover, causing a computer to support creation of a care plan makes it possible to achieve the objects; namely, increasing the efficiency of creation of care plans and/or averaging the quality of created care plans.

5 [0075] Note that, as a factor of hindering improvement of the quality of a created care plan in a traditional care plan creation method, for example, assessment on whether selecting the care plan is right or wrong is made based on a determination standard that changes easily due to a subjective view of an observer, such as whether or not the care receiver provided with a care service included in the care plan seems lively and active, for
10 example. In this respect, when assessment on a care plan is made using an assessment standard that allows for objectively determining whether it is large or small, i.e., whether or not the level of needed care has improved, a subjective view of an observer that has an impact on the assessment of a care plan can be eliminated as much as possible.

[0076] Furthermore, in a case where the care-plan output support model is configured to
15 include a multi-layered neural network as in this embodiment, the care-plan output support model can be changed so as to increase the probability of outputting a specific care plan upon input of an item having a feature that the possibility that the level of needed care improves is high when the specific care plan is provided, from among survey items included in an inputted care receiver situation. For this reason, upon input of a similar
20 care receiver situation which includes a survey item having the above-mentioned feature, the specific care plan is outputted with high probability. Thus, care-plan outputting section 110 can output a care plan having a high probability of improving the level of needed care even for a situation of a care receiver not included in training data (or there are only few data pieces).

25 [0077] [Second Embodiment]

FIG. 6 is a flowchart illustrating specific processing included in learning processing

(step S200) in another embodiment of the present invention. This embodiment is different from the first embodiment in that a care plan assessment model which is a probabilistic inference model different from the care-plan output support model is used in changing a care-plan output support model by the learning processing. The other parts of the processing and the configuration of the system are the same as those of the first embodiment, so that the overlapping description will be omitted.

[0078] The care plan assessment model is a probabilistic inference model that outputs, for the input of a combination of a care receiver situation and a care plan, the probability that the level of needed care improves by carrying out the care plan, and is configured to be changeable by the learning processing. The care plan assessment model includes, for example, a neural network, a Boltzmann machine, a decision tree and/or the like.

[0079] Hereinafter, a configuration of case where the care plan assessment model includes a neural network (hereinafter, may be simply referred to as "assessment network") will be exemplified. In this case, the care plan assessment model includes: an input layer including multiple input units; one or more middle layers each including multiple middle units; and an output layer including a single output unit. The assessment network is a multi-layered neural network having N layers including multiple middle layers from an input layer side to an output layer side, and a middle unit included in each of the middle layers outputs information received from one or more middle units (or input units) included in a middle layer at the previous layer position to one or more middle units (or output unit) included in a middle layer at the next layer position. The number (N) of layers included in the assessment network is at least three and can be optionally determined in accordance with the number of combinations of care receiver situations and care plans, for example. The number (N) of layers can be, for example, at least three but not more than 25, and preferably between 5 and 20 (both inclusive), and even more preferably, between 8 and 16 (both inclusive).

[0080] The assessment network can be configured in a manner similar to the above-mentioned plan output network except that an input item to an input layer is set to a combination of a care receiver situation and a care plan and that an inference value outputted from an output layer is set to the probability of improving the level of needed
5 care for the above-mentioned combination.

[0081] In this case, after it is determined in step S540 that a sufficient amount of data is newly registered to storage section 150 (step S540: YES), probability calculating section 130 obtains, from among records stored in storage section 150, a total number of records having the same care receiver situation and the same care plan used for care, and the
10 number of records which are included in the records and which indicate that it is determined that the level of needed care has improved, then calculates the ratio of the number of records indicating that it is determined that the level of needed care has improved with respect to the total number of records (step S550). Processing changing section 140 then changes the assessment network such that the ratio mentioned above is
15 outputted when the combination is inputted to the care plan assessment model (step S570).

[0082] More specifically, processing changing section 140 obtains a difference (error) between the probability of improving the level of needed care outputted from the assessment network when the combination is inputted and the ratio obtained by the calculation. Next, processing changing section 140 changes one or more values of the
20 weights and bias included in any of the middle units and output unit of the assessment network such that the error becomes small.

[0083] Processing changing section 140 then changes by processing similar to the processing in the first embodiment, the plan output network such that the inference value outputted from each of the output units when the care receiver situation is inputted to the
25 plan output network becomes the probability of improving the level of needed care outputted from the assessment network when a combination of the care receiver situation

and the care plan corresponding to the output unit is inputted (step S560-2).

[0084] The method of changing an assessment network and a plan output network is not particularly limited, and a publicly known method such as a gradient descent method using an error backpropagation method can be used. In addition, an error function used in
5 expressing the error in the gradient descent method is not limited to any particular type, and a publicly known formula such as mean square error and cross entropy can be used.

[0085] With this configuration, the probability that the level of needed care has improved with higher accuracy than "the ratio of the records in which the level of needed care has improved" in the first embodiment can be used as a target output value at the time of
10 changing the care-plan output support model. For this reason, the recommended care plan outputted from the care-plan output support model can be a care plan having a higher probability of improving the level of needed care.

[0086] Note that, with this configuration, it is also possible to extract only output from the assessment network and to make prognostic prediction of the care receiver, for
15 example.

[0087] [Third Embodiment]

FIG. 7 is a block diagram illustrating a configuration of a care-plan creation support system according to still another embodiment of the present invention. Care-plan creation support system 700 according to this embodiment includes care-plan changing section 710
20 that changes a care plan displayed on display section 160.

[0088] Care-plan changing section 710 includes various operation keys, such as a numeric keypad and a start key, an audio receiving section, and/or a video receiving section such as a camera, for example, and receives various input operations made by a care manager for changing the outputted care plan, and transmits the generated input data to
25 care-plan outputting section 110. Care-plan outputting section 110 receives the input data and changes the outputted care plan. Note that, although FIG. 7 illustrates an example in

which care-plan changing section 710 and display section 160 are configured as separate components, display section 160 may have an operation portion that is integrally configured with a display screen as in a touch panel or may be configured in connection with a hardware key such as a button or a key to allow display section 160 to
5 simultaneously function as care-plan changing section 710, for example.

[0089] The changed care plan is registered to storage section 150 as in the first and the second embodiments.

[0090] Meanwhile, display section 160 may be configured to connect to a server of a care service provider and to display information such as a reservation state and availability of a
10 care service included in the outputted care plan. With this configuration, for example, when reservation of the displayed care service is determined to be impossible, the care manager can change the care plan on display section 160.

[0091] Moreover, care-plan changing section 710 may be configured to connect to a server of a care service provider and to allow for arrangements of a care service via input
15 from the touch panel key or hardware key, for example.

[0092] [Fourth Embodiment]

FIG. 8 is a block diagram illustrating a configuration of a care-plan creation support system according to yet another embodiment of the present invention. Care-plan creation support system 800 according to this embodiment includes cloud server 810 which is a
20 virtual server cooperating with various devices via the Internet. Cloud server 810 saves therein part or the entirety of a program for executing processing performed by care-plan outputting section 110, determination section 120, probability calculating section 130, and processing changing section 140 as well as data stored in a storage medium such as storage section 150, for example.

25 [0093] Cloud server 810 is owned, managed, and operated by an operating company operating a care business or a subcontractor operating the care business outsourced by the

operating company (hereinafter, may be simply referred to as "operating company 830"). Operating company 830 accesses cloud server 810 from one or more processing sections 835, each being a PC or the like connectable to cloud server 810, and causes processing section 835 to execute the processing.

5 [0094] In this case, input section 170 can be an Internet connectable device (such as a smartphone, PC, or TV, for example) owned by group 820 such as an assessment business operator that makes assessment on a care receiver. The input data inputted from the above-mentioned device serving as input section 170 is transmitted to cloud server 810 from the device. In this case, it is preferable that input section 170 be configured to
10 automatically delete personal information such as the full name and birth date of a care receiver and a care receiver situation after transmission of the input data.

[0095] Furthermore, in this case, display section 160 can be an Internet connectable device (such as a smartphone, PC, or TV, for example) owned by group 840 such as a care manager creating a care plan. The care plan outputted from care-plan outputting section
15 110 is transmitted to the device serving as display section 160 and displayed on display section 160. When group 840 corrects the care plan on display section 160, the corrected data is transmitted to cloud server 810.

[0096] Note that, groups 820 and 840 may be the same business operator or individual.

[0097] The embodiments described above each illustrates only an exemplary
20 embodiment mode for carrying out the present invention, and the technical scope of the present invention should not be restrictively interpreted by these embodiments. In other words, the present invention can be carried out in various forms without departing from the gist or the primary feature of the present invention.

[0098] In each of the embodiments described above, for example, a case where the level
25 of needed care is changed by one level and a case where the level of needed care is changed by two or more levels are treated in a similar manner as data pieces each

indicating that the level of needed care has improved, but the data pieces may be used for the learning processing while the degrees of improvement are each assigned a weight depending on how many levels the level of needed care has improved by the past care plan.

[0099] In each of the embodiments, storage section 150 is described as an element
5 incorporated into the care-plan creation support system, but storage section 150 may be configured independently of the care-plan creation support system and configured to allow the data for carrying out the processing mentioned above to be referred by connection via the care-plan creation support system. In this case as well, storage section 150 may be stored in a cloud server in the fourth embodiment.

10 [0100] Moreover, in each of the embodiments, the result of determination made by determination section 120 is registered to storage section 150, and probability calculating section 130 newly calculates the probability of improving the level of needed care using the registered result of determination, but the past level of needed care and the level of needed care included in input data may be registered to storage section 150 in advance, and
15 determination section 120 may determine a change of the level of needed care by comparing the two levels of needed care registered to storage section 150. In this case, a change of the level of needed care as a result of provision of care using the care plan may be separately registered to storage section 150.

[0101] In the third embodiment, it is possible to employ a configuration in which
20 multiple care plans are outputted from care-plan outputting section 110 as recommended care plans, and a care plan selected by a care manager from among the multiple care plans is inputted from care-plan changing section 710, and the selected and inputted care plan is registered to storage section 150.

[0102] In each of the embodiments, display section 160 is described as a smartphone or a
25 tablet PC that can be carried around by a care manager, but display section 160 may be a desktop PC or the like installed at a business office or the like, and a care manager may

create a care plan while checking a recommended care plan displayed on the screen of the desktop PC. Note that, outputting section 160 may be configured not only to display a care plan on a screen, but also to read aloud as audio.

[0103] The present application claims priority based on Japanese Patent Application No. 2016-155859 filed on August 8, 2016, the contents of the claims, description, and drawings of which are incorporated herein.

Industrial applicability

[0104] According to the care-plan creation support system of the present invention, a care plan having a high probability of improving the level of needed care can be outputted in accordance with each care receiver situation, and also the accuracy of output can be increased by the learning processing. Thus, when a care plan created using the care-plan creation support system of the present invention is provided to a care receiver, improvement of the level of needed care of the care receiver can be expected. When the level of needed care of the care receiver improves, reduction of the care benefit expense, reduction of the care unemployment, and/or the like are anticipated, and suppression of the financial and social burden due to the increase in care receivers can be expected.

Reference Signs List

- [0105]
- 100, 700, 800 Care-plan creation support system
- 110 Care-plan outputting section
- 120 Determination section
- 130 Probability calculating section
- 140 Processing changing section
- 150 Storage section

- 160 Display section
- 170 Input section
- 710 Care-plan changing section
- 810 Cloud server
- 5 820 Group
- 830 Operating company
- 835 Processing section
- 840 Group

CLAIMS

Claim 1 A care-plan creation support system comprising:

a care-plan outputting section that obtains, for each care plan, using a care-plan output support model, a probability of improving a level of needed care of a care receiver for input of a care receiver situation, and outputs, as a recommended care plan, a care plan for which the obtained probability is higher, the care-plan output support model outputting, for each care plan, the probability of improving the level of needed care for the input of the care receiver situation;

a determination section that determines whether or not the level of needed care of the care receiver after provision of care using the outputted care plan to the care receiver has improved;

a probability calculation section that newly calculates, using a result of the determination by the determination section, the probability of improving the level of needed care of the care receiver when the care is provided according to the outputted care plan; and

a processing changing section that changes the care-plan output support model such that a probability to be obtained for the outputted care plan for input of the care receiver situation becomes close to the calculated probability.

Claim 2 The care-plan creation support system according to claim 1, wherein the care-plan output support model includes a neural network.

Claim 3 The care-plan creation support system according to claim 1 or 2, wherein the care receiver situation is a result of selecting an option for a survey item determined for use in certifying the level of needed care, the option most matching the care receiver situation.

Claim 4 The care-plan creation support system according to any one of claims 1 to 3, further comprising a care-plan changing section capable of changing output from the care-plan outputting section.

5 Claim 5 The care-plan creation support system according to any one of claims 1 to 4, wherein the determination section determines whether or not the level of needed care of the care receiver newly inputted after the provision of care using the care plan has improved as compared with the level of needed care of the care receiver before the provision of the care.

10 Claim 6 The care-plan creation support system according to any one of claims 1 to 5, wherein at least part of a program for executing processing by the care-plan outputting section, the determination section, the probability calculation section and the processing changing section is saved in a server.

15 Claim 7 The care-plan creation support system according to claim 6, wherein at least part of a program for executing processing by the care-plan outputting section, the determination section, the probability calculation section and the processing changing section is saved in a cloud server.

20

Claim 8 A care-plan creation support method comprising:

obtaining, for each care plan, using a care-plan output support model, a probability of improving a level of needed care of a care receiver for input of a care receiver situation of the care receiver, and outputting, as a recommended care plan, a care plan for which the
25 obtained probability is higher, the care-plan output support model outputting, for each care plan, the probability of improving the level of needed care for the input of the care receiver

situation;

determining whether or not the level of needed care of the care receiver after provision of the outputted care plan to the care receiver has improved;

5 newly calculating, using a result of the determining, the probability of improving the level of needed care of the care receiver by the provision of the outputted care plan; and

changing the care-plan output support model such that a probability to be obtained for the outputted care plan for input of the care receiver situation becomes close to the calculated probability.

10 Claim 9 A care-plan creation support program causing a computer to execute processing comprising:

obtaining, for each care plan, using a care-plan output support model, a probability of improving a level of needed care of a care receiver for input of a care receiver situation of the care receiver, and outputting, as a recommended care plan, a care plan for which the
15 obtained probability is higher, the care-plan output support model outputting, for each care plan, the probability of improving the level of needed care for the input of the care receiver situation;

determining whether or not the level of needed care of the care receiver after provision of the outputted care plan to the care receiver has improved;

20 newly calculating, using a result of the determining, the probability of improving the level of needed care of the care receiver by the provision of the outputted care plan; and

changing the care-plan output support model such that a probability to be obtained for the outputted care plan for input of the care receiver situation becomes close to the calculated probability.