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ARTICLE

New Paradigm in Nutrition Practice – Initial Findings From Ntuitive Software

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ABSTRACT

Objective: Nutrition practice in India has generally been confined to pen and paper with little use of algorithms and technology. Nutritionists in practice find it difficult to go beyond macronutrient analysis for dietary intake or diet plans. Since nutrition practice requires lot of data processing, we decided to develop software to aid in these calculations and to empower nutritionist with technology enabled scientific practice using software. Method: Ntuitive software was developed by a team of nutrition experts and technologists over a period of 18 months. Data for nutrient values was sources from IFCT 2017 [6], RDA's were taken from ICMR guidelines and growth charts from IAP publications [7]. Design and coding of the software was done inhouse. Ntuitive database has over 8500 recipes and packed foods and has most of the national and international cuisine items. The software module enables client / patient management, detailed profiling, recording anthropometric data and plotting on WHO and IAP growth charts, recording food allergies and medical condition. The dietary recall be it one day, three day or seven day can be easily recorded and analysis of nutrients can be obtained for the same. The software is hosted on Amazon Web Server and applied as SAAS platform for practice. Result: 800 children and adults underwent analysis and consultation using Ntuitive software. All 189 micronutrients could be calculated using the software and deficiency or excess quantified when compared with RDA. Conclusion: Nutrition practice can be made easy and technology enabled keeping in mind scientific standards. This helps in data collection not just in macro nutrients, but also in micronutrients.

1. Introduction

Nutrition sector is a continuously emerging sector and in today's world technology is rapidly making its way into dietetics practice. It is a fact that technology can radically alter the way nutritionists connect with their clients, discover new clients, and contribute to positive nutrition care. Technology can be a crucial asset in nutrition care if utilised to practice effectively in clinical or hospital settings either at an OPD, IPD or even at a private clinic level.

In many foreign countries like USA, Australia, UK, New Zealand, Canada etc nutritionists have aid to softwares which enhances their skill and are able to deliver better guidance. Nutrition practise in India is majorly limited to calculations using paper and pen. Appointments

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of clients are generally managed either through mail or phones or by maintaining diaries and it becomes difficult to keep a record of them. Even, medical records and follow up of patients at large are maintained on papers. Nutritionists utilise a major portion of their time maintaining and tracking data of their clients. Also, keeping a track of this huge amount of data becomes difficult when practice increases multiple fold.

With diverse flow of patients and clients, it becomes tedious and time consuming to calculate all the nutrient requirements, infact, even macro nutrients for each patient. The dietitian has to be all over google and refer different sources for obtaining authentic information with regards to specific nutrients found in food or nutrient rich specific foods. Easing out the calculations, hassle-free management of clients as well as finding authentic information under one roof will definitely be a boon to the nutritionists as that will save lots of time and resources and help them channelise their energy in providing efficient nutrition care to their clients.

Keeping this in mind, Ntuitive software was created by an expert team of nutritionists and technologists. After reviewing softwares like ESHA [2], Nutrium [1], and NutritIO [3]; it helped the team to develop the software strategically. Taking the international software ESHA [2] as a base, the team could start off with the basic designing of the software keeping the Indian scenario in mind. Nutrium helped in further developing the design which enhanced the way a nutritionist could function on the software [1]. NutritIO, as well became useful to bridge the gap between patient and nutritionist by helping to understand how to converse with each other [3].

Ntuitive is a perfect combination of nutrition and technology simplifying the work of multi-tasking nutritionists. Though similar softwares are present in foreign countries, with diverse culture, eating habits and food found all over India, there was a need to create a software catering to Indian data.

This software serves the purpose of practicing complete nutrition care at a click. Apart from processing a lot of saved data for providing nutrition care, the nutritionist is also able to utilise the same data in doing advanced researches.

2. Methodology

Looking at the urge of creating an all-rounder tool for the nutritionists, a meticulously planned and fully functional software was developed by a team of nutrition experts and technologists over a period of 18 months. Coding language used by technology department were HTML, CSS, Angular JS, Ruby on Rails, PosGres, Java Script, GitHub and AWS Cloud. Data was derived from authentic sources like IFCT (Indian Food Composition Tables) 2017 (for nutrient values) [6], Recommended Dietary Allowance's were taken from ICMR (Indian Council of Medical Research) guidelines and growth charts from IAP (Indian Academy of Pediatrics) publications [7] and World Health Organization [8].

The module of the software was designed to work in perfect coordination with the process of nutrition consultation .The various sections which were designed included:

2.1 Appointment Calendar

The software ensures smooth tracking of upcoming appointments as well as follow-ups and helps in managing clients easily across multiple clinics. The nutritionist can keep a track of patients or clients consulted in different clinics by creating multiple clinics. The patients can be classified into different clinics based on their medical condition.

It ensures that the nutritionist never misses any of the scheduled clients. Through the appointment calendar, it becomes a matter of seconds to handle appointments efficiently.

2.2 Client Management

This shoots out an easy accessible list of clients. Also, helps to segregate clients as per clinics. This functionality is quite useful in searching for a specific client from a huge list.

2.3 Detailed Profiling

Basic Information like Gender, Date of Birth, Height, Weight, BMI (Body Mass Index), Plotting on growth charts, Preferences, Allergies and Medical conditions can be recorded using this feature of the software. Specific Questionnaires can be prepared as per the client or the medical condition handled and utilized accordingly. This information could include fluid requirement, biochemical parameters, temperature, etc. and would be saved in the profile of the client. Multiple such questionnaires can be created which eventually can be very well utilized for analyzing data or could prove beneficial during consultation.

2.4 Recording Food Intake

There is an easy to use calendar interface to maintain food, water and activity records of the client as per date and time. This recall can be for one or multiple days. The clinical or other observations can also be recorded in the notes section for additional information to be associated

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with the client.

2.5 Configuring Recommended Allowances (RDA) of Nutrients

There is an option to choose appropriate and patient specific recommended requirements from the pre-listed formulae for both macro nutrients as well as micronutrients. Nutrition Atlas was referred to understand the range, sources and deficiency of each nutrient [5]. Disease specific nutrient requirement formulae can also be configured easily. The software allows the nutritionist to change the requirement as and when required. The default requirement adheres to Indian Council of Medical Research (ICMR) recommendations.

2.6 Analysis- Day-wise/Meal-wise of the Food Intake

Nutritionists spend most of their time in calculating micronutrients and disease specific nutrients. All 189 nutrients mentioned in IFCT 2017 [6] and NIN (National Institute of Nutrition) [4] is calculated within seconds in Ntuitive. Multiple day recalls can be saved in Ntuitive and analysis can be obtained in a click. In the analysis section, the nutritionist is not only able to understand how much requirements are being met, but the nutritionist can also check the specific food sources from which the nutrients are derived. Detailed nutrient intake analysis across months, weeks, days, meal-times and food items is possible through this section. One can also view aggregated energy distribution charts for all or selected days. There is an option to create custom templates of nutrients for targeted specific analysis. The analysis can also be shared with the client through a shareable link.

2.7 Advanced Diet Planner

It is an experience to create diet plans adhering to RDA by adding foods or nutrient dense ingredients with real time charts. The nutritionist can make multiple menu plans (day-wise) and also meal-wise plans and save it as templates. These could be easily re-used in different combinations and permutations to create unique plan for each client without spending time on calculations. While creating these plans, the nutritionist gets a visual display of how much recommended requirements are met. The nutritionist have an option to provide 7 days diet plan to the clients or generic plans keeping in mind the convenience of the client.

2.8 Curating Specific Guidelines

Nutritionist can make guideline templates using this feature of the software and save it for future use. These guidelines can be based on specific medical condition or some general instructions which need to be given to clients can be generated. Creating multiple templates for guidelines make the consultation speedy. These guidelines could be integrated directly in Client Consultation Interface.

2.9 Client Consultation

For consultation, a special interface is linked which can be utilized by the nutritionist to explain how much recommended requirements are being met. The nutritionist can also show client or patient the sources from where the nutrients are being consumed. This gives the clients a visual representation of their food and nutrient pattern and helps the nutritionist to self-educate the clients.

2.10 Sharing Reports with the Client

Nutrient reports can be generated based on the food intake documented and can be shared to the clients either by sending a message link or on email.

2.11 Information Centre

The most time consuming task is finding which nutrient is present in particular food ingredient or what are the richest sources of a particular nutrient. Ntuitive is a pool of such vital information and it's just a matter of few fractions to browse for the required data. This information is taken from IFCT 2017 [6] and NIN [4]. The nutritionist can find the rich food sources of a particular nutrient or all nutrients present in a particular food ingredient.

2.12 Recipe Database

Ntuitive database has over 8500 recipes and packed foods and has most of the national and international cuisine items. The ntuitive database has recipes which are all standardized recipes created using nutrient values from ICFT 2017 [6] and NIN [4]. With diversity in eating habits, recipes from all over India are found and are being added on day to day basis. The nutritionist can also create new recipes as per their need and share them with others. The software consists of many international ingredients and recipes which are sourced from USDA (United States Department of Agriculture) [9].

The software is cloud based, meaning all the data entered in the software is stored in Amazon Web Server and applied as Software as a Service (SaaS) platform for practice. Hence, there is no limit in saving or creating the data and the data remains safe.

Also, each nutritionist can have their own account.

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Each account information remains confidential and is not shared without the permission of concerned nutritionist.

The software can be used in multi-speciality hospital, with multiple nutritionists functioning and using the software. In this scenario, the chief dietitian can have all the rights to assign the clients to other nutritionist of the team.

After creating the software, we decided to check the functionality and feasibility of the software by conducting nutrition consultation for a sample size of 500 adults and children. The sample populations were residents of Mumbai, Thane and Navi Mumbai. The software was fruitfully utilized right from booking appointments to maintaining the patient profile, to feeding in the food intake as well as for doing final nutrient analysis and final consultation with the clients.

3. Results and Discussion

Nutrition consultation was conducted for a sample size of 500 children and adults using Ntutive Software.

Listed below are the detailed set of observations that we made about how the software was utilized step-wise to manage the entire process of consultation for the sample size mentioned.

3.1 Managing Appointments

The software was first used to manage appointments and first visit of the client. 500 clients could be easily managed using the 'manage appointment feature' of this software. Segregating the clients as per the schools or the clinics was quite easy. One could also search for a specific client easily either by putting up a contact number or search could be even performed by entering the first/last name of the client for locating the client account. Appointments could be added for current date as well as future dates. It thus, proved to be an easy tool to manage the appointments in a systematic manner. Listed below in Figure 1 is the appointment screen wherein all clients could be seen under a respective activity/clinic.

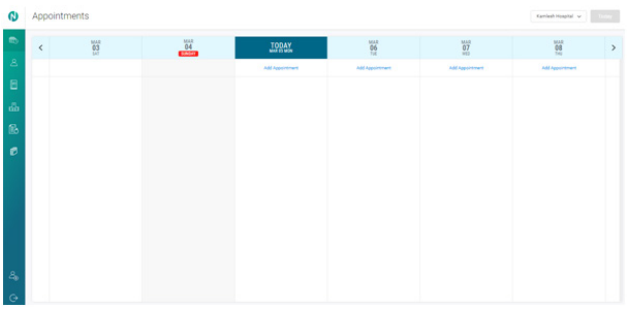

Figure 1. Appointment schedule

Once an appointment was booked, they were seen as shown in figure 2

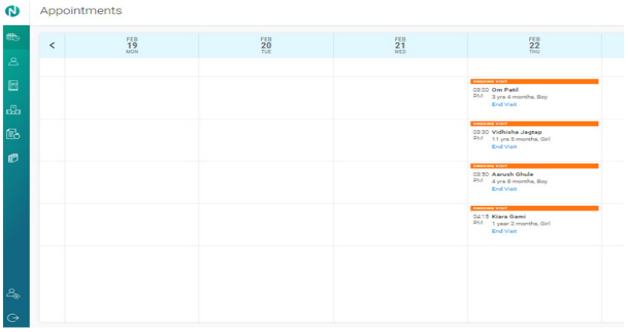

Figure 2. Scheduled appointments view

With client management as shown in figure 3, it was convenient to visualise the total number of clients. It even gave details of the last appointment and had a tab to schedule new appointment if follow-up was advised for the same client/patient.

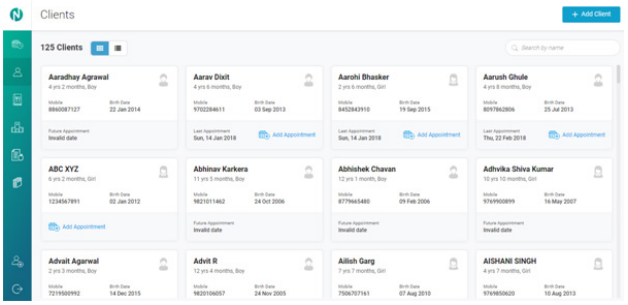

Figure 3. Current data (personal details of the clients/patients)

3.2 Client Profiling

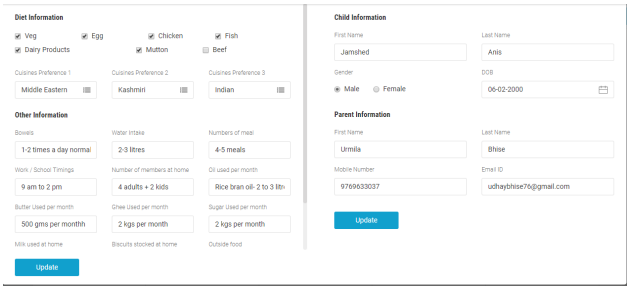

Figure 4. Basic Profiling

Basic profiling information like food and cuisine preferences was recorded. General details like bowel movements, water intake, and monthly consumption of oil, ghee, sugar and butter were also listed. Regular schedule of the clients were recorded along with eating habits.

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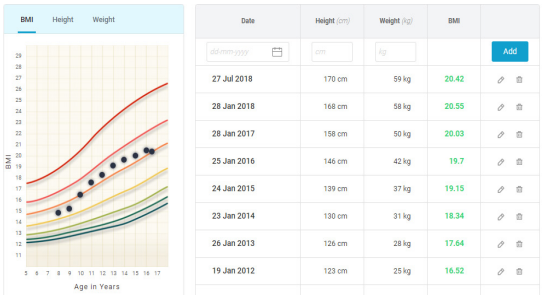

Figure 5. Growth charts

Height, weight and BMI of the client or patient were recorded. For pediatric age group, 0-5 years, the height, weight and weight for height were plotted on the World Health Organization (WHO) [8] growth charts and clients between 5-18 years were plotted on Indian Academy of Pediatrics (IAP) [7]. These formulas were in the database which helped achieve easy calculation of the same. Ideal weight of the child was obtained by back calculation of Body Mass Index (BMI) on the system itself and the ideal weight of adults, was obtained by Broca's Index formula. There was a provision to enter height and weight for multiple visits.

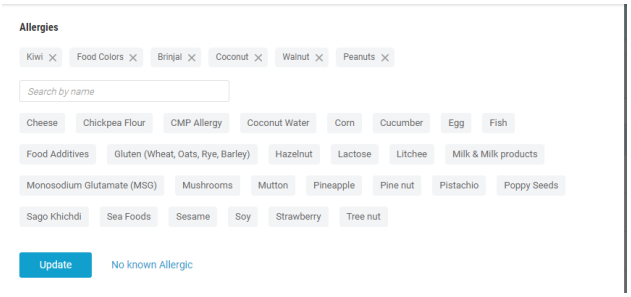

Figure 6. Selection of allergies

Food related allergies also could be selected. This allergies were highlighted as red alerts in the diet plan, which indicated the nutritionist to avoid the recipe having the allergic ingredient while making the diet plans.

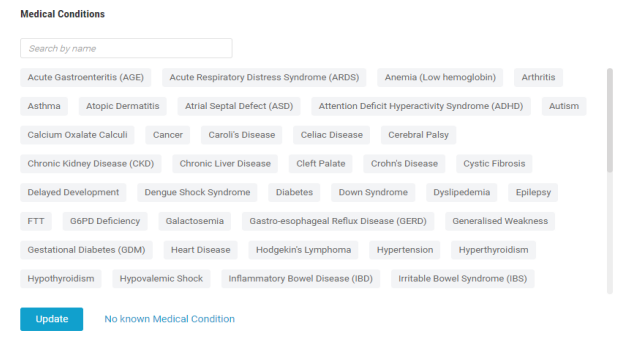

Figure 7. Selection of medical condition

Medical condition can be selected and added as a part of basic profiling.

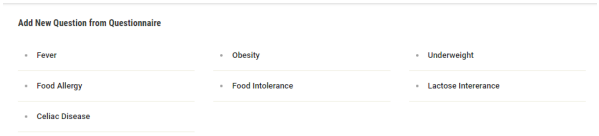

Figure 8. Selection of questionnaire

Questionnaires could be created and saved with reference of disease or medical condition name. The questionnaire could have biochemical parameters, intake and output questions etc. Below is the image of questionnaire created for fever template.

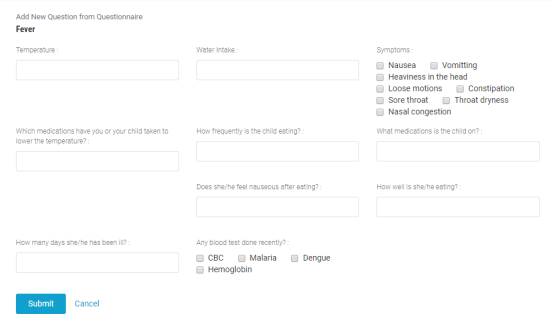

Figure 9. Condition specific questionnaire

Multiple sentences, paragraph, multiple choice can be added while making the questionnaire. This feature assisted us with collecting more information about the client.

3.3 Maintaining Client Food Diary and Notes

The software was quite user-friendly in terms of entering the food recalls for the sample size chosen for multiple days. We took recalls majorly for 7 days, however depending upon the data received, some clients even chose to give data only for 3 days or 5 days. Day-wise meal entries, water intake and activity data for the clients was added using this interface section of the software. There was an option to enter a date, time as well as select a specific recipe from the list of recipes found in the master database. One could choose the quantity and the portion size of the food consumed.

Figure 10 shows steps on selection of a date and selecting from the option of adding meal, water or adding activity for the client.

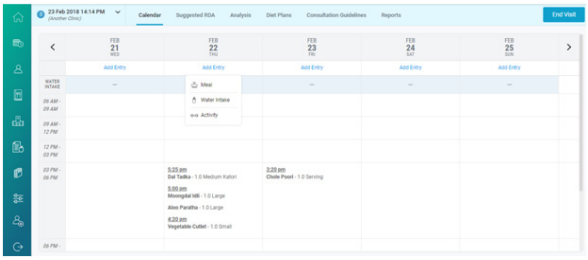

Figure 10. Food diary calendar view

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Further clicking on the meal option, another pop-up box (as shown in Figure 11) to fill the details of the timings, food consumed and the portion size was available. The steps were repeated to add the intake for a full day/ multiple days (as shown in Figure 12)

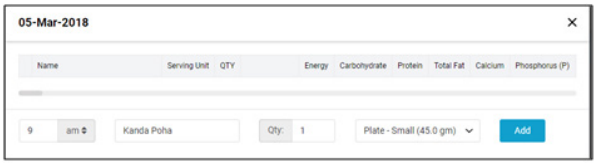

Figure 11. Selection of food item to fill food diary

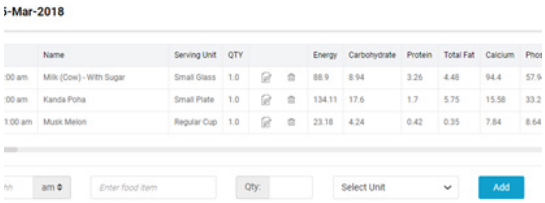

Figure 12. Recording food data

This is how a calendar looked (as in Figure 13) after filling in meal details for 4 days. One could go back and edit meal/water/activity options as per need.

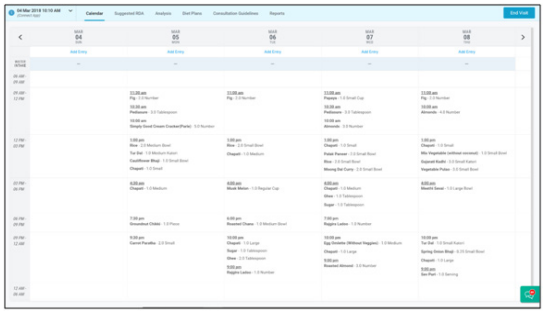

Figure 13. Food diary overview

We could also add different notes about client, their meal patterns and specific requirements in notes as shown in figure 14 below. These notes were quite helpful to add on more information about the client that was utilized appropriately during the diet planning as well as the consultation process.

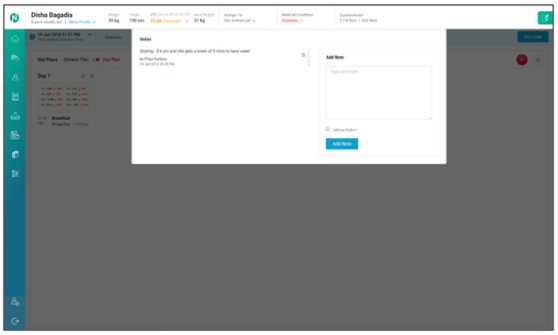

Figure 14. Notes section

3.4 Working on Formulae/Suggested RDA

The default formula set in the database was as per RDA. Suggested RDA is seen in the analysis while comparing client's meal intake. However, formulas/ RDA could be changed/edited as per client case/medical condition by clicking on edit as shown in Figure 15. Being easy to edit the formulae made it ever more easier to generate the analysis at the click of a button.

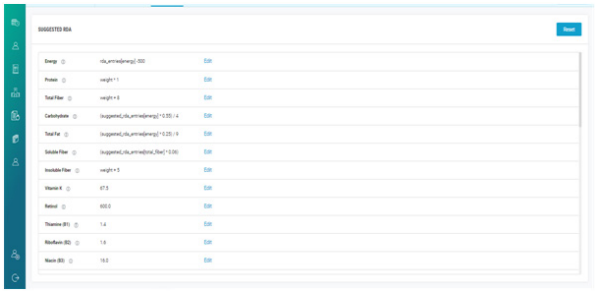

Figure 15. Suggested RDA

3.5 Analysis of the Food recall

Once a multiple day recall of the client is taken, the analysis per day was calculated under Analysis tab. The calculations were based on food items entered during recall. The percentage shown in figure 16, next to the intake, indicated the deficit or excess quantity of the specific nutrient. This analysis was shown for all the 189 nutrients listed in IFCT 2017 [6]. This section could help us keep a tab on the range of nutrients coming from the diet on a daily basis.

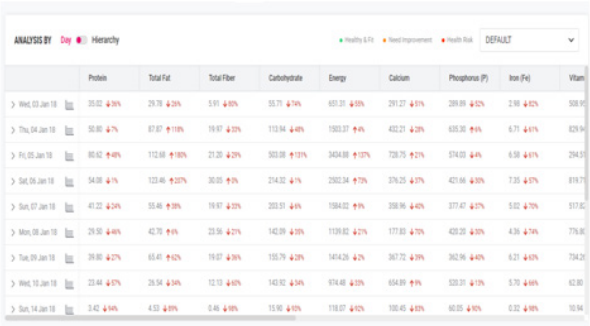

Figure 16. Food diary analysis

Further this could be divided also into meal wise and food wise calculation on clicking the drop-down arrow. as shown in figure 17. That helps the nutritionist to study meal wise and food wise distribution of nutrients.

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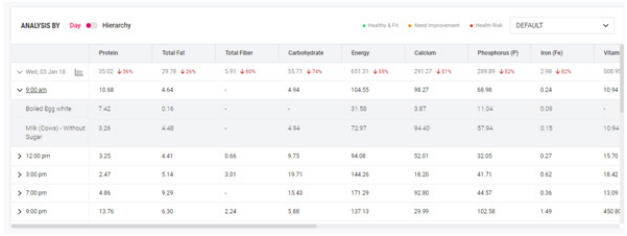

Figure 17. Meal wise analysis

The nutritionist could also select the number of days and find out how much requirement the client is meeting. Only specific days could also be selected from a whole lot entered to analyze nutrient ranges in a particular period.

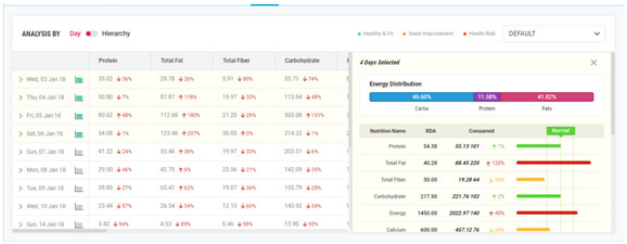

Figure 18 Analysis in comparison with RDA

The graphical representation can be obtained for one or more days. Figure 18 shows graphical representation for 4 days.

3.6 Diet Planning

Effective diet Plans could be created quite easily for the clients along with real time correlation with RDA using Ntuitive.

Meal wise diet plan entries could be done with suggested individual food item along with serving size and simultaneously nutrient's value could be checked for individual food item compared to RDA value as shown in figure 19.

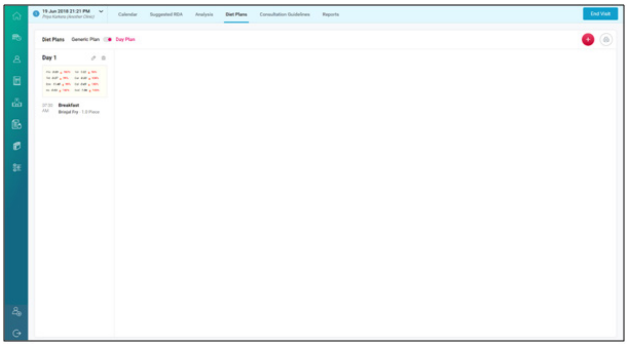

Figure 19. Creating Day wise diet plans

Diet plan could also be customised based on disease specific nutrient calculations by clicking on 'Default' (shown in figure 20).

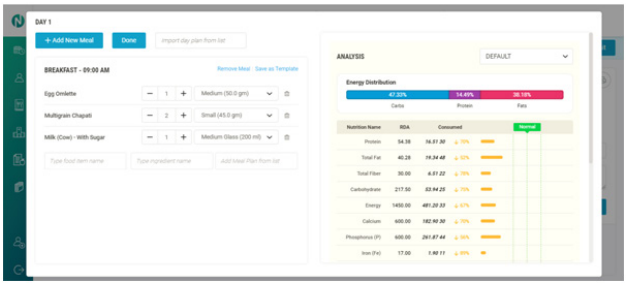

Figure 20. Entering meals in the diet plan (Left) and nutrients values (right)

Meal plan templates could be saved by making a meal plan and then saving it as 'Save as Template' along with adding a name to the meal plan. Examples of template name can be Protein Rich Breakfast, Low Carbohydrate Snack, etc. List of saved meal plans could also be viewed as shown in figure 21.

Figure 21. Sample Meal Plans

Entire Day Plans could be created and saved as templates too. To make a new day plan, click on 'Add Day Plan' and give the desired name of the template as shown in figure 22. Example- Lactose Free Diet, Ketogenic Diet, Low Carbohydrate Diet, etc.

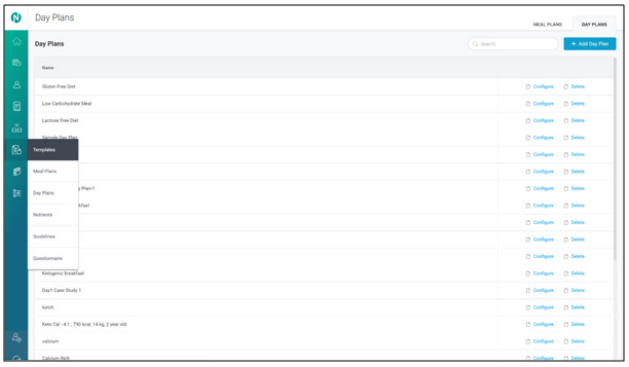

Figure 22. Sample Day Plans

The option to save Meal Plans and Day Plans as template was a boon as one could easily replicate individual client based diet plans extracting these saved templates.

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Diet plans made could be saved in .pdf format and mailed to the client or could be printed and given to the client as a hard copy.

3.7 Curating Consultation Guidelines

This section helped the nutritionist to prepare structured guidelines based on individual nutrients. These could be tailor-made for the specific client based on the food diary analysis, food habits, activity level, food allergies/intolerances and medical conditions, if any (collated during basic profiling).

Guidelines could be created either by creating templates and saving them to edit later and utilise specific to case of the client (as displayed in figure 23)

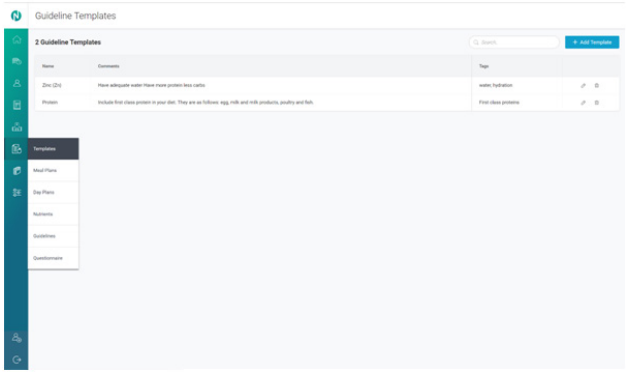

Figure 23. Guidelines templates

or they could be directly written in the client profile after analysing the report (as in figure 24)

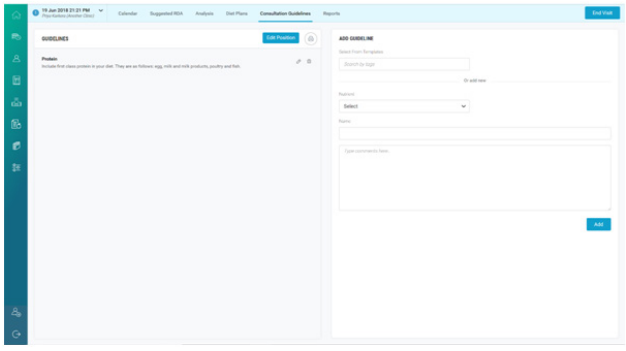

Figure 24. Final Guidelines

These saved guidelines can be referred to during one-to one consultations as they are integrated directly in client consultation interface or could also be shared with the client by clicking on 'Print icon' option at the top of the tab as seen in the figure 24.

One could also select individual nutrient and write guidelines pertaining to that nutrient by clicking on 'Nutrient' option to create nutrient specific guidelines as shown in figure 25 and figure 26.

Thus, a lot of time was invested in creating templates and later quickly editing them to make them more client specific.

Figure 25. Nutrient wise guidelines

Figure 26. Nutrient wise guidelines

3.8 Generating Reports and Client Consultation Interface

Reports tab (refer figure 27) was one of the most important tabs since it showed the total nutrient analysis of a client's recall. This tab helped to understand which macronutrient or micronutrient the client is deficient or excess with. On the basis of these findings, one could create guidelines or new diet plans for the client.

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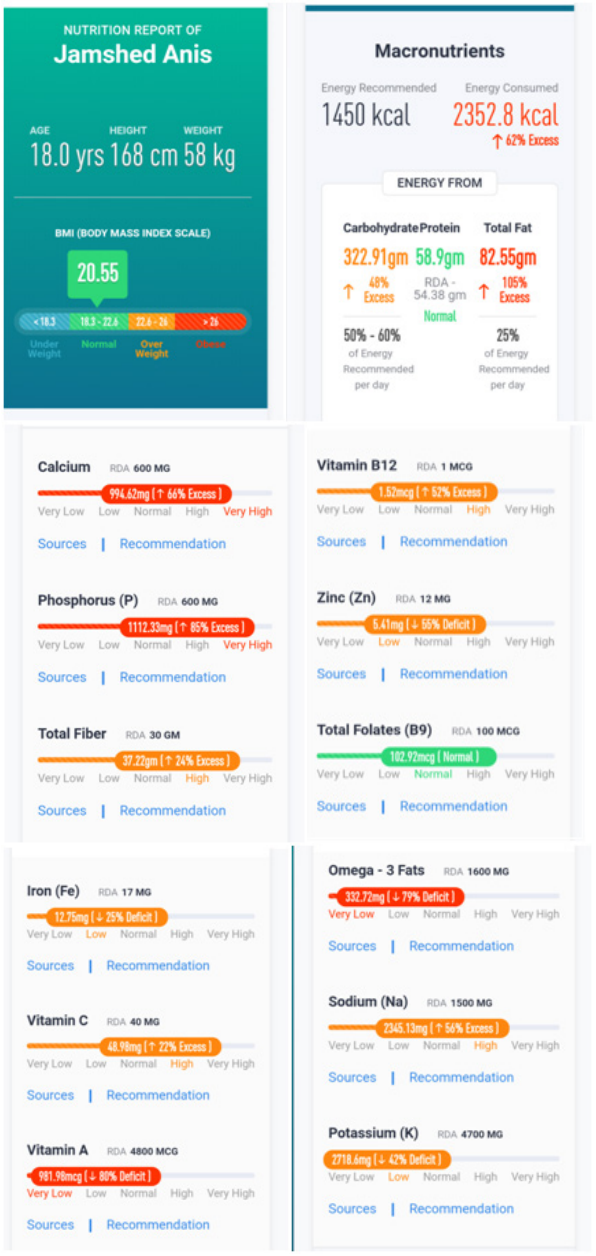

Figure 27. Mobile report

If any of the nutrients displays deficit/excess, one may choose to view the sources of food from the individual's diet which contribute to that nutrient. The values or percentage of excess and deficit of each nutrient are set by referring values given by ASPEN guidelines. These nutrient values are derived from the food consumed by the client, taking into consideration the absorption of each nutrient in different food groups.

To view the individual nutrient sources, click on the right side of the report which opens up a consultation interface as seen in figure 28 and 29 to check which foods contribute to which amount of the selected nutrient.

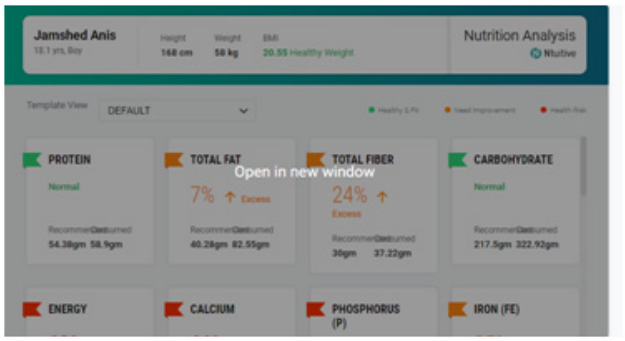

Figure 28. Nutrient wise consumed sources

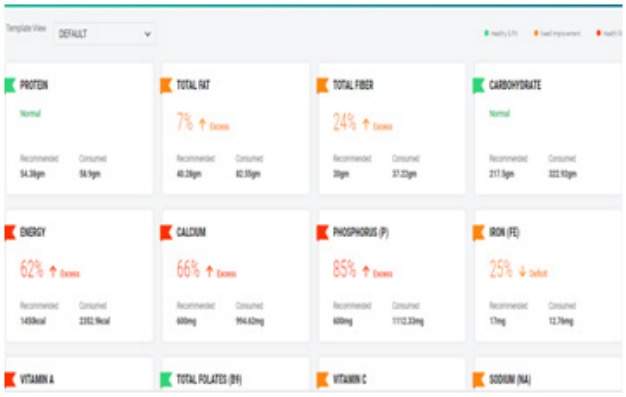

Figure 29. Nutrientwise Food Sources

One can also choose the nutrient whose sources want to be viewed by clicking on the nutrient. Figure 30 shows the sources of nutrient. This can be easily transmitted to the client during consultation. This gives the client a reality check of the food sources and their exact nutrients being consumed which further assists in smooth consultation process and making the client understand where the diet should be exactly worked on.

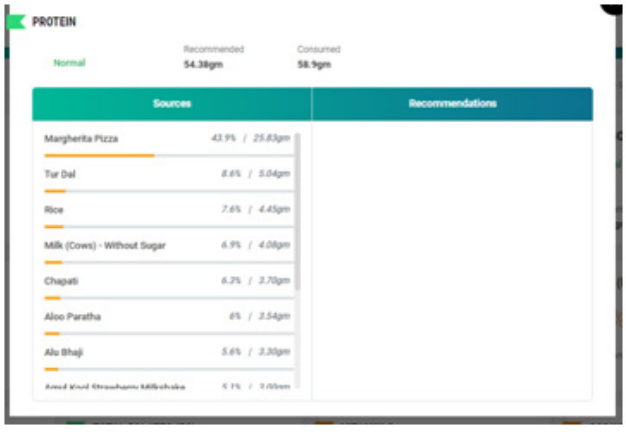

Figure 30. Food sources

Disease specific nutrients and nutrient related sources could also be viewed using the 'Template View 'option shown in figure 31 on top of the sources screen to select

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a specific disease and view only the disease specific nutrient and nutrient related sources. This certainly took off a burden off our shoulders to easily concentrate on more case-specific nutrients specially for certain disease related clients from the huge sample size

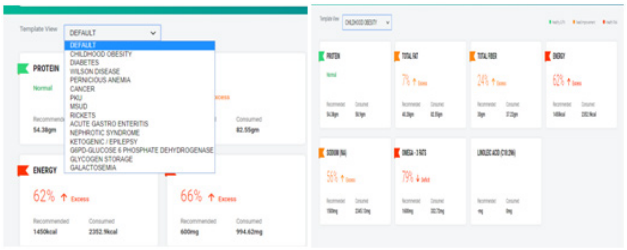

Figure 31. Condition Specific Nutrients

3.9 Knowledge Centre

This section could also be referred to as information pool since it includes sources and RDA of definite nutrients as well as specific ingredients all at one junction. Select a specific ingredient or nutrient to find more about it at the click of a button.

(1) Nutrient Knowledge Centre:

Total 189 nutrients are listed in knowledge centre as seen in figure 32

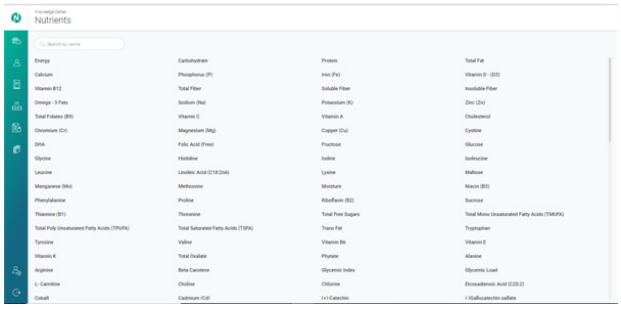

Figure 32. Knowledge Center

Each nutrient has information listed about its chemical nature, functions, rich food sources, cause of deficiency, treatment, toxicity, digestion and absorption, signs and symptoms, RDA for different age groups and ingredients with grammage of that specific nutrient as seen in figure 33.

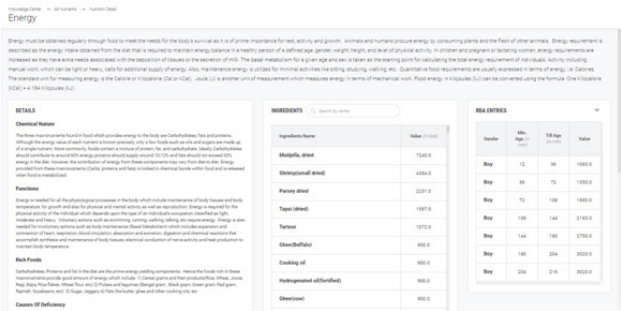

Figure 33. Knowledge center

(2) Ingredient Knowledge Centre:

Around 800 ingredients from IFCT [6], NIN [4] and USDA [9] are present in the ingredient sheet. A gist of ingredients can be seen in figure 34.

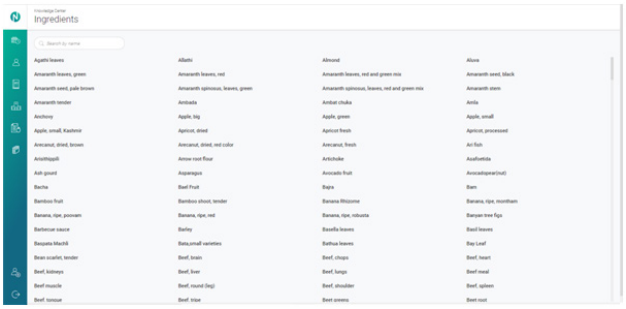

Figure 34. Knowledge center

Each ingredient as shown in figure 35 displays information about the nutrient content, summary, benefits, caution, recommended in and not recommended in. Along with it, a list of recipes present from the master recipe database which has the ingredient is displayed.

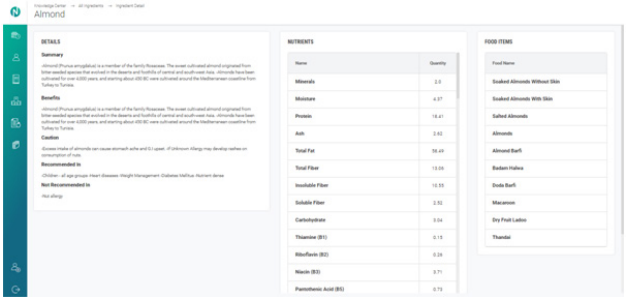

Figure 35. Knowledge Center

We could calculate all 189 micronutrients for 500 children and adults who underwent analysis and consultation using the functionalities of these Ntuitive software and deficiency or excess could be quantified when compared with RDA.

With the help of the functionalities of the software, the data could be accessed at any point of time and the nutritionist got a chance to view the entire case. The most tedious and time consuming tasks saved on quite an amount of time with the help of the software, especially the calculations for the diet plan and the client consultation interface which enhanced the consultation quality.

4. Summary and Conclusion

Nutrition practice can be made easy and technology enabled keeping in mind scientific standards. A walk-through of the entire software makes one realise how dietetics practice can become much easier. Quality amount of time can be devoted by the nutritionist in providing nutrition care to the clients rather than spending time on

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calculations or maintaining records. This not only helps in easy data collection of macro nutrients, but also of micronutrients. Managing a huge chunk of clients and maintaining accessibility to their information is much easier with this software coming in practice.

Loaded with information, the functionalities of this software definitely makes it a ready-reckoner for every working nutritionist in the dietetic fraternity as it can be used to enhance the knowledge and skills of the nutritionist. With the practical difficulties faced by the practising nutritionist, this software is like a boon saving time, enhancing the skills as well as taking the dietetic practice to a different level.

With the help of the software, the Ntuitive was successful in testing the nutritional assessment of 800 children and adults. The time spent on taking recall and getting the nutrition analysis was merely few minutes. All 189 nutrients were calculated with statistics of how requirements are being achieved. Based on their analysis weekly plans were provided to clients which were specific to their needs and customized. As the nutritionist can view the requirements achieved while planning, it became very easy to create multiple plans for them. Lastly, during consultation, with technological appeal, it became easy for client to understand where are they lacking and where they need to improve.

Thus the goal of improving the lifestyle and medical condition was achieved with easy, innovative and scientific aid of Ntuitive software.

Acknowledgement

The need of technology for nutrition was always there, but it would not have been possible without the vision of CEO Dr Arbinder Singal, Fitterfly technologies and Mr. Shailesh Gupta. A heartwarming thank you to Mr. Jayesh Sawant, Technology head and his team for leading the technology development. With the help of Nutrition team, the software could be tested and launched for mass practice.

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