# CS551H - Natural Language Generation
# Assessment 3

## Nutrify - The Nutritionist Assistant


Group - MedicalOne

Authors:

Nour Taweel 51987273

Jess McGowan 52093344

Hao Chen 52096148

Yassin Dinana 52094480

Al-Hussein Abutaleb 52096834

# Vision

Nutrify will be a convenient and effective tool in the arsenal of healthcare providers to optimise their productivity given limited resources; in turn to alleviate some of the suffering that many go through with eating disorders (ED). Nurify's NLG features automate and reduce the time to extract clinically salient insights from the patient's food diary which directly translates to time savings, and thus reduction in operational costs, for the NHS. The overall objective of Nutrify is to optimise the output of working nutritionists and dietitians who work with patients suffering from EDs. Using Nutrify's NLG technology, high-quality text reports can be generated using a patient's comprehensive food diary as an input, leading to better and faster results.

## Background

Eating disorders (ED) are a major factor in life dissatisfaction and deterioration in the quality of life (McCarthy, 1990; Mischoulon et al., 2011). It is estimated that 7.8% of the global population suffer from one form of EDs causing over 3.3 million deaths annually. Moreover, they are significantly more prevalent in women of all ages, and especially young women. Concerningly, rates of EDs have been steadily increasing globally but especially in developed countries (Galmiche et al., 2019; van Hoeken, and Hoek, 2020). Furthermore, EDs are associated with a $326.5 billion reduction in economic output in the U.S alone (Streatfeild et al., 2021). Nutrition and diet intervention strategies by trained professionals are an essential component of the drive to ameliorate the suffering of the individuals affected and in reducing the overall negative effects of EDs (Ozier and Henry, 2011).


Figure 1. Our grand vision for Nutrify is for it to serve as a tool to improve performance of healthcare providers. It does this by saving operating costs on the level of nutrition/patient contact time.

In the UK, the primary health care provider is the National Health Service (NHS). It offers free medical care for citizens at the point of care. Concerningly, following the financial crisis of 2008, funding for the NHS has been reduced, and hiring for new healthcare professionals is at an all-time low (Beech et al., 2019). A symptom of these conditions is that waiting lists for receiving care have become long, with direct consequences on patient quality of life (O'Dowd, 2021).

In the UK, the primary health care provider is the National Health Service (NHS). It offers free medical care for citizens at the point of care. Concerningly, following the financial crisis of 2008, funding for the

NHS has been reduced, and hiring for new healthcare professionals is at an all-time low (Beech et al., 2019). A symptom of these conditions is that waiting lists for receiving care have become long, with direct consequences on patient quality of life (O'Dowd, 2021). Thus, we postulate that under the current conditions there is a need for systems, technological or otherwise, to optimize workers' outputs using the currently available resources. In fact, such emphasis in increasing productivity and reducing costs was heavily emphasised in the 2017 NHS Five Year Forward View report[1].

Food tracking apps such as MyFitnessPal (Gordon et al., 2019) offer a robust well-tested tool for nutritionists[2] to use with their patients for food logging purposes. However, the practice entails an extra workload for healthcare providers as such diaries need to be carefully examined to detect dietary patterns. Our postulation is that using cutting-edge Natural Language Generation (NLG) technology to summarise such food diaries into a written summary can reduce workload and improve productivity for dietitians and nutritionists[3].

This report will present cloud-based Nutrify, an NLG tool that uses a patient's detailed food diary and transforms it into a detailed summary report for the nutritionist and a less detailed summary for the patient. Our tool employs three primary technologies: 1) Natural Language Generation (NLG) - present in the prototype. 2) Web development to build the cloud-based platform and user interface - not present in the prototype. 3) Machine Learning to detect patterns in behaviour, and to suggest behaviour modifications to the healthcare provider to pass on to the patient (Figure 1).

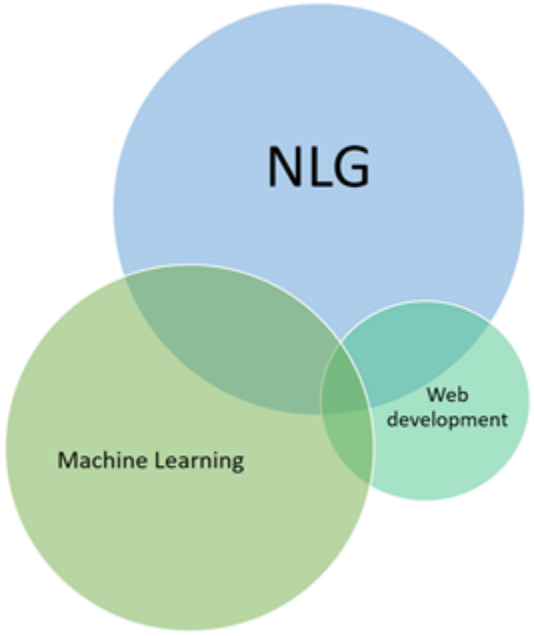


Figure 2. The intersection of the three main technologies used in Nutrify. Size is provisionally proportional to the final production ready version/

[1] The NHS Five Year Forward View report - Funding and Efficiency section: https://www.england.nhs.uk/five-year-forward-view/next-steps-on-the-nhs-five-year-forward-view/funding-and-efficiency/
[2] We recognise that the terms dietitian and nutritionist are not equal, particularly in the UK. However, for the introductory purposes of this report we make no distinction between the two roles and they will be used interchangeably.
[3] Our "back of the envelope" calculations show that there's an estimated 53% savings in time per dietitian per patient. Please see section titled "Market Analysis"

# Vision Details

The primary tool used for developing Nutrify is Arria Studio. Various ATL scripts transform the patient's dietary data input into human-readable language. The dataset used to build and test the prototype includes a wide range of entries reflecting the patient's dietary habits, in addition to markers that reflect the overall wellbeing of the patient.
To see our vision come to fruition, we propose the following short and long term milestones:

**Short-term milestones:**

- Build Nutrify's NLG core functions:

Our highest priority short-term objective is to build a Nutrify prototype capable of producing high-quality English language reports to improve decision-making and assessment of patients' dietary habits.

- Establish, test, and deploy Nutrify's payment system:

As proof of concept, Nutrify's module for receiving payments from end-users was built and tested in our system evaluation phase.

- Develop a cloud-based platform for Nutrify:

Mobile applications are important to offer a mobile-friendly service to a wide range of people, however, a website is a very important tool for nutritionists to better engage and interact with their patients - The generated report will be automatically available on the users' account where it can be accessed from both the application and the web page.

**Long-term milestones:**

Following successful evaluation, launch, and market penetration, we begin moving toward reaching our long-term milestones:

- Establish Nutrify as the market leader in dietitians' oriented NLG-based reporting in the UK over the next 5-7 years
- Apply different languages on Nutrify:
  At first, our focus will be on Latin-based languages with an aim to expand to emerging markets in the next five years. The extra revenue generated from adding Latin-based language capability will be used to expand Nutrify's repertoire to languages in the Indian sub-continent and far-east Asia.
- Reaching break-even and making profit:
  Another long-term goal is to reach break-even by the 5th year of operation and to start making profit within the 6th year by profiting with a rate of 20% per year.
- Establish Nutrify as the international market leader in dietitians' oriented NLG-based reporting

# Market Analysis

To the best of our knowledge, no app exists in the market today that has as its core functionality what we propose. A unique NLG-based tool designed to optimise the workflow of nutritionists and dietitians, as opposed to apps that are designed with ordinary users in mind, has no truly existing market yet. The core market niche of Nutrify sits at the intersection between companies that use NLG to generate revenue ($624M worldwide in 2021), irrespective of use case, companies that use NLG to produce reports specific for dietary insights (no information is available since our product is ground-breaking), and food tracking apps ($3.9B worldwide in 2021) (figure 3). Therefore, for most of the calculations we will assume that for the duration of the short-term goals period (1-2 years), there will be no direct competition from existing players in the market. Well established NLG companies and food tracking apps will not attempt to introduce a product similar to Nutrify. Our calculations below will show that expected total addressable market[4] (TAM) size for Nutrify is £596,498.48.

**Customer-base**

Currently, there are 10,128 registered dietitians in the UK according to the Health & Care Professions Council (HCPC)[5], and a further 2,358 active registered nutritionist according to the Association of Nutrition's 2020 Annual report[6]. This puts our figure for end users in the UK, both in the public and private sector, at an estimated 12,486 healthcare professionals. We will assume that 80% of them work for the NHS and 20% work privately.

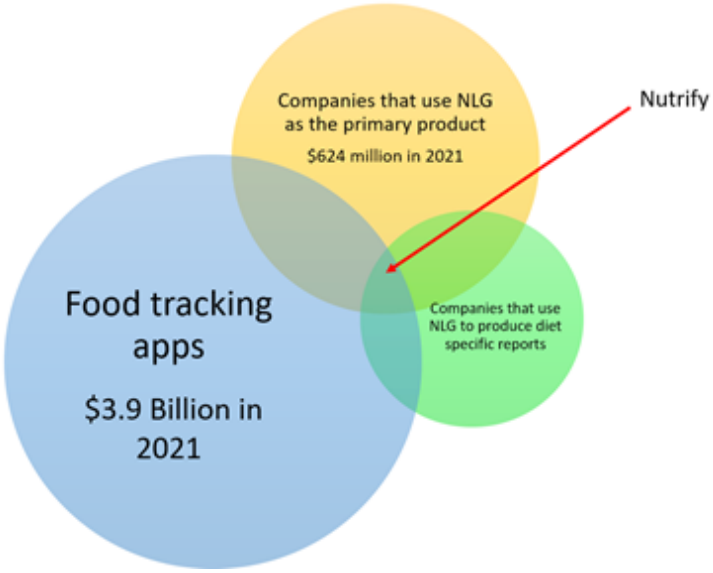


Figure 3. Nutrify occupies a unique niche between three existing markets. The intersection between food tracking apps, general purpose NLG tech, and nutrition-specialised NLG products. At the moment, no existing product in the market occupies this space.

[4] TAM is the maximum possible size of a given market if all target customers were to buy Nutrify (ie if all dietitians in the private sectors bought Nutrify)
[5] https://www.hcpc-uk.org/about-us/insights-and-data/the-register/registrant-snapshot---3-november-2020/
[6] https://www.associationfornutrition.org/wp-content/uploads/2020/09/2019-Annual-Report.pdf

We introduce two approaches to reach an estimate of the current market size. We begin by defining our customer-base:

1. Governmental healthcare agencies. We use the NHS as a stand-in in most of our analysis.

2. Private healthcare providers whether individuals or private clinics, spas or gyms.

A third non-paying customer base are the patients themselves. Nutrify produces two reports, a detailed report containing insights and conclusions based on the patient's food diary. And a simpler report, with no jargon, highlighting where the patient could alter their behaviour with regards to food and exercise to move them closer toward achieving their goal. In this regard, Nutrify also serves as a bio pedagogical tool (Lupton, 2018).

The following two subsections will outline our methodology for calculating the potential market size and value. A large number of assumptions have been made due to a lack of publicly available information. These assumptions will be made explicit. All calculations relating to future growth potential are attached in the appendix.

**Selling price and revenue generation**

1. For large publicly funded healthcare agencies, we use the NHS as a proxy
    a. We estimate that there are 2.3 million[7] patients who suffer from eating disorders in the UK. However, a large majority of both adults and adolescents from both genders do not seek help with regards to ED, conservatively we estimate that 75% of those who meet diagnosis criteria for ED will not seek medical help. (Forrest et al., 2017; Hart et al., 2011; Mohler-Kuo et al., 2016). This leaves ED patients who will seek help at 575,000 patients out of 2.3 million.
    b. We assume that 90% of those patients will seek help using the NHS. 517,500 patients remain to be cared for by the NHS. And the remaining 57,500 (10%) will be cared for by the private sector.
    c. We make the assumption here that 80% of registered dietitians and nutritionists in the UK (9,989 out of 12,486) will be working for the NHS, each will be responsible for 52 patients[8] to treat at any point in time. This leaves 2,497 working privately.
    d. We estimate that each trained nutritionist will need 10 minutes to go over a standard two weeks food diary[9]. This adds up to 520 minutes per dietitian for the 52 patients[10].
    e. Average annual salary for a dietitian[11] in the NHS is £34,000[12]. This converts to £653.80 in a 35 hours workweek or £ 18.70 per hour or £0.31 per minute.

[7] This is the median value between the lower and higher estimated range of ED prevalence in the UK population. Information was taken from the NICE report on eating disorders in the UK: UK, N. G. A. (2017). Eating Disorders: Recognition and Treatment.
[8] 517,500 patients/9,989 dietitians
[9] At this point, we make the assumption that the presentation and medium used to log and store the food diary bears no consequence to the dietitian's speed in extracting the salient and relevant insights from it.
[10] Another necessary approximation is mad here; which is that the diary is only inspected once. In reality, the dietitians may recommend 1) longer period of food loo
[11] Average salaries for nutritionists were not available from the NHS recruiting website.
[12] We noted the maximum and minimum advertised annual salaries for dietitians on the vacancies available on the respective NHS website. The average between the two was calculated.

f. We assume that average reading speed for a dietitian will be at the top range of the average values reported in (Trauzettel-Klosinski et al., 2012)[13]; 213 words per minute.
g. We will assume that reports generated by Nutrify average 1000 words in length. On average, the time taken to read the report will be around 4.7 minutes.
h. This constitutes 50.3% savings in time (time not spent on examining the diary is 5.3 minutes).
i. Or, at £0.31 per minute saving, £1.64 per patient (5.3 minutes X £0.31)
j. Or £85.28 per the 52 patients per dietitians (52 X £1.64). Or £851,862 for all the 9,989 dietitians working with the NHS. We continue with the assumption that the exercise of extracting insight from a food diary takes place only once in the second appointment where the first appointment is to instruct the patient to use a food logging apps such as MFP to log their food intake.
k. Since calculations assume only a singular event where the food diary is involved and do not assume hospitalisation or residential treatment for the patient; it only factors in salaries cost, there is a high likelihood that actual savings to the NHS are well above £851,862. We do not attempt to quantitatively find that value at this stage.
l. Following the above we set our price for an NHS wide licence agreement to be £425,932 per annum. This leaves the NHS with conservative savings of, also, £425,932.

2. For private health care providers (private clinics, gyms, self-employed dietitians…etc) - from the above analysis, for the estimated 2,497 dietitians and nutritionist (20% of 12,486) who work privately:
    a. We assume that only 20%[14] of private practitioners will choose to use Nutrify, 499 dietitians out of 2,497.
    b. 57,500 patients (10% of 575,000) are estimated to seek care privately.
    c. This leaves each dietitian with 115 patients in the private sector market (57,500/499).
    d. We follow the exact procedure followed[15] earlier for calculating the savings for the NHS to reach the figure of £188.60 per 115 patients per dietitians or £470,934 for all dietitians working privately (2,497 dietitians). This is the Total Addressable Market (TAM) size for the private sector.
    e. Of the £470,934 TAM only 20% segment will be penetrated since we made the assumption that only 20% of dietitians will buy Nutrify. Thus, Serviceable Obtainable Market (SOM) is: 20% X £470,934 = £94,186.84 for the 499 dietitians available.
    f. Dividing SOM by 499, and then by 12 we obtain the possible monthly revenue if we were to follow a monthly subscription model: £15.72

| | **NHS** | **Private Sector** |
|---|---|---|
| **Model** | Single NHS wide annual licence | Monthly subscription per dietitian |
| **Selling price** | £425,932 | £15.72 |

[13] 184±29= 213 top range
[14] Since Nutrify is not mission critical for daily productivity of nutritions in the UK, we assume a conservative penetration rate.
[15] We further assume that private sector nutritionists will receive the same salary as those employed by the NHS

Table 1 Summary of Nutrify pricing for both public sector (NHS) and private dietitians

**Growth potential - Future market size**

The following assumptions are made to facilitate the calculation of future potential market growth of Nutrify:

- That over the near future, five years, the population of the UK will continue to grow steadily at a fixed rate of 0.5%[16].
- Changes in the national and global economy will not affect decision making policies in the public (NHS) and private sectors.
- The rate of increase in the number of both public and private sectors healthcare workers will follow that of the population[17]. This makes the number of dietitians and nutritionists in 2026 at 12,801.
- That the rate of inflation in the UK economy will not change over this period and will remain at 1%[18]. Salaries will follow suit.
- The rate of eating disorders in the UK has had a positive upward trend over the past two decades; between 2013 and 2017 this increase was 7.8% on average (Galmiche et al., 2019). We will assume that this rate will remain constant up until the end of 2026.
- This makes the estimated number of possible patients suffering from EDs, who also proactively seek help, at the end of 2026 to be 1.22 million from the estimated current 0.835 million in 2021. This still maintains the assumption that the rate of patients choosing not to seek help remains at 75% throughout the next five years.
- This implicitly assumes that the current measures taken by health care agencies (NHS) and policy makers will not adapt to the increase (for example, no emergency increase in funding).

Taking into account the assumptions above, our prediction is that the market for the public sector in the UK for Nutrify will grow from £615,447.26 at the end of 2021 to £947,855.75 at the end of 2026. For the private sector, we expect the market will grow from the current £137,025.9 (at a rate of £22.90 per month) to £203,735.04 (at a rate of £33.16 per month) at the end of 2026 (figure 4, next page).

We note here that all calculations performed in this section are more 'back of the napkin' methodology rather than a rigorous quantitative analysis

[16] Rate of population growth in the UK from the Office for National Statistics: https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/articles/overviewoftheukpopulation/january2021

[17] This makes the current 12,486 dietitians and nutritionist increase by 0.5% dietitians for the first year; at the end of the five years short-term vision the total number of practitioners will be 12,801 professionals (compound)

[18] Rate of inflation between March 2020 and March 2021 in the UK from the Office for National Statistics: https://www.ons.gov.uk/economy/inflationandpriceindices#:~:text=Consumer%20price%20inflation%2C%20UK%3A%20March%202021&text=The%20Consumer%20Prices%20Index%20including,transport%20(0.44%20percentage%20points).

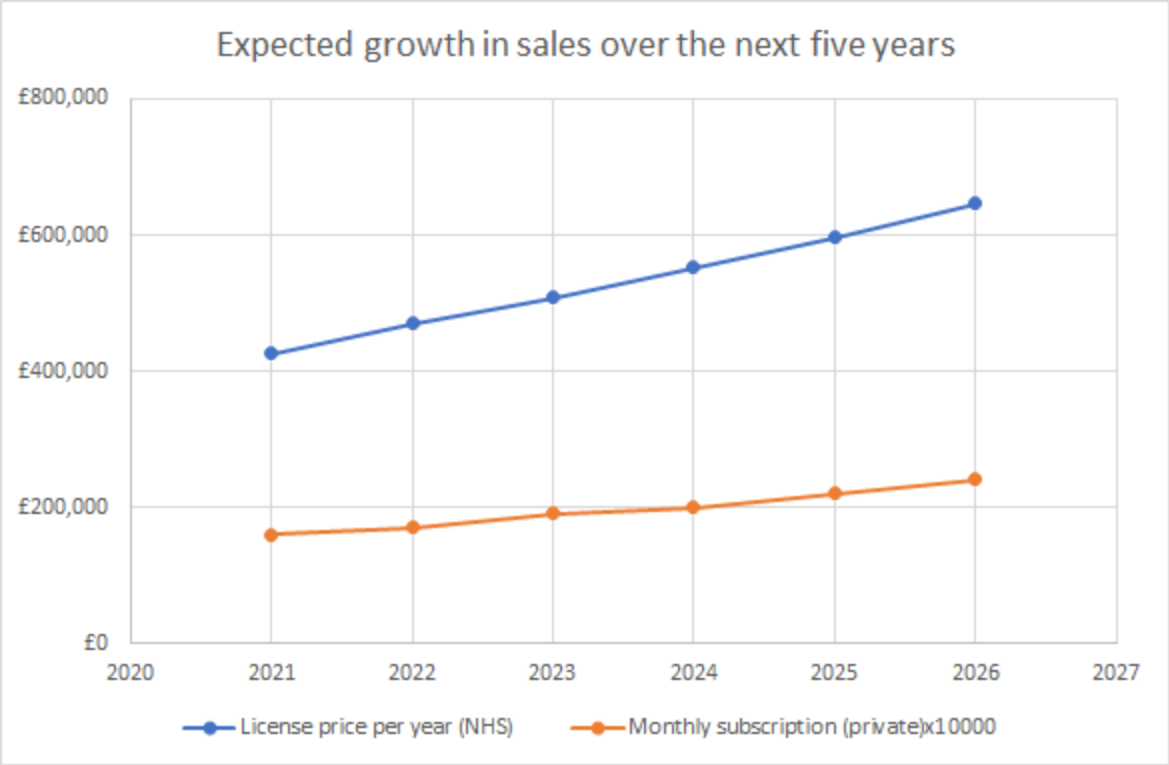


Figure 4: Our future growth in sales projections over the next five years. Figure of monthly subscriptions (private sector) is scaled by x10000 for comparison. Monthly subscriptions were multiplied by a factor of 10000 for representational purposes

Full calculations of market growth over the next five years for both public and private sectors is detailed in the Appendix.

# Competitors

As stated above, no products on the market were found which generate a text report to summarise patients' weekly nutrition information for nutritionists. This provides us with an advantage with respect to the potential gains possible after the initial launch as no other products fulfil this specific need. However, we take note that existing products fulfil a similar niche, and are more oriented towards using NLG to generate patients' reports. Furthermore, existing market leaders in NLG tech are fully capable of producing a similar product and introduce novel offerings that may destabilise early market gains expected in the early 1-3 years. We will treat these companies as indirect competitors, these include Arria, AX Semantics, Yseop. Some of them are relatively mature in the NLG field while the others emerged more recently and are in the position of challengers.

The rest of this section will introduce current players and describe their products' features, which will indicate the competitiveness of this domain.

**NutriAdmin** is our closest competitor, which uses a rule-based template for generating nutrition reports for non-specialist users. Established in 2016 in the UK, consisting of a relatively small team[19]. A NutriAdmin report consists of both tables and simple text. The content of the text is simple dietary advice on what to eat and what to avoid.

**Nutritics** provides the second closest competitor to the functionality that Nutrify is offering. The company offers support for multiple languages, with a global customer-base. Their clients include the NHS, Nestle, GSK, which may affect our initial expected market dominance. However there is no available data which details the extent of the relationship between Nutritics and the NHS. Nutritics' offering does not generate written summary reports, such as Nutrify; however the information is presented to the user in table format that does include NLG created text.

**Nutrium** is another company that provides nutrition reports for non-specialist users, including specialised reports for prenatal, paediatric and sports nutrition. These reports are included as part of a graphical dashboard, and the focus on text is limited compared to our product.

**Arria** is a market leader in NLG technology. One of their primary offerings is the Arria Studio; a generic powerful tool for developing NLG applications. Arria uses rule-based methods for development of NLG applications.

**AX Semantics** is a market leader who has expertise in NLG technology. AX Semantics is a company based in Germany, having more than 500 customers including globally recognized brands, like Porsche, Otto, Deloitte and so on. Currently, AX Semantics does not offer products specialized in the nutrition domain. However the company provides services to the pharmaceutical sector to generate Clinical Study Report for human drug trials. Their services include support for 110 languages, although only 17 of these are reliably supported (Weißgraeber & Madsack, 2017). The similarities between AX Semantics offering for clinical reports with Nutrify is that both rely on generating NLG text using structured data as input in a healthcare setting.

[19] Based on information from https://www.linkedin.com/company/nutriadmin/about/

**Yseop** is a market leader in using NLG for Clinical Study Reporting. Yseop's Augmented Medical Writer is a similar product to AX SEMANTICS offering of NLG produced clinical study reports.

The key information of the software listed above are summarized in the table below:

| Company Name | Software Name/version | NLG Feature | Pricing | Competitor type | Company profile |
|---|---|---|---|---|---|
| AX Semantics | AX Semantics | generate Clinical Study Report based on structured data up to 110 languages | £239.86[20]/month | Indirect | based in Germany, more than 500 customers including globally recognized brands |
| Yseop | Augmented Medical Writer | Generate Clinical Study Reports (CSRs) based on Ai and standard reasoning | N/A | Indirect | Established in 2000 with offices in Paris, New York, Lyon and Bogota. |
| Arria | Arria Studio | Rule based, various plugins | £1,692/year[21] | Indirect | Headquartered in Aberdeen UK |
| Nutritics | Health Edition | Configurable report in format of table only | £12/month | Direct | founded in 2013 customers including globally recognized brands, more than 165 countries |
| NutriAdmin | NutriAdmin | templates based, mixed of tables and simple text | £22.99/month | Direct | founded in 2016, Small team |
| Nutrium | Nutrium | specialized for three specific groups of users | £24/month | Direct | |

The products that have been found have a focus on delivering reports for the patients themselves. Only one of the nutrition focused products provides a narrative report, NutriAdmin, with most of the others focusing on tables or graphical information. It is noteworthy that none of the existing competitors in the market offers a NLG-based nutritional reporting as a standalone feature. Indeed, all of them offer a range of functionalities that are heavily skewed toward fitness-app consumers with minor NLG features in some cases.

To conclude, the two aspects, i.e. nutrition report for nutritionists and the narrative style of report for patients are identified as two gaps that could potentially be filled by our proposed product.

[20] Converted from €279, on 18/05/21, by Morningstar via Google
[21] Personal communication with Dr Gowri Sripada.

# Cost

**Assumptions:**

Cost estimation or project budgeting is always a challenging task as it needs to take various and complex costing factors into consideration. To calculate the cost of developing Nutrify, we begin by stating the assumptions underlying the calculations below:

1. As required in the assessment specification, the cost for building the proposed product will be calculated in this section. In addition, the running cost will be estimated so that we will have a good understanding of Nutrify's profitability in the long run.
2. Our team will be aspiring to hire talent for all needed tasks, ranging from web development to Nutrify's final deployment and continuous maintenance .
3. No office rent is taken into account. All employees are assumed to be working remotely.
4. Thus, logistical costs like utility bills are not taken into consideration for this estimation.

Under the assumptions made above, the major cost factors for building the proposed product are identified as labour cost and development tool/Infrastructure cost (necessary hardware and software license).

**Labour Costs:**

For building the proposed product, the following tasks need to be fulfilled:

1. Overall project and development management
2. Web application development, this is Nutrify's access point for all users. Nutritionists will be able to view patients' data and the generated reports. Patients will be able to input their diet information and to receive the nutrition summary report. There will also be access for admin users for maintenance purposes.
3. NLG API development for connecting with the web application.
4. Full system testing and debugging
5. User documentation

The tasks listed above can be assigned to five different roles, namely product manager, front-end developer, back-end engineer, User Interface designer and NLG specialist. The product team shall cover the skills listed above and the total number of the team members is flexible contingent upon work-load requirements.

To achieve a reasonable balance between the number of team members at any point in time and duration of project deliverables, we assume that the development team will consist of a project manager, two fullstack developers and one NLG specialist.

Personnel's salary estimation is based on the UK employment market. It is found that the annual salary for most full-time software developer employees in the UK ranges from £25,000 to £70,000[22] depending on experience and competences. The estimated salaries for the required roles are:

- Full stack - £50,000 per annum[23]
- Project Manager - £49,000 per annum[24]
- Rule-based NLG Specialist - £40,000 per annum[25]

The estimation for each task's duration includes any applicable documentation time. Furthermore, our time allocation for each task was multiplied by a factor of 1.2 to account for contingencies or delays in meeting development milestones.

In conclusion, the estimation of task duration and the associated labour are summarised in the table below. The overall product development cycle is estimated to be 3 months approximately.

| Projected Tasks | Responsible Role | Estimated Duration | Annual salary | Labour Cost |
|---|---|---|---|---|
| Web application development | 2x Fullstack dev | 6 weeks | 2x £50,000 | £11,500 |
| NLG functionality development | NLG specialist | 4 weeks | £40,000 | £3,100 |
| Full system testing and debugging | Full team | 4 week | Various | £14,300 |
| User manual creation | Project manager | 2 week | £49,000 | £1,900 |
| Overall project management and functionality specification | Project manager | 10 week duration | £49,000 | £9,500 |
| **Overall Labour Cost** | | | | **£40,300** |

[22] https://uk.talent.com/salary?job=full+stack+developer.
[23] https://uk.talent.com/salary?job=project+manager
[24] Ibid
[25] Insights on salaries were gained from the Glassdoor profile page of Arria

**Development tool and Infrastructure cost**

The development tool cost includes the cost for hardware and software tools. For this product development, there is no need for high performance equipment, standard IT equipment will suffice.

For developing the rule based NLG functionalities, a development platform like Arria NLG Studio will expedite the development dramatically, hence it is a necessary software tool to use. However at the time this report is written, the price for subscribing to Arria NLG Studio is unknown, instead the pricing of a similar software, AX Semantics will be referenced for calculating the subscription fee.

Integrated development environment (IDE) for the rest of the product development is necessary too. Basic functionalities of most IDEs are free for use[26] and they are considered adequate for our product development. For all team members, a Microsoft 365 package will be provided for facilitating daily work including documentation and on-line communication.

The infrastructure cost comes from the Cloud services. The major players on the global market include AWS, MS Azure, Google Cloud, and many other brands. This is an ongoing cost which is incurred throughout the product life-cycle. For this estimation, only the cost of the first three month are counted as the building cost. The total costs of the required hardware and software tools are listed below

| Development tools required | | Quantity | Unit Price | Overall Cost |
|---|---|---|---|---|
| Hardware | Dell XPS Tower + Monitor[27] (for developers) | 3 | £947 | £2,439 |
| | Dell Inspiron 24 5000 All-in-One (for project manager) | 1 | £532 | £532 |
| Software | Microsoft 365 Business Standard | 4 | £9.40 user/month | £113 |
| | AX Semantics | 1 | £239.86/month | £720 |
| Infrastructure | Cloud services[28] | N/A | £300/month | £900 |
| **Total Development tools Cost** | | | | **£4,704** |

So far, all costs for the development stage are all calculated based on a period of 3 month. Combining the two costing factors, labour cost and development tool cost, the total cost comes to £45,004 approximately.

[26] For example. MS Visual Studio Code is an open source IDE which is free to use: https://code.visualstudio.com/
[27] https://www.dell.com/en-uk/shop/desktops-and-all-in-ones/new-xps-tower/spd/xps-8940-desktop/cdx89426
[28] https://azure.com/e/9526f705448449e38680d3359240846a

**Running Costs:**

The running cost of the 9-month period after Nutrify's launching will be calculated to provide stakeholders an overview of the approximate investment required for the first year of Nutrify's development and operation.

It is estimated that one full stack engineer is required to carry out all maintenance work and one product manager is needed to cope with all operation issues, customer's feedback and overall management work. The labour costs are calculated below:

| Projected Tasks | Responsible Role | Estimated Duration | Annual salary | Labour Cost |
|---|---|---|---|---|
| System maintenance | 1x Fullstack dev | 9 month | £50,000 | £37,500 |
| Overall product management | Project manager | 9 month | £49,000 | £36,750 |
| **Overall Labour Cost** | | | | **£74,250** |

The software too and infrastructure cost are calculated below:

| Development tools required | | Quantity | Unit Price | Overall Cost |
|---|---|---|---|---|
| Software | Microsoft 365 Business Standard | 2 | £9.40 user/month | £170 |
| | AX Semantics | 1 | £239.86/month | £720 |
| Infrastructure | Cloud services[29] | N/A | £300/month | £2,700 |
| **Total Development tools Cost** | | | | **£3,590** |

The overall running comes to £77,840 approximately.

In conclusion, the investment required for developing Nutrify (3 month duration estimated) and operating it for a period of 9 month is £122,844 approximately in total.

[29] https://azure.com/e/9526f705448449e38680d3359240846a

# Summary

Nutrify occupies a unique non-realised niche at the intersection of various well-tested and reliable technologies. All of the technologies that Nutrify utilises are well proven with a track record of reliability and minimal unexpected hurdles. Our offering will generate more liquidity for the NHS by reducing time-waste of nutritionists and dietitians. In turn, this creates the opportunity to either 1) use the savings in time to serve more patients. Or 2) to dedicate more time for current patients and to focus on improving the quality of care. Furthermore, a secondary function of Nutrify is to provide patients suffering from EDs, or those wishing to achieve specific dietary goals, an opportunity to engage more with the treatment/coaching process via an NLG generated report designed for non-specialists. We believe this provides the patients with some agency by involving them, even if implicitly, in the decision making process with regards to their treatment. In turn, this may increase likelihood of a positive prognosis (Elwyn et al., 2000).

Our commercial analysis covers methodology used to estimate initial product pricing, existing market potential in both public and private sector, and a short survey into products and companies that may be deemed threatening to any market gains obtained after launch. Our calculations are based on a significant number of assumptions and this inherently increases the risk.

Choosing ‘status-quo’ numbers rather than attempting to predict future societal and financial trends was certainly the more feasible option given the current resources available. No consideration was made to what possible defensive measures could limit damage stemming from big players in the market, such as Arria, attacking the niche that Nutrify addresses. In our estimation, a national and international patent is a necessary measure before product launch.

Moreover, the costs for developing Nutrify within 3 months and operating it for another 9 months, in total one year period, it will cost £122,844 approximately. The projected revenue of the first 9 month, according to the calculation in the Market section is approximately £390,000. We have therefore seen a considerable profit space.

While nutritionists were the intended target end-users, we see a potential market with users who need to gain insights and control over their clients' diets. For example, athletics coaches or dietitians working for military or law-enforcement organisations. These are markets that were not explored in our analysis. Therefore, we estimate that our projections are in fact conservative. The commercial analysis presented herein remains high level and is to be used as a guideline but not to make firm decisions with regards to any possible investment in Nutrify.

With respect to our market niche, we recognise that EDs are complex disorders with various underlying psycho-social and physical causes and assuming dietary intervention alone is sufficient to address the suffering is shortsighted. Indeed, we do not make this claim whatsoever; however, dietary interventions, especially in mild presentations of ED, are recognised tools in the multi-tool bag of healthcare providers. We further see that future integration into the NHS current system is vital for the product to have both a

long term impact on improving patients' outcomes and for generating a reliable revenue stream that could be used to launch more products in the future.

Given the above discussion with regards to the nuance and complex nature of eating disorders and coupled with researched commercial opportunity; we predict Nutrify to be a viable and profitable commercial product with potential that is worth exploring.

# References

Burrows, T. L., & Rollo, M. E. (2019). Advancement in dietary assessment and self-monitoring using technology.

Di Renzo, L., Gualtieri, P., Pivari, F., Soldati, L., Attinà, A., Cinelli, G., ... & De Lorenzo, A. (2020). Eating habits and lifestyle changes during COVID-19 lockdown: an Italian survey. *Journal of translational medicine*, *18*, 1-15.

Elwyn, G., Edwards, A., Kinnersley, P., & Grol, R. (2000). Shared decision making and the concept of equipoise: the competences of involving patients in healthcare choices. *British journal of general practice*, *50*(460), 892-899.

Forrest, L. N., Smith, A. R., & Swanson, S. A. (2017). Characteristics of seeking treatment among US adolescents with eating disorders. *International Journal of Eating Disorders*, *50*(7), 826-833.

Galmiche, M., Déchelotte, P., Lambert, G., & Tavolacci, M. P. (2019). Prevalence of eating disorders over the 2000–2018 period: a systematic literature review. *The American journal of clinical nutrition*, *109*(5), 1402-1413.

Gordon, M., Althoff, T., & Leskovec, J. (2019, May). Goal-setting and achievement in activity tracking apps: a case study of MyFitnessPal. In *The World Wide Web Conference* (pp. 571-582).

Hart, L. M., Granillo, M. T., Jorm, A. F., & Paxton, S. J. (2011). Unmet need for treatment in the eating disorders: a systematic review of eating disorder specific treatment seeking among community cases. *Clinical psychology review*, *31*(5), 727-735.

Lupton, D. (2018). 'I just want it to be done, done, done!'food tracking apps, affects, and agential capacities. *Multimodal Technologies and Interaction*, *2*(2), 29.

McCarthy, M. (1990). The thin ideal, depression and eating disorders in women. *Behaviour research and therapy*, *28*(3), 205-214.

Mischoulon, D., Eddy, K. T., Keshaviah, A., Dinescu, D., Ross, S. L., Kass, A. E., ... & Herzog, D. B. (2011). Depression and eating disorders: treatment and course. *Journal of affective disorders*, *130*(3), 470-477.

Mohler-Kuo, M., Schnyder, U., Dermota, P., Wei, W., & Milos, G. (2016). The prevalence, correlates, and help-seeking of eating disorders in Switzerland. *Psychological medicine*, *46*(13), 2749.

O'Dowd, A. (2021). NHS waiting list hits 14 year record high of 4.7 million people.

Ozier, A. D., & Henry, B. W. (2011). Position of the American Dietetic Association: nutrition intervention in the treatment of eating disorders. *Journal of the American Dietetic Association*, *111*(8), 1236-1241.

Radd-Vagenas, S., Fiatarone Singh, M. A., Daniel, K., Noble, Y., Jain, N., O'Leary, F., ... & Flood, V. M. (2018). Validity of the Mediterranean diet and Culinary index (MediCul) for online assessment of adherence to the 'Traditional' diet and aspects of cuisine in older adults. *Nutrients*, *10*(12), 1913.

Streatfeild, J., Hickson, J., Austin, S. B., Hutcheson, R., Kandel, J. S., Lampert, J. G., ... & Pezzullo, L. (2021). Social and economic cost of eating disorders in the United States: Evidence to inform policy action. *International Journal of Eating Disorders*.

Thompson, F. E., & Subar, A. F. (2013). Chapter 1-dietary assessment methodology. *Nutrition in the Prevention and Treatment of Disease*, *3*, 5-46.

Trauzettel-Klosinski, S., Dietz, K., & IReST Study Group. (2012). Standardized assessment of reading performance: The new international reading speed texts IReST. *Investigative ophthalmology & visual science*, *53*(9), 5452-5461.

van Hoeken, D., & Hoek, H. W. (2020). Review of the burden of eating disorders: mortality, disability, costs, quality of life, and family burden. *Current Opinion in Psychiatry*, *33*(6), 521.

Weißgraeber, R. and Madsack, A., 2017, September. A working, non-trivial, topically indifferent nlg system for 17 languages. In Proceedings of the 10th International Conference on Natural Language Generation (pp. 156-157).

# Appendix

## Growth potential for the public sector - detailed calculations

Year 2022

- Factoring in population growth, 12,548 dietitians in total will be working in the UK by 2022. 80% of those (10,038) will be working for the NHS and 2,510 will be working privately.
- Given population 7.8% growth in ED, and that only 25% of them will seek help, we estimate the total number of patients with ED in 2022 will be 2.3*0.078 + 2.3= 2.48 ED patients. 2.48*0.25 = 619,985 patients will seek assistance.
- 90% of them will seek care in the NHS, that's 557,865. 10% will seek care in the private sector, that's 61,998 patients.
- Number of patients per dietitian is 56 at any point in time. This adds up to 560 minutes for examining the food diary.
- Average annual salary for a dietitian in the NHS is £34,000*.01+£34,000= £34,340. This too converts to £660.38 in a 35 hours workweek or £ 18.88 per hour or £0.315 per minute.
- We assume that average reading speed for a dietitian will be at the top range of the average values reported in (Trauzettel-Klosinski et al., 2012); 213 words per minute.
- Reports produced by Nutrify averaged 1000 words in length. On average, the time taken to read the report will be around 4.7 minutes.
- This constitutes 50.3% savings in time (time not spent on examining the diary is 5.3 minutes).
- Or, at £0.315 per minute saving, £1.67 per patient (5.3 minutes X £0.315)
- Or £93.52 per the 56 patients per dietitians. Or £938,754 for all the 10,038 dietitians working with the NHS. We continue with the assumption that the exercise of extracting insight from a food diary takes place only once in the second appointment where the first appoint is to instruct the patient to use a food logging apps such as MFP to log their food intake.
- Following the above we set our price for an NHS wide licence agreement to be £469,377 per annum. This leaves the NHS with conservative savings of also £469,377.

Year 2023

- Factoring in population growth, 12,611 dietitians in total will be working in the UK by 2023. 80% of those (10,089) will be working for the NHS and 2,522 will be working privately.
- Given population 7.8% growth in ED, and that only 25% of them will seek help, we estimate the total number of patients with ED in 2023 will be 2.48*0.078 + 2.48= 2.67M ED patients. 2.67*0.25 = 667,500 patients will seek assistance.
- 90% of them will seek care in the NHS, that's 600,750. 10% will seek care in the private sector, that's 66,750 patients.
- Number of patients per dietitian is 60 at any point in time. This adds up to 600 minutes for examining the food diary.
- Average annual salary for a dietitian in the NHS is £34,340*.01+£34,340 = £34,683. This to converts to £667 in a 35 hours workweek or £ 19.1 per hour or £0.3176 per minute.
- We assume that average reading speed for a dietitian will be at the top range of the average values reported in (Trauzettel-Klosinski et al., 2012); 213 words per minute.
- Reports produced by Nutrify averaged 1000 words in length. On average, the time taken to read the report will be around 4.7 minutes.

- This constitutes 50.3% savings in time (time not spent on examining the diary is 5.3 minutes).
- Or, at £0.3176 per minute saving, £1.68 per patient (5.3 minutes X £0.3176).
- Or £100.8 per the 60 patients per dietitians. Or £1,016,971 for all the 10,089 dietitians working with the NHS. We continue with the assumption that the exercise of extracting insight from a food diary takes place only once in the second appointment where the first appoint is to instruct the patient to use a food logging apps such as MFP to log their food intake.
- Following the above we set our price for an NHS wide licence agreement to be £508,489 per annum. This leaves the NHS with conservative savings of also £508,489.

Year 2024

- Factoring in population growth, 12,674 dietitians in total will be working in the UK by 2024. 80% of those (10,139) will be working for the NHS and 2,535 will be working privately.
- Given population 7.8% growth in ED, and that only 25% of them will seek help, we estimate the total number of patients with ED in 2024 will be 2.67*0.078 + 2.67= 2.88M ED patients. 2.88*0.25 = 720,000 patients will seek assistance.
- 90% of them will seek care in the NHS, that's 648,000. 10% will seek care in the private sector, that's 72,000 patients.
- Number of patients per dietitian is 64 at any point in time. This adds up to 640 minutes for examining the food diary.
- Average annual salary for a dietitian in the NHS is £34,683*.01+ £34,683 = £35,030. This to converts to £673.7 in a 35 hours workweek or £ 19.25 per hour or £0.321 per minute.
- We assume that average reading speed for a dietitian will be at the top range of the average values reported in (Trauzettel-Klosinski et al., 2012); 213 words per minute.
- Reports produced by Nutrify averaged 1000 words in length. On average, the time taken to read the report will be around 4.7 minutes.
- This constitutes 50.3% savings in time (time not spent on examining the diary is 5.3 minutes).
- Or, at £0.321 per minute saving, £1.7 per patient (5.3 minutes X £0.321)
- Or £108.8 per the 64 patients per dietitians. Or £1,103,123 for all the 10,139 dietitians working with the NHS. We continue with the assumption that the exercise of extracting insight from a food diary takes place only once in the second appointment where the first appoint is to instruct the patient to use a food logging apps such as MFP to log their food intake.
- Following the above we set our price for an NHS wide licence agreement to be £551,561 per annum. This leaves the NHS with conservative savings of also £551,561.

Year 2025

- Factoring in population growth, 12,737 dietitians in total will be working in the UK by 2025. 80% of those (10,190) will be working for the NHS and 2,547 will be working privately.
- Given population 7.8% growth in ED, and that only 25% of them will seek help, we estimate the total number of patients with ED in 2025 will be 2.88*0.078 + 2.88= 3.1M ED patients. 3.1*0.25 = 775,000 patients will seek assistance.
- 90% of them will seek care in the NHS, that's 697,500. 10% will seek care in the private sector, that's 77,500 patients.

- Number of patients per dietitian is 68 at any point in time. This adds up to 680 minutes for examining the food diary.
- Average annual salary for a dietitian in the NHS is £35,030*.01+ £35,030 = £35,380. This to converts to £680.4 in a 35 hours workweek or £ 19.44 per hour or £0.324 per minute.
- We assume that average reading speed for a dietitian will be at the top range of the average values reported in (Trauzettel-Klosinski et al., 2012); 213 words per minute.
- Reports produced by Nutrify averaged 1000 words in length. On average, the time taken to read the report will be around 4.7 minutes.
- This constitutes 50.3% savings in time (time not spent on examining the diary is 5.3 minutes).
- Or, at £0.324 per minute saving, £1.72 per patient (5.3 minutes X £0.324)
- Or £117 per the 68 patients per dietitians. Or £1,192,230 for all the 10,190 dietitians working with the NHS. We continue with the assumption that the exercise of extracting insight from a food diary takes place only once in the second appointment where the first appoint is to instruct the patient to use a food logging apps such as MFP to log their food intake.
- Following the above we set our price for an NHS wide licence agreement to be £596,115 per annum. This leaves the NHS with conservative savings of also £596,115.

Year 2026

- Factoring in population growth, 12,801 dietitians in total will be working in the UK by 2026. 80% of those (10,241) will be working for the NHS and 2,560 will be working privately.
- Given population 7.8% growth in ED, and that only 25% of them will seek help, we estimate the total number of patients with ED in 2026 will be 3.1*0.078 + 3.1= 3.34M ED patients. 3.34*0.25 = 835,000 patients will seek assistance.
- 90% of them will seek care in the NHS, that's 751,500. 10% will seek care in the private sector, that's 83,500 patients.
- Number of patients per dietitian is 73 at any point in time. This adds up to 730 minutes for examining the food diary.
- Average annual salary for a dietitian in the NHS is £35,380*.01+ £35,380= £35,734. This to converts to £687.4 in a 35 hours workweek or £ 19.64 per hour or £0.327 per minute.
- We assume that average reading speed for a dietitian will be at the top range of the average values reported in (Trauzettel-Klosinski et al., 2012); 213 words per minute.
- Reports produced by Nutrify averaged 1000 words in length. On average, the time taken to read the report will be around 4.7 minutes.
- This constitutes 50.3% savings in time (time not spent on examining the diary is 5.3 minutes).
- Or, at £0.327 per minute saving, £1.73 per patient (5.3 minutes X £0.327)
- Or £126.29 per the 73 patients per dietitians. Or £1,293,336 for all the 10,241 dietitians working with the NHS. We continue with the assumption that the exercise of extracting insight from a food diary takes place only once in the second appointment where the first appoint is to instruct the patient to use a food logging apps such as MFP to log their food intake.
- Following the above we set our price for an NHS wide licence agreement to be £646,668 per annum. This leaves the NHS with conservative savings of also £646,668.

## Growth potential for the private sector - full calculations

Year 2022

- Following the above we set our price for an NHS wide licence agreement to be £425,932 per annum. This leaves the NHS with conservative savings of also £425,932.
- We assume that only 20% of private practitioners will choose to use Nutrify, 502 dietitians out of 2,510.
- 61,998 patients (10% of 619,980) are estimated to seek care privately.
- This leaves each dietitian in that year with 124 patients in the whole of private sector market (61,998 /502).
- We follow the exact procedure followed earlier for calculating the future savings for the NHS to reach the figure of £207 per 124 patients per dietitians or £519,570 for all dietitians working privately for the year 2022. This is TAM for the private sector for the year 2022.
- Of the £519,570 TAM only 20% segment will be penetrated since we made the assumption in point a that only 20% of dietitians will buy Nutrify. Thus, Serviceable Obtainable Market (SOM) is: 20% X £519,570 = £103,914 for the 502 dietitians available.
- This makes monthly subscription at £17

Year 2023

- Following the above we set our price for an NHS wide licence agreement to be £737,304.12 per annum. This leaves the NHS with conservative savings of also £737,304.12.
- We assume that only 20% of private practitioners will choose to use Nutrify, 504 dietitians out of 2,522.
- 66,750 patients (10% of 667,500) are estimated to seek care privately.
- This leaves each dietitian on that year with 132 patients in the whole of private sector market (66,750 /504).
- We follow the exact procedure followed earlier for calculating the future savings for the NHS to reach the figure of £222 per 132 patients per dietitians or £559,884 for all dietitians working privately for the year 2023. This is TAM for the private sector for the year 2023.
- Of the £810,570.8 TAM only 20% segment will be penetrated since we made the assumption in point a that only 20% of dietitians will buy Nutrify. Thus, Serviceable Obtainable Market (SOM) is: 20% X £559,884 = £111,977 for the 504 dietitians available.
- This makes monthly subscription at £19

Year 2024

- Following the above we set our price for an NHS wide licence agreement to £801,487.95 per annum. This leaves the NHS with conservative savings of also £801,487.95.
- We assume that only 20% of private practitioners will choose to use Nutrify, 507 dietitians out of 2,535.
- 72,000 patients (10% of 720,000) are estimated to seek care privately.
- This leaves each dietitian on that year with 142 patients in the whole of private sector market (72,000 /507).
- We follow the exact procedure followed earlier for calculating the future savings for the NHS to reach the figure of £241 per 142 patients per dietitians or £611,949 for all dietitians working privately for the year 2024. This is TAM for the private sector for the year 2024.
- Of the £611,949 TAM only 20% segment will be penetrated since we made the assumption in point a that only 20% of dietitians will buy Nutrify. Thus, Serviceable Obtainable Market (SOM) is: 20% X £611,949 = £122,390 for the 507 dietitians available.
- This makes monthly subscription at £20

Year 2025

- Following the above we set our price for an NHS wide licence agreement to £876,340 per annum. This leaves the NHS with conservative savings of also £876,340.
- We assume that only 20% of private practitioners will choose to use Nutrify, 509 dietitians out of 2,547.
- 77,500 patients (10% of 775,000) are estimated to seek care privately.
- This leaves each dietitian on that year with 152 patients in the whole of private sector market (77,500 /509).
- We follow the exact procedure followed earlier for calculating the future savings for the NHS to reach the figure of £261 per 152 patients per dietitians or £664,767 for all dietitians working privately for the year 2025. This is TAM for the private sector for the year 2025.
- Of the £664,767 TAM only 20% segment will be penetrated since we made the assumption in point a that only 20% of dietitians will buy Nutrify. Thus, Serviceable Obtainable Market (SOM) is: 20% X£664,767 = £132,953 for the 509 dietitians available.
- This makes monthly subscription at £22

Year 2026

- Following the above we set our price for an NHS wide licence agreement to £947,855.75 per annum. This leaves the NHS with conservative savings of also £947,855.75.
- We assume that only 20% of private practitioners will choose to use Nutrify, 512 dietitians out of 2,560.
- 83,500 patients (10% of 835,000) are estimated to seek care privately.
- This leaves each dietitian on that year with 163 patients in the whole of private sector market (83,500 /512).
- We follow the exact procedure followed earlier for calculating the future savings for the NHS to reach the figure of £282 per 163 patients per dietitians or £721,920 for all dietitians working privately for the year 2026. This is TAM for the private sector for the year 2026.
- Of the £721,920 TAM only 20% segment will be penetrated since we made the assumption in point a that only 20% of dietitians will buy Nutrify. Thus, Serviceable Obtainable Market (SOM) is: 20% X £721,920 = £144,384 for the 512 dietitians available.
- This makes monthly subscription at £24