

# **THE DEVELOPMENT OF A NUTRITION AND PHYSICAL ACTIVITY EXPERT DASHBOARD TO SUPPORT A PERSONALISED MOBILE APPLICATION ACROSS VARIOUS EU POPULATION GROUPS**

A White Paper

*24.03.2022*



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 817732

## Abstract

This paper presents the design and development of the PROTEIN nutrition and physical activity expert dashboard ('the expert dashboard') which is used across all PROTEIN pilot implementations and across various EU population groups. This prototype dashboard, based on an existing platform provided by a consortium partner, is expected to facilitate the monitoring of pilot activities via a user-friendly interface. The expert dashboard can also serve as an example of a necessary asset for achieving Personalised Nutrition via a mobile application, in collaboration with Healthcare Professionals.

## Introduction / Background

There is a vast number of diet and health mobile applications ('apps') available on the market; however, despite the large variety, few of them provide quality scientific and expert-driven advice to their end-users. Many of the most popular dietary assessment apps, providing extensive databases of commercial food products, are reliant on crowdsourcing for their nutritional information, with little to no validation of the dietary data quality. Others may score highly on usability and aesthetic appeal but the scientific basis, and therefore safety and efficacy, of their nutrition and health messages is unclear or unvalidated (1). Scientifically robust online personalization systems do exist, such as the system developed by the EU funded Food4Me project (2,3); however, the challenge remains to apply these in a fully automated form across a variety of real-time and real-user scenarios from various population groups. This would create a more dynamic system, which is able to respond to user behaviours and preferences and would therefore be anticipated to promote a greater engagement, and ultimately greater health benefits for the end user (4).

There is a wealth of evidence within nutritional sciences and a broad consensus as to what constitutes a healthy lifestyle and diet for the general population, such as represented by the visual models created by Public Health England within the UK (the 'Eat Well Plate', (5)) and the Food Pyramid, now updated to the 'Choose My Plate' model, within the US (6). However, whilst these generic models have undoubtedly been refined over time, there has been a parallel shift towards greater tailoring of advice to the individual, considering their lifestyle, physiology, genetics and even social demographics. This is commonly referred to as 'Personalized Nutrition' and, with further evidence emerging from genetic studies (7), there is a clear need for modern nutritional science to take a more personalized approach to providing dietary and lifestyle advice.

The PROTEIN project (4) aims to amalgamate, for the first time, the latest technological capabilities (such as the use of artificial intelligence (AI) and the latest sensor technology) and the capacity to manage a large volume of data with an evidence-based repository, generated by experts in the field of nutrition, biochemistry, medicine and physical activity. This aims to provide the end-user with personalized and dynamic nutrition and lifestyle goals to help them



achieve a healthier lifestyle, cognizant of their requirements, preferences and actual daily behaviours. These goals will be delivered via a mobile application system, developed by a pan-European team of experts and piloted in a wide range of EU populations including healthy older adults, individuals with type 2 diabetes mellitus (T2DM) and athletes.

Overall, the principle aim of this white paper is to outline and discuss the development of an expert dashboard to register users, deliver the user group-specific nutrition and physical activity guidelines and to monitor user interaction with them.

## **Proposed Solution(s)**

As user groups targeted within the PROTEIN project include those that are under nutritionist or medical specialist care, it is imperative that the consortium facilitates a method for these health care professionals (HCPs) to follow their users' progress through the PROTEIN application. Furthermore, due to the COVID-19 pandemic, it has become increasingly pertinent to provide practical alternatives to in-person clinic appointments with HCPs. HCPs would be expected to derive value from a dynamic platform allowing them to deliver their messages or recommendations directly to the user's smartphone or tablet at home, whilst it is hoped this approach may also offer value to the users, improving HCP-user communications (including monitoring and support), facilitating self-management and ultimately improving adherence and therefore outcomes.

Therefore, the main function of the expert dashboard is to provide a centralized management system that facilitates the delivery and monitoring of the HCP's nutrition and physical activity advice. By also linking with the underpinning knowledge tracker and the PROTEIN meals and activities databases it is envisaged that the expert dashboard will provide an efficient and evidence-based meal plan creation and behavioural 'prescription' system. Within the expert dashboard, an end user profile, nutritional/physical activity plan and the display of patient physiological/nutritional responses and updates are required. With these requirements in mind, Nutrium<sup>1</sup>(8) as a consortium partner, offered a useable readily available solution to serve as a mainstay of the expert dashboard for the technical team of the PROTEIN mobile application to employ.

---

<sup>1</sup> Nutrium is the trading name for the product provided by Healthium – Healthcare Software Solutions



### ***Overview of the PROTEIN Expert Dashboard***

The PROTEIN Expert Dashboard is accessed and used only by HCPs registered within the PROTEIN project and allows them to manage all data related to their users. It is a full-fledged appointment and nutrition management platform, based on an existing Healthium product, that enables the simplification of complex tasks. This includes, but is not limited to, the management and analysis of nutritional information of users, planning, analysis and creation of food plans and direct follow-up of the users. The most distinctive feature of the service relates to the fact that it structures, facilitates and may improve the nutritional monitoring and follow-up of the user by the HCP. The information available to select on the expert dashboard within the PROTEIN project are shown in Table 1, which includes allergies, food intolerances, preferences and medical conditions. Further items that are supported by the PROTEIN system include: pregnancy status, smoking status, diagnosed nutritional deficiencies, sleep quality and user self-reported favourite/ disliked foods.

Once the expert enters these measurements this triggers the goal adaptations and personalisation for the recommender system, which in the case of PROTEIN is a reasoning-based decision support subsystem (RDSS). This is a unique feature of the PROTEIN application as the recommendations are automated by the AI advisor and in real-time. In contrast, within the Nutrium dashboard, a user will have to wait for their respective HCP to review the information provided and generate their own recommendations, which can take considerable time per person. Furthermore, a user has the added capability within the PROTEIN application to be able to view and amend their reported food preferences, allergies and intolerances. However, this can take up to 1 week to be reflected within the nutritional plans. This issue has been highlighted by the experts and technical team within the consortium and would be a priority for future refinement of the app prior to any commercial release on the app market.



**Table 1.** Information available to select on the PROTEIN Expert Dashboard

Medical Conditions	Clinical Goals	Intolerances	Allergies	Food Preferences
Adults who are overweight (>25 kg/m <sup>2</sup> )	Muscle gain	Amines	Avocado	Halal
Athletes	↕ Energy expenditure	Caffeine	Banana	Kosher
Adults with obesity (>30 kg/m <sup>2</sup> )	↕ Fibre intake	Fermentable Oligosaccharides, Disaccharides, Monosaccharides and Polyols (FODMAP foods)	Celery	Lacto-Ovo-Vegetarian
Patients with T2DM	↕ Carbohydrate intake	Fructose	Eggs	Lacto-Vegetarian
Patients with cardiovascular disease	↕ Fat intake	Gluten	Fish	Ovo-Vegetarian
Irritable Bowel Disease	↕ Protein intake	Lactose	Garlic	Pescatarian
Coeliac Disease	Increase electrolytes	Salicylates	Kiwi	Red Meat Avoider
Kidney Disease	Increase folic acid intake	Sulphites	Linseeds	Vegan
Musculoskeletal Conditions	Increase iron intake		Milk	Vegetarian
Previous History of Stroke	Reduce sodium		Mollusc	
	Increase Vit A intake		Mustard	
	Increase B12 intake			
	Increase Vit C intake		Peach	
	Increase Vit D intake		Peanuts	
	Increase fluid intake		Pollen	
	↕ Body weight		Sesame	
			Soya	
			Strawberry	
			Tree Nuts	
			Wheat	
			Gluten	
			Shellfish	



The measurements that can be entered and tracked within the expert dashboard are presented within Table 2. At set up the HCP can enter specific measurements through the expert dashboard on behalf of the user. Following the initial set up, the user can edit some of their metrics such as weight and waist/ hip circumference within the mobile application. These changes can all be tracked by the HCP within the expert dashboard to monitor their progress against the targets set (as shown in Figure 4).

**Table 2.** User measurements that are supported by the PROTEIN Expert Dashboard

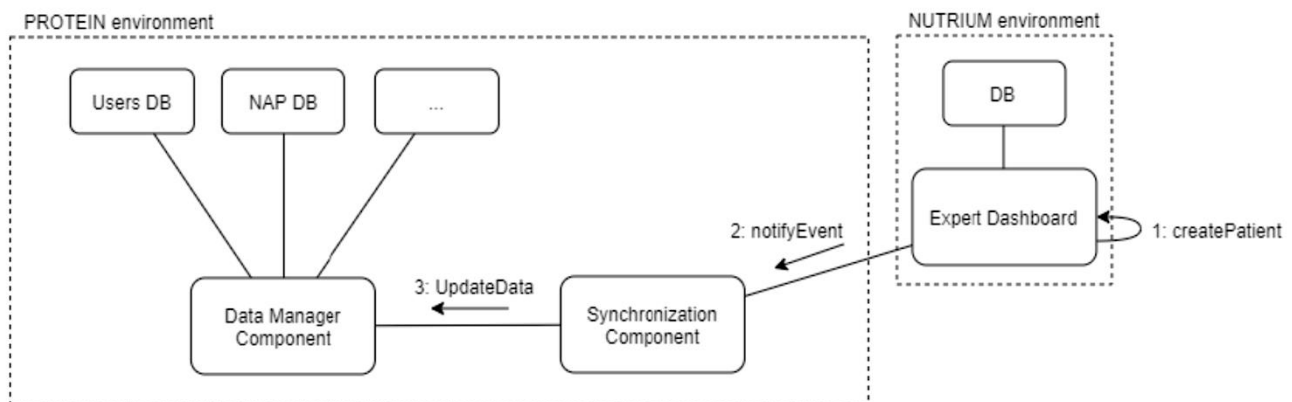
Measurement	Metrics supported	User can edit/ add?
Weight	kilograms (kg) or pounds and ounces (Lbs, Oz)	Yes
Height	metres (m) or centimetres (cm)	No
Waist Circumference	centimetres (cm)	Yes
Hip Circumference	centimetres (cm)	Yes
Waist: Hip Ratio	N/A	No
Body fat	%	No
Lean Body Mass (LBM)	% OR kilograms	No
Sum of Eight Skinfold Measurements	N/A	No
Systolic blood pressure	mmHg	No
Diastolic blood pressure	mmHg	No
Heart Rate (HR)	beats per minute (bpm)	User can enter resting HR
Glucose (Continuous)	mmol / L	No- updated through sensor
Total Cholesterol	mmol/ L	No
High Density Lipoprotein Cholesterol	mmol/ L	No
Low Density Lipoprotein Cholesterol	mmol / L	No
Triglycerides	mmol / L	No
Haemoglobin A1C (HbA1C)	mmol/mol OR %	No
Iron	mmol/ L	No

**Note:** Each one of the measurements is registered with a date and it is possible to see its evolution over time through a chart on the expert dashboard (such as weight, which is shown in Figure 5).



### *Technical Description of the Expert Dashboard*

The expert dashboard is a cloud-based service (SaaS), developed in Ruby (the programming language) and Ruby on Rails (the web app framework), that uses PostgreSQL as its relational database and is integrated within the PROTEIN cloud with a set of representational state transfer (REST) application programming interfaces (API) that have been developed to enable external components to interact with other entities such as the users' anthropometric measurements and dietary preferences or allergies. As pointed out previously, it is an HTTP REST API, developed in the context of the project to allow direct communication with the PROTEIN cloud through the Synchronization Component (SC), as shown in Figure 1. This is accomplished by making available a large set of individual endpoints to be used by PROTEIN, namely the synchronization component, so once the Expert's dashboard sends a synchronization request, the SC processes it and routes the data to the corresponding data management (DM) components APIs to save it within the PROTEIN cloud. To create the specification and documentation for the API it was used a tool called OpenAPI (<https://www.openapis.org/>) that allowed the parties to define the API through coding and not just plain test. The service used to host the API



specification is SwaggerHub. The Swagger API documentation is not publicly available, but the dashboard is available online (9).

**Figure 1.** A diagram of the communication between the expert dashboard and the PROTEIN Ecosystem. NAP: Nutrition and Physical Activity Plans; DB: Database; API: application programming interface.

The user interface of the expert dashboard is shown in the following images. Figures 2 and 3 illustrate the homepage as seen by the HCP when first registering a new client's profile. Figure 4 illustrates how the HCP can input their anthropometric measurements within the expert dashboard, which can be amended over time to track their progress. The user measurements that are supported within PROTEIN are presented in Table 2. Finally, Figure 5 illustrates the homepage with all the information that can be facilitated by the HCP as part of the PROTEIN



project. include dietary preferences, clinical goals, medical history and even their smoking status,

Powered by Nutrium

### Register client

Register your client and continue scheduling the appointment

- Full name
- Gender: Male
- Birthdate
- Country of residence: Portugal
- Mobile phone number: 351
- Workplace: Healthium
- Occupation
- Zip code
- Email

Cancel Register client

the full list is presented in Table 2.

Follow-up package Unlimited

### Client profile

Check and update information about the client

Currently at Healthium  
Monday, July 27, 2020 6:00 AM

Sample Client  
Sample profession

+ New tag

Schedule appointment  
Send message  
Delete client

#### Client Information

Update client's personal information

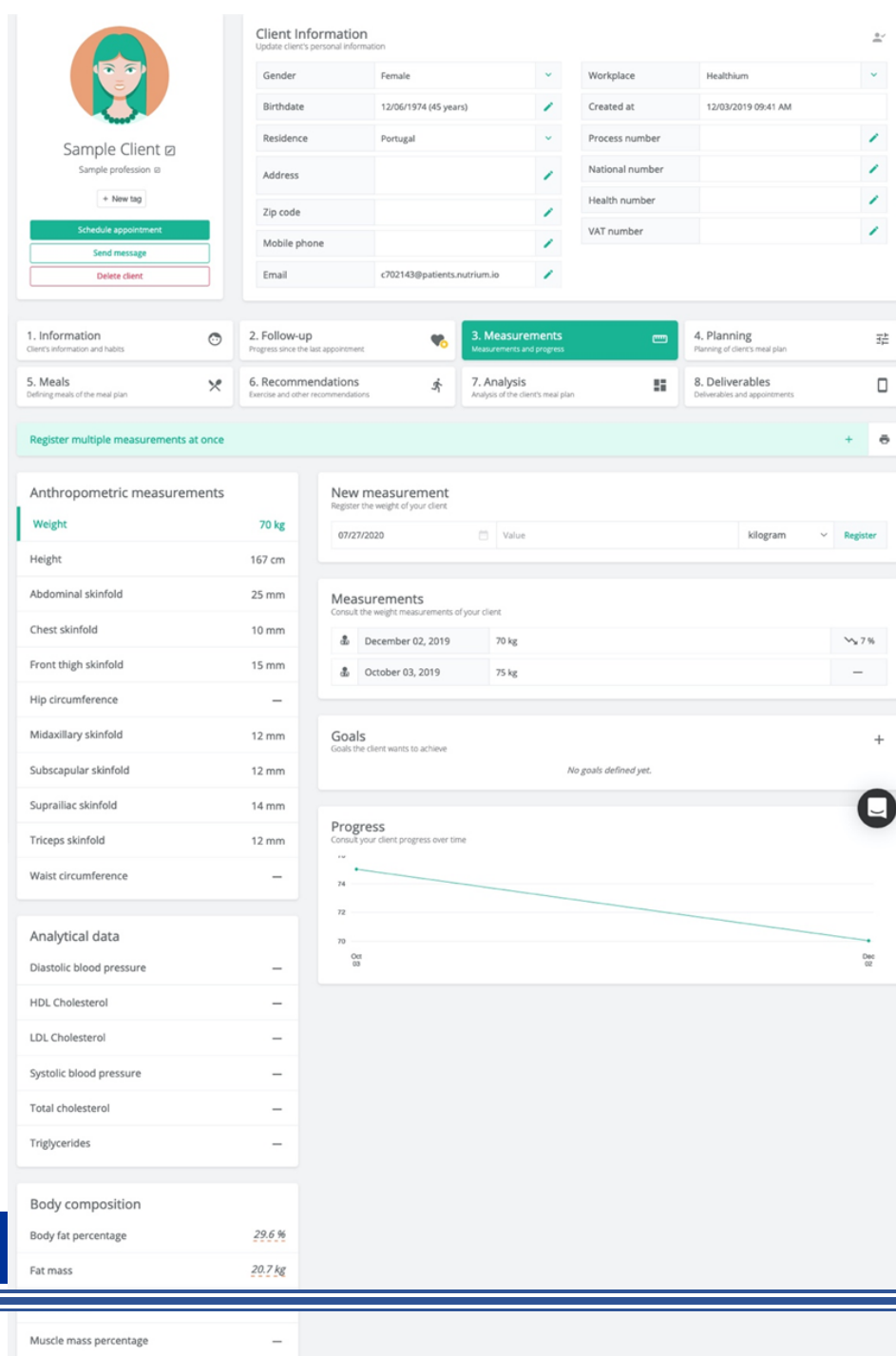
Gender	Female	Workplace	Healthium
Birthdate	12/06/1974 (45 years)	Created at	12/03/2019 09:41 AM
Residence	Portugal	Process number	
Address		National number	
Zip code		Health number	
Mobile phone		VAT number	
Email	c702143@patients.nutrium.io		

1. Information  
Client's information and habits
2. Follow-up  
Progress since the last appointment
3. Measurements  
Measurements and progress
4. Planning  
Planning of client's meal plan
5. Meals  
Defining meals of the meal plan
6. Recommendations  
Exercise and other recommendations
7. Analysis  
Analysis of the client's meal plan
8. Deliverables  
Deliverables and appointments

**Figure 2.**  
The  
PROTEIN  
Expert  
Dashboard  
homepage





**Figure 3.** The creation of a patient profile by a HCP within the Expert Dashboard


**Client Information**  
Update client's personal information

Gender	Female	Workplace	Healthium
Birthdate	12/06/1974 (45 years)	Created at	12/03/2019 09:41 AM
Residence	Portugal	Process number	
Address		National number	
Zip code		Health number	
Mobile phone		VAT number	
Email	c702143@patients.nutrium.io		

**1. Information**  
Client's information and habits

**2. Follow-up**  
Progress since the last appointment

**3. Measurements**  
Measurements and progress

**4. Planning**  
Planning of client's meal plan

**5. Meals**  
Defining meals of the meal plan

**6. Recommendations**  
Exercise and other recommendations

**7. Analysis**  
Analysis of the client's meal plan

**8. Deliverables**  
Deliverables and appointments

Register multiple measurements at once

**Anthropometric measurements**

Weight	70 kg
Height	167 cm
Abdominal skinfold	25 mm
Chest skinfold	10 mm
Front thigh skinfold	15 mm
Hip circumference	—
Midaxillary skinfold	12 mm
Subscapular skinfold	12 mm
Suprailiac skinfold	14 mm
Triceps skinfold	12 mm
Waist circumference	—

**New measurement**  
Register the weight of your client

07/27/2020 Value kilogram Register


**Measurements**  
Consult the weight measurements of your client

December 02, 2019	70 kg	7 %
October 03, 2019	75 kg	—

**Goals**  
Goals the client wants to achieve

No goals defined yet.

**Progress**  
Consult your client progress over time



**Analytical data**

Diastolic blood pressure	—
HDL Cholesterol	—
LDL Cholesterol	—
Systolic blood pressure	—
Total cholesterol	—
Triglycerides	—

**Body composition**

Body fat percentage	29.6 %
Fat mass	20.7 kg
Muscle mass percentage	—

**Figure 4.** An example of the input of measurements within the Expert dashboard, showing the user's progress in weight loss across time

The dashboard is divided into several sections for client management and health tracking.

### Client Information

Update client's personal information

Gender	Female	Workplace	Healthium
Birthdate	12/06/1974 (45 years)	Created at	12/03/2019 09:41 AM
Residence	Portugal	Process number	
Address		National number	
Zip code		Health number	
Mobile phone		VAT number	
Email	c702143@patients.nutrium.io		

### Appointment information

Motivation and expectations for the follow up

Clinical goals	None
Reason for appointment	
Expectations	
Other information	

### Personal and social history

Information and physiological and social habits of the client

Bowel movements	
Sleep quality	
Smoker	
Alcohol consumption	
Marital status	
Physical activity	
Race	
Other information	

### Dietary history

Habits and food preferences of the client

Usual wake up time	
Usual bedtime	
Diet type	
Favorite food	None
Disliked food	None
Allergies	None
Food intolerances	None
Nutritional deficiencies	None
Water intake	
Other information	

### Food Diaries

Log your client's food diaries

You haven't logged any food diary

### Eating behaviour

Log your client's eating behaviour

You haven't logged any eating behaviour

### Medical history

Pathologies, medication and personal and family history

Diseases	None
Medication	None
Personal history	None
Family history	None
Other information	

### Goals

Goals the client wants to achieve

No goals defined yet.

### Files

Files attached to this client

There aren't any files associated to this filter

**Figure 5.** Overview of the patient's clinical goals, personal preferences and medical history

## **Future Direction / Long-Term Focus**

Initial testing and iterative development of the expert dashboard during the project's functional testing phases has resulted in a working first version of the expert dashboard, which provides the described functionality to HCPs. As the project workflows are implemented during pilot trials, the expert dashboard's User Interface and API endpoints should be further adapted to provide information in a more customizable way; for example, providing multiple filters for viewing user data such as meal choice and additional graphs to visually present relevant information over the course of time.

## **Results / Conclusion**

This white paper presents the PROTEIN nutrition and physical activity expert dashboard, an integral component of achieving personalised nutrition through a mobile app for end users who are under nutritionist or medical specialist supervision. Through the extension of the Nutrium dashboard capabilities and incorporating unique components of the PROTEIN Personalised Nutrition Framework, such as the AI advisor, HCP can view and monitor their users' data in an easily accessible web-based environment.



## Appendices

### *Appendix A – Authors*

Kathryn Hart – Contributor

Saskia Wilson-Barnes – Contributor

Ion Pagkalos- Contributor

Elena Patra – Contributor

Pedro Bacelar – Contributor

### *Appendix B – References*

1. Eldridge AL, Piernas C, Illner AK, Gibney MJ, Gurinović MA, de Vries JHM, et al. Evaluation of New Technology-Based Tools for Dietary Intake Assessment—An ILSI Europe Dietary Intake and Exposure Task Force Evaluation. *Nutrients* 2019, Vol 11, Page 55 [Internet]. 2018 Dec 28 [cited 2022 Mar 13];11(1):55. Available from: <https://www.mdpi.com/2072-6643/11/1/55/htm>
2. Celis-Morales C, Livingstone KM, Marsaux CFM, Macready AL, Fallaize R, O'Donovan CB, et al. Effect of personalized nutrition on health-related behaviour change: Evidence from the Food4Me European randomized controlled trial. *International Journal of Epidemiology* [Internet]. 2017 [cited 2020 Oct 12];46(2):578–88. Available from: <https://pubmed.ncbi.nlm.nih.gov/27524815/>
3. Macready AL, Fallaize R, Butler LT, Ellis JA, Kuznesof S, Frewer LJ, et al. Application of behavior change techniques in a personalized nutrition electronic health intervention study: Protocol for the web-based food4Me randomized controlled trial. *Journal of Medical Internet Research* [Internet]. 2018 Apr 1 [cited 2020 Oct 12];20(4). Available from: <https://pubmed.ncbi.nlm.nih.gov/29631993/>
4. Wilson-Barnes S, Gymnopoulos LP, Dimitropoulos K, Solachidis V, Rouskas K, Russell D, et al. PeRsOnalised nutriTion for hEalthy livINg: The PROTEIN project. *Nutrition Bulletin* [Internet]. 2021 Mar 1 [cited 2022 Mar 7];46(1):77–87. Available from: <https://onlinelibrary.wiley.com/doi/full/10.1111/nbu.12482>
5. Public Health England. The Eatwell Guide [Internet]. 2018 [cited 2019 Nov 13]. Available from: <https://www.gov.uk/government/publications/the-eatwell-guide>
6. United States Department of Agriculture (USDA). ChooseMyPlate [Internet]. 2019 [cited 2019 Nov 13]. Available from: <https://www.choosemyplate.gov/>



7. Ordovas JM, Ferguson LR, Tai ES, Mathers JC. Personalised nutrition and health. BMJ (Online) [Internet]. 2018 [cited 2021 Jan 7];361. Available from: [/pmc/articles/PMC6081996/?report=abstract](https://pmc/articles/PMC6081996/?report=abstract)
8. Nutrium. Nutrium | Nutrition Software [Internet]. 2022 [cited 2022 Mar 10]. Available from: <https://nutrium.com/>
9. Protein | Welcome Back | Sign In Now [Internet]. [cited 2022 Mar 13]. Available from: [https://app.nutrium.xyz/accounts/sign\\_in](https://app.nutrium.xyz/accounts/sign_in)

