



# DIETETICS & NUTRITION NEWS



# TABLE OF CONTENTS

<b>CHAIRPERSON'S MESSAGE.....</b>	<b>1</b>
<b>THE INSPECTORATE OFFICE IN THE HPCSA LEGAL AND REGULATORY AFFAIRS DEPARTMENT.....</b>	<b>2</b>
<b>THE REGISTERED DIETITIAN - NUTRITIONIST (RDN).....</b>	<b>4</b>
<b>TRAINING AND REGISTRATION OF NUTRITION PROFESSIONALS IN SOUTH AFRICA.....</b>	<b>7</b>
<b>OPENING THE REGISTER FOR THE REGISTERED DIETITIAN - NUTRITIONIST.....</b>	<b>8</b>
<b>CEU ARTICLES .....</b>	<b>12</b>
<b>GENERAL INFORMATION .....</b>	<b>29</b>



# CHAIRPERSON'S MESSAGE



As we enter another year, the Dietetics and Nutrition Board (DNB) wishes you and your family peace and prosperity for the coming year.

My fellow practitioners, by now you would already have received notification for payment of your annual fees which are due on the 1<sup>st</sup> April 2024. For this year (2024-2025) the DNB has once again managed to keep the annual fee increase to 2%, which remains lower than the January 2024 inflation rate of 5.3%. The DNB remains ever mindful that all Board activities are funded by practitioner fees and are constantly aware of the need to engage in activities essential to the regulation of the DN professions. In addition, we have noted the lack of adequate placements for our community service practitioners as well as adequate job opportunities for our independent practitioners. As the Regulator, we will continue to do everything within the ambit of our influence to support future placement and employment.

As at December 2023, the Board had 4 194 registered practitioners and 2 160 registered students. We are pleased to report that practitioners re-registering with the Board are on the increase. During 2023, the Board has restored 79 practitioners for registration with the Board. Practitioners deregistering from the Board are also decreasing. During 2023, 151 practitioners were deregistered from the Board. Practitioners are once again reminded that fees may also be paid to the HPCSA quarterly or monthly (using your DT or NT number as a reference) if they are unable to pay the annual fees in a once-off lump sum payment.

At long last, some good news for all the practitioners on the Register for Dietitians. The Regulations defining the **Scope of Profession for Dietitians** has finally been updated and **promulgated on 23<sup>rd</sup>**

**February 2024.** You will recall that these Regulations were last published on 26<sup>th</sup> April 1991 making them 33 years old! The Board has worked hard on updating these Regulations and would like to take this opportunity to also thank all the practitioners for submitting their comments on the draft Regulations. It was through the receipt and consideration of these copious comments that we were able to update these Regulations accordingly.

In addition, the Board has worked simultaneously to prepare a **Scope of Practice for Dietitians (2024)** document which is now complete and published for use by all stakeholders, and available on the online portal of the DNB on the HPCSA website. Both documents support each other and we would suggest that you use them in combination.

Finally, we are very pleased to let you know that in February 2024, the Higher Education Qualifications Committee (HEQC) of the Council of Higher Education (CHE) approved the Qualification Standard for the B.Sc. in Dietetics and Nutrition. This means that we now have a standard against which all higher education institutions can develop their programmes for the new Registered Dietitian-Nutritionist (RDN) qualification. This standard is also published on the DNB website.

This is indeed very exciting progress for our professions.

Best wishes,  
**Lenore Spies**

*Chairperson of the Professional Board for Dietetics and Nutrition*





# THE INSPECTORATE OFFICE IN THE HPCSA LEGAL AND REGULATORY AFFAIRS DEPARTMENT

Dietitians and Nutritionist have a real problem or challenge relating to non-registered, untrained, non-professional people with a passion for or interest in nutrition who encroach on the scope of our professions. For many years we were told to report these people to the South African Police, which was indeed discouraging, as they are overburdened in terms of their workload and prioritised cases. The HPCSA Inspectorate Office is the solution to this problem.

The vision of the Health Professions Council of South Africa (HPCSA) is “Quality and equitable healthcare for all”, and the mission is “Protecting the Public and guiding the professions”. The Inspectorate Office was established by Council as a compliance enforcement unit.

As a compliance enforcement office, the mandate of the inspectorate is to enforce compliance with the Health Professions Act, 56 of 1974 in particular Sections 17, 19, 39 and 40, as well as the HPCSA's Ethical rules and regulations. The focus of the work of the office is to improve compliance and to protect the public through conducting inspections of:

- Registered practitioners
- Suspended and erased practitioners to check compliance with imposed sanctions
- As well as attending to illegal practices by unregistered persons.

These inspections could be scheduled, unscheduled or unannounced, and could be referred by the Professional Boards, Prelim committees and legal officers or a complaint from the public or a registered professional.

The office works closely with other regulatory bodies and law enforcement agencies to protect the public against illegal practices by unregistered persons (bogus practitioners).

The Inspectorate Office follows an integrated approach in collaboration with other organisations which is key for an effective compliance enforcement as it recognises that in order to eradicate or reduce the problem of illegal practices, an integrated approach with other regulatory councils, medical aid schemes and the media is essential to be more effective and have a meaningful impact. One of the challenges of the Inspectorate Office is that it depends on the South African Police Service (SAPS) and National Prosecuting Authority (NPA) for arrests and prosecution of those found practising illegally while not registered, however there is notable improvement in this regard.

## Who can report complaints and referrals to the Inspectorate Office?


- As a registered dietitian or nutritionist you may report a bogus practitioner online at: <https://hpcsaonline.custhelp.com/app/inspectorate> and you have a choice to remain anonymous or be contacted on the matter.
- Members of the public can report a complaint online at: <https://hpcsaonline.custhelp.com/>
- Employees of Council, Members of Professional Boards and Committees; Internal stakeholders may use a memorandum detailing the reasons, points of investigation or inspection for referral;
- In matters relating to encroachment of the scope of practice, the Chairperson of the Board or the Deputy Company Secretary should attach a detailed affidavit setting out the infringement in order to expedite the process.

## Information on where to find the Inspectorate Offices is available on the HPCSA website (www.hpcsa.co.za) on the landing page of the Department of Legal and Regulatory Affairs:

The Inspectorate Office is based at the Council's Head Office in Pretoria (Gauteng), with regional offices in Cape Town (Western Cape), Durban (KwaZulu-Natal) and East London (Eastern Cape). Inspectors for Limpopo, Mpumalanga and the Free State, North West and Northern Cape are based at the National Office in Pretoria. The position of inspectors for the Northern Cape, Mpumalanga and Limpopo are currently vacant, however complaints for these provinces are serviced by officials from other regional offices. There is currently a shortage of inspectors, which is a challenge that affects

turnaround time for finalisation of investigation and inspection negatively. The results are high workload which lead to delays in the investigations of complaints and safety risks of inspectors travelling long distance alone and sometimes in unfriendly environment. Currently there is only one inspector for each province except Gauteng which has two inspectors.

Nonetheless the DNB would like to encourage practitioners to actively report bogus practitioners to the HPCSA.




Log in or Sign up

Home | Online Services | New Registration | Professional Boards

### Complaint Against Bogus Practitioner


Details of Practitioner | Details of Complaint | Complaint Review | Acknowledgement


#### DETAILS OF BOGUS PRACTITIONER(s)

First Name of Practitioner \* 

Last Name of Practitioner \*

Practitioner's Physical Address (not PO Box) \*


HPCSA Registration Number 

Practice Number 

Mobile Number

Telephone Number

Fax Number

Email Address 

Next

3

2024 DNB NEWS



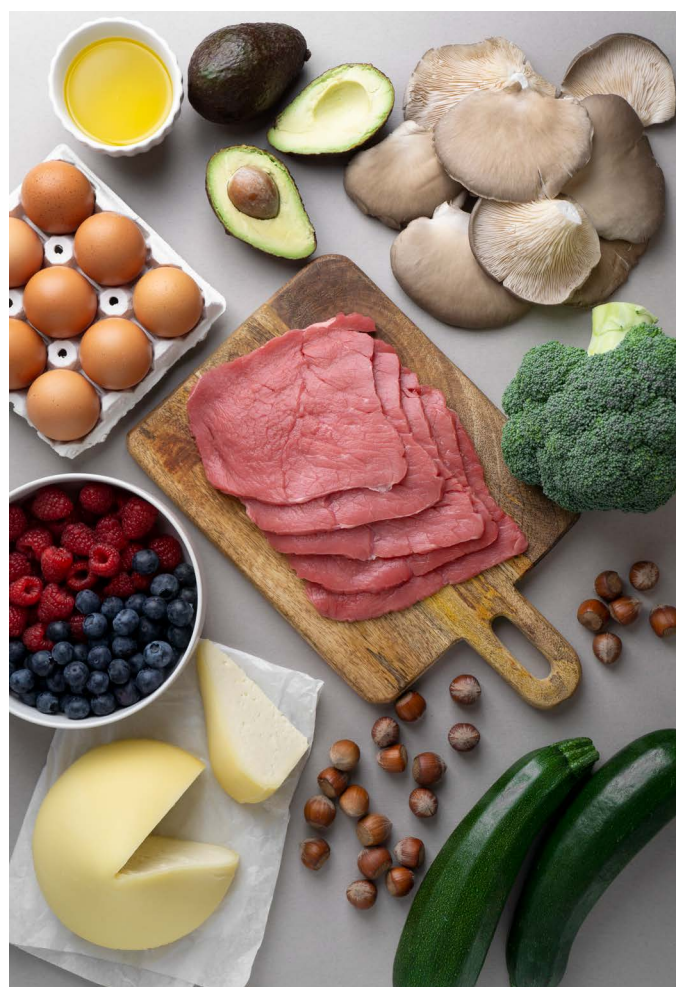
# THE REGISTERED DIETITIAN - NUTRITIONIST (RDN)

## HISTORY OF THE REGISTRATION OF THE DIETITIAN AND NUTRITIONIST PROFESSIONS

The registration of the dietetics profession with the HPCSA was promulgated in 1980 and the first Professional Board for Dietetics was established in 1981 with Prof Elma Nel from the then Natal University as the Chairperson. The first task of the Board was the development of the minimum standards for the training of dietitians. Since then the competencies of the dietitian have been revised by working groups in 1994 and in 2001. The most significant development in the competencies of the dietitian during this period has been the extension of the area of community nutrition from none in 1980, to about 5% in 1987 (then identified as functions performed by Department of Health), to at least 25% in 2001.

After a long and interrupted process which started around 1980, momentum towards the registration of a nutritionist was gained again in 2000 with regular meetings and workshops between 2000 and 2005 when the registration of this cadre was finally approved by the Professional Board for Dietetics and Nutrition and documentation for promulgation prepared. The register for nutritionists was eventually promulgated in the Government Gazette in 2008 with the Grandfather clause registration process closing in March 2010.

Currently the training of both dietitians and nutritionists is of high quality and a number of registered dietitians and nutritionists are working outside the country in for example the UK and Australia.



## BACKGROUND

The Professional Board for Dietetics and Nutrition embarked in 2012 on a consultative process with all the stakeholders to assess if the training of the two professions registered with the Board are mitigating the nutrition-related challenges of the country. A short summary is presented here of the process.



# STAKEHOLDERS OF THE PROFESSIONAL BOARD FOR DIETETICS AND NUTRITION

The Board usually meets once a year with their stakeholders for discussion of issues of mutual concern. These meetings are usually held in February and representatives of the following stakeholder groups are invited to attend:

- All the universities training dietitians and/or nutritionists (11 in 2012)

- National Department of Health, Directorate: Nutrition
- Provincial Departments of Health: Nutrition managers (all 9 provinces)
- South African Military Health Services (SAMHS): Dietetics/Nutrition
- Association for Dietetics in South Africa
- Nutrition Society of South Africa

## TASK TEAMS

In 2012 the Professional Board for Dietetics and Nutrition realised that it is necessary to relook at the training of the dietitian and nutritionist as part of the mandate of the Professional Board and to ensure that the training is in line with the vision of the HPCSA - "Quality and Equitable Health Care for All". It is the responsibility of the Professional Board to ensure that nutrition professionals registered with the Board is able to contribute to optimise the health and well-being of all South Africans through food and nutrition. The Professional Board mandate also gives it the authority to be the custodian of the process.

The Professional Board for Dietetics and Nutrition appointed on 23 February 2012 the **first Task Team** to investigate the overlap between the two professions. The Task Team comprised representatives of the Professional Board and the stakeholders. The first Task Team reported a big overlap between the two professions and recommended further investigations. See Addendum 1 for details of the process followed, outcomes and conclusions.

Subsequently the Professional Board appointed a **second Task Team** on 26 February 2014. The members of the first Task Team served on the second Task Team with additional members from the stakeholders to make a team of 12 members. The terms of reference were outlined as follows:

- To provide appropriate background information of the current situation;
- To describe the role of the nutrition profession (current and future opportunities) in the different sectors;
- To describe the skills and competencies required to execute these roles;
- To establish the number of known practitioners in the sectors;
- To establish the required number of NP in the sectors;
- To compare the skills and competencies of the NP as identified with the current skills and competencies for dietitians and nutritionist as contained in the SGB documents;
- To make a recommendation to the Professional Board for Dietetics and Nutrition on the way forward by 11 July 2014.

The most important **recommendation** of the second Task Team was that only one nutrition professional should be trained in future instead of the current two professions. See Addendum 2 for details of the process followed, outcomes and conclusions.



## SUMMARY OF SITUATION

Although improvements in some selected aspects of the nutritional status of the population have been documented, it is clear that the improvements are not sufficient. South African nutrition strategies and programmes are in line with current international recommendations and that the limited success of these is due to inadequate implementation. Researchers suggested that the improvement of impact of these strategies are dependent on programme choices, the development of a range of capacities such as technical, operational, programme / action research, information management and strategic capacity as well as the provision of adequate numbers of **appropriately trained** human resources.

From the comments received from different stakeholders as part of the process, it was also clear that the training and registration of two nutrition professionals with the current overlap between the scopes of practice and the unclear role delineation is not viable. The attempt by the first task team to create differences between the two professions by

ensuring that dietitians and nutritionists will operate at a facility and community level respectively has resulted in uncertainties and antagonism between the two professions at the implementation level and did not clarify the matter sufficiently for employers. At some levels there is also a perception that the new cadre of nutritionist is a duplication of the dietitian. Yet, the gap in service delivery to address nutrition problems at the community and household level has not been closed. Furthermore, the polarization of the nutrition workforce does not serve either of the professions or the future of nutrition in South Africa well.

At the Stakeholder meeting held on 23 February 2015 the final report was tabled, discussed and approved by the Stakeholders.

After the meeting of 23 February 2015, the full Professional Board for Dietetics and Nutrition approved the training of only one nutrition professional in future, namely the registered dietitian-nutritionist.

## FINAL MOTIVATION

At a Professional Board meeting in February 2022 the Professional Board summarised all the factors in 6 major points:

1. Current nutrition practice
  - Fragmentation of services
  - Training does not meet all the expectations/ health and disease profile
2. Training of two nutrition professionals
  - Limited training places for one of the professions
  - Costly to train two professionals
3. Lack of career path leading to unemployment
  - Especially for the current nutritionist
4. Not delivering nutrition service
  - Shift in focus of health/disease management to PHC
5. National Health Insurance
  - The NHI initiated after the competencies and skills of two professions were formalised. NHI = universal access so need to ensure alignment with skills at prevention level
6. International trend
  - Worldwide shift to prevention. Economic benefit of the shift to prevention vs curative models







# TRAINING AND REGISTRATION OF NUTRITION PROFESSIONALS IN SOUTH AFRICA

## Universities training nutrition professionals in 2012

Currently training of dietitians is taking place at 10 Universities in South Africa, namely:

- Nelson Mandela University - Port Elizabeth; Eastern Cape Province: started in 2013
- North-West University - Potchefstroom; North West Province
- Sefako Makgatho Health Sciences University (previously University of Limpopo; Medunsa) - Pretoria; Gauteng
- Stellenbosch University - Bellville, Tygerberg; Western Cape Province
- University of Cape Town - Cape Town; Western Cape Province
- University of KwaZulu Natal - Pietermaritzburg; KwaZulu Natal
- University of Limpopo; Turfloop Campus - Polokwane; Limpopo Province
- University of Pretoria - Pretoria; Gauteng
- University of the Free State - Bloemfontein; Free State
- University of the Western Cape - Bellville; Western Cape Province

Nutritionists are currently trained at only one university, namely the University of Venda - Thohoyadou; Limpopo Province.

Two other universities previously trained nutritionists, but has now close down their programmes, due to financial constraints and low number of applications:

- North-West University – Potchefstroom; North West Province – closed programme in 2016
- University of KwaZulu Natal – Pietermaritzburg; KwaZulu-Natal – closed programme in 2014.

## Universities who indicated that they would train the registered Dietitian - Nutritionist in future

All the universities currently training dietitians and/or nutritionists indicated that they would train the registered dietitian-nutritionist in future except the University of Cape Town.

- The following universities will thus train the new nutrition professional:
- Nelson Mandela University – Port Elizabeth; Eastern Cape Province: started in 2013
- North-West University – Potchefstroom; North West
- Sefako Makgatho Health Sciences University (previously University of Limpopo; Medunsa) – Pretoria; Gauteng
- Stellenbosch University – Bellville, Tygerberg; Western Cape
- University of KwaZulu-Natal – Pietermaritzburg; KwaZulu-Natal
- University of Limpopo; Turfloop Campus - Polokwane; Limpopo Province
- University of Pretoria – Pretoria; Gauteng
- University of the Free State – Bloemfontein; Free State
- University of Venda – Thohoyadou; Limpopo Province
- University of the Western Cape – Bellville; Western Cape



# OPENING THE REGISTER FOR THE REGISTERED DIETITIAN - NUTRITIONIST

## Processes and project management

A couple of processes ran simultaneously to finalise the training of the registered dietitian-nutritionist in future. The organisations/departments involved in the processes are (see figure 1 below):

- The Professional Board for Dietetics and Nutrition as well as the Council of the HPCSA
- National and Provincial departments of health
- All the different role players within higher education, namely the Department of Higher Education and Training, South African Qualification Authority, Council of Higher Education
- The universities to train the new nutrition professional.

Since all these processes had to be addressed in a coherent way to ensure the desirable outcome, the Professional Board in July 2019 appointed a Coordinator and Task Team to conclude these processes. This task team, under the Chairperson of the Education, Training and Registration Committee of the Professional Board, is meeting regularly with all the universities to guide them in the process and provide support when needed.

The team also had meetings with the Department of Higher Education and Training and National Department of Health.

The Task Team members were:

- Prof. Edelweiss Wentzel-Viljoen (Coordinator)
- Ms Lenore Spies (Chair of the Education, Training and Registration Committee of the DNB of the HPCSA)
- Dr Heather Sedibe (Department of Human Nutrition, University of Pretoria)
- Mrs Jill Wilkenson (Department of Dietetics and Nutrition, University of the Western Cape)

Due to the COVID-19 pandemic and the influence of it on the functioning of the universities, the Professional Board decided in June 2020 to postpone the project. The project continued in October 2021. The Professional Board also decided to do away with an official Task Team and rather co-opt Professor Edelweiss Wentzel-Viljoen on the Professional Board to coordinate and conclude the process.

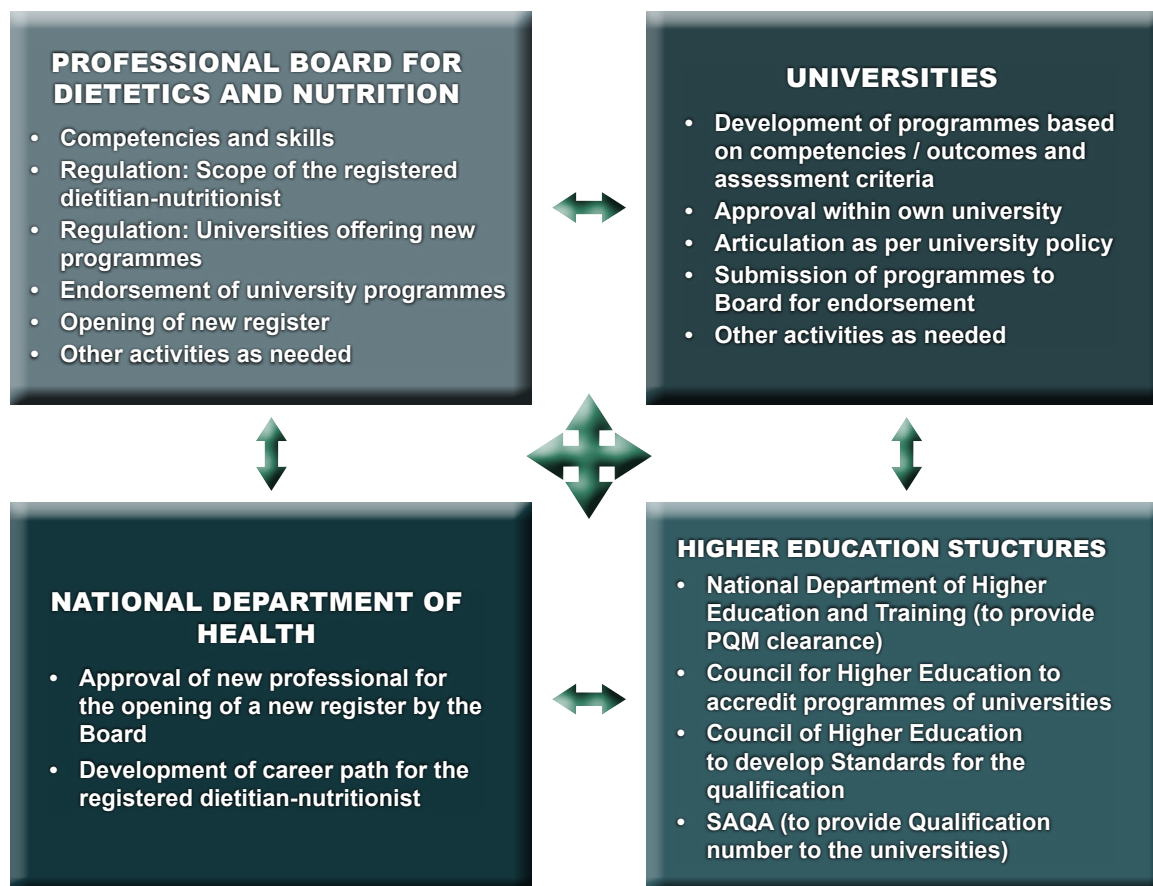


Figure 1: Illustration of the interaction between the different sectors to establish a new register for the registered dietitian-nutritionist



## Practitioners currently registered as a dietitian or nutritionist

The Professional Board is fully aware of the possible impact the training of only one nutrition professional could have in future on the current registers

The route of action will depend on individual choice.

**Option 1:** Practitioner retains current registration and continues to practice within her/his scope of the profession (either as a dietitian or as a nutritionist)

**Option 2:** A number of reskilling courses could be developed by any of the Higher Education Institutions. For example: A nutritionist who would like to have the new interchangeable qualification may apply to the HPCSA for registration on providing evidence of successful completion of accredited courses / qualifications towards the therapeutic nutrition competencies. Similarly, dietitians may choose to complete additional courses in order to register in the new interchangeable qualification.

**Option 3:** There are practitioners currently registered in both professions. Their unique situation will have to be addressed within the bigger framework.

**Option 4:** The Department of Health could decide to assist the nutrition professionals already employed in the health care system and wishing to be able to register as a RDN. Reskilling of the current practitioners will be needed and the necessary resources for this purpose would need to be provided – through the sector education and training units; as well as time off to complete the required training.

All these processes must be discussed and finalised in collaboration with the stakeholders of the Professional Board and the legal department of the HPCSA.

## HUMAN RESOURCE IMPLICATIONS FOR THE DEPARTMENT OF HEALTH

The Professional Board for Dietetics and Nutrition do not anticipate any problems with the integration of the RDN in the health care system. As previously indicated, the RDN will be able to function on the full care continuum from the individual to public health nutrition.

The current register for dietitians and nutritionists will stay open and these practitioners will continue to function within their scopes of practice. In the situation that the DoH needs to appoint new nutrition professionals, it is important to remember that positions previously ear-marked for dietitians could be filled by either a dietitian (RD(SA)) or a registered dietitian-nutritionist (RDN). The same apply for a nutritionist (RNT(SA)).

There should be no financial implications since it will not be necessary to change the current salary structure or add a new professional to the current professional mix.

The implications of the new qualification on community service would also need to be considered and provided for.

Reskilling of the current nutrition workforce to be able to register as a RDN will need additional resources depending on the model that will be used, for example:

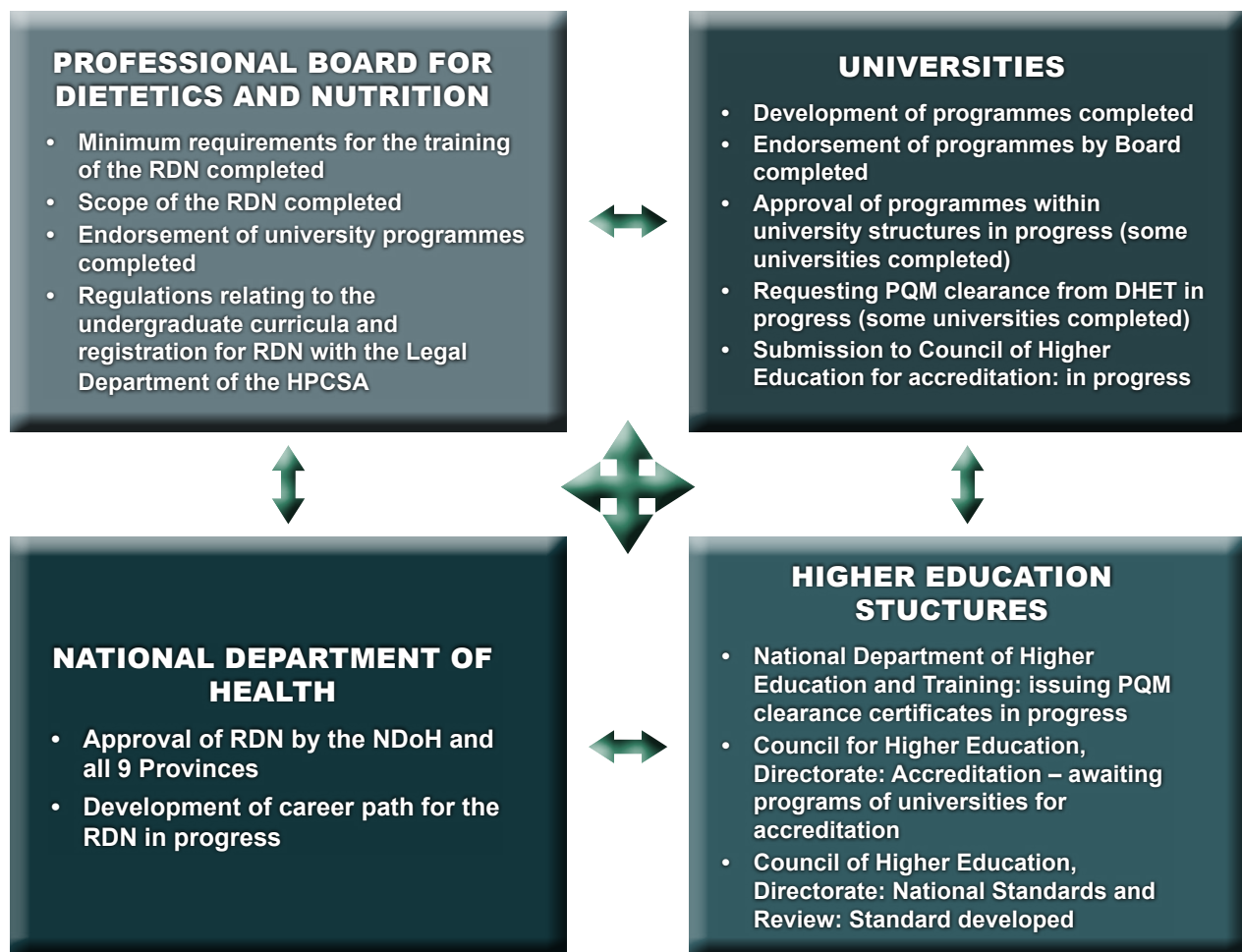
- Liaise with universities to offer short courses as needed
- Offer in-house training





## WHERE DO WE STAND NOW WITH THE PROCESS?

In the figure 2 below the progress of the process is summarised.



## CONCLUSION

The process to review, update and renew the training of the nutrition professionals in South Africa that started in 2012 is nearing the final stages of development and implementation. The Board is hopeful that the process of submission by the universities to the Council of Higher Education (CHE), Directorate: Accreditation for accreditation of their programmes will be completed this year. The Board had fruitful discussions with the CHE (CEO and Directors) on the accreditation process (this is done by a CHE appointed committee using the Standards as reference) and trusts that the process will not take too long. After the accreditation process the programmes are submitted to SAQA (South African

Qualifications Authority) to provide the universities with their unique qualification number. Once this number has been received universities may proceed to advertise the new programme in their year books for implementation from the next year.

The Board would like to express their gratitude and thanks to each individual and stakeholder group that participated in this process to make the project a success.

The Board looks forward to registering the first qualified registered dietitian-nutritionists!



## CEU Activity 1

You can obtain 2 CEUs ethics credits for reading the article **Artificial intelligence, nutrition, and ethical issues: A minireview**; and answering the included questions. Please submit your answer sheet to [Annelie.Gresse@mandela.ac.za](mailto:Annelie.Gresse@mandela.ac.za). by due date as indicated.

CPD Accreditation No:

### Reference:

Detopoulou, P., Voulgaridou, G., Moschos, P., Levidi, D., Anastasiou, A., Dedes, V., Diplari E-M., Fourfour, N., Giaginis, C., Panoutsopoulos, G.I. & Papadopoulou, S.K. 2023. Artificial intelligence, nutrition, and ethical issues: A minireview. *Clinical Nutrition Open Science*, 50: 46-56. DOI:10.1016/j.nutos.2023.07.001

## Review

## Artificial intelligence, nutrition, and ethical issues: A mini-review

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Dietitian

## SUMMARY

**Background and aims:** Artificial intelligence (AI) has expanded applications in both medicine and biomedical sciences, focusing on medical diagnosis, risk prediction of disease onset, support of therapeutic techniques, and other subjects. In parallel, several applications in nutrition have been developed, such as microbiota/genes-diet interactions, investigation of diet-disease relationships, chatbots for lifestyle intervention, dietary assessment with food photographs, and food composition applications.

**Methods:** The positive aspects and ethical concerns were analyzed regarding the use of AI in nutrition.

**Results:** In general, AI should do no harm and contribute to human well-being, while AI professionals should be honest, trustful, and fair. Privacy and confidentiality should be protected. Other concerns include the "dehumanization" of care, social disparities, responsibility assignment in case of errors or malfunctions, and bias in training models and delivering care. Moreover, the prediction of disease onset in high-risk individuals may be connected to stigma, over-medicalization, and stress. There is also a serious concern that AI systems in the field of nutrition and dietetics may cause a partial replacement of dietitians; however, health professionals can use

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## Introduction

Artificial Intelligence (AI) is a scientific field within Computer Science that aims to simulate human behavior and intelligence within computational systems programmed to learn and think like humans [1]. The crucial goal of AI development is to create intelligent systems, which could be capable of performing tasks that until now may only be accomplished by humans, as they require human intelligence. These tasks include visual perception, speech recognition, problem-solving, decision-making, etc [1]. A key distinction in AI is between narrow (or weak) and broad (or strong) AI [2]. In its narrow sense, AI refers to systems designed to perform specific tasks such as natural language processing, facial recognition, object detection, etc. These systems are currently characterized by specialization and operating within predefined boundaries. In its broader sense, AI refers to systems that would possess the ability to learn, understand, and apply the knowledge they have acquired across various domains, in the same manner a human would [2]. Some of the key fields within AI include Machine Learning (ML), Deep Learning (DL), Natural Language Processing (NLP), and Computer Vision (CV) (Fig. 1) [1].

Artificial intelligence (AI) has expanded applications in medicine, biomedical sciences, and nutrition [3]. However, several ethical concerns are arising along with its implementation in all disciplines [4]. Thus, the present mini-review aims to summarize the AI applications in health, with a focus on nutrition, as well as to analyze the concomitant challenges and ethical issues.

## Applications of AI in health

The usage of AI in biomedical sciences accomplishes analyzing large datasets, which is difficult with standard statistical methodologies. In our era, AI has widened applications in medicine and biomedical sciences. AI focuses on medical diagnosis, support of therapeutic techniques, risk prediction of disease onset, and other subjects [3].

Important and measurable clinical benefits have been achieved in the fields of drug research, cardiology, radiology, ophthalmology and others [3]. Machine Learning techniques are becoming more and more popular in diabetes research, especially in predicting blood glucose and developing artificial pancreas [5], predicting hypoglycemia [6], as well as predicting the onset of diabetes [7] and gestational diabetes [8] as well as diabetes complications [9]. Also, ML algorithms can be used in the study of gut microbiota, especially for the analysis of the large datasets which are collected in these studies [10]. Artificial Neural Networks (ANNs) are also, useful in modeling nonlinear functions. Nowadays many AI applications exist for the evaluation of biochemical test results [11] and cell cultures [12,13]. They have also been beneficial in pharmaceutical analysis [14,15], nutritional studies [3], and body composition analysis [16]. New opportunities are appearing for research in nutritional ingredients and sensors used in medicine [3].



### Machine Learning (ML)

- Enables machines to learn from data (data-driven) and improve their performance without explicitly being programmed beforehand.
- Capable of generating mathematical models for decision making.
- Allows computers to recognize specific patterns and adapt based on previous experiences based on large training data set

### Deep Learning (DL)

- Involves training artificial neural networks with multiple hidden layers to process complex data.
- Artificial Neural Networks (ANNs) are inspired by the structure of human brain.
- They are designed to process incoming signals via artificial neurons, which are interconnected through artificial synapses. They consist of three layers: the input, hidden, and output layers.
- ANNs gain knowledge by detecting patterns and correlations among data, a process that occurs through experience rather than programming



### Natural Language Processing (NLP)

- Involves the ability of computers to understand, interpret, and generate texts similar to human - natural language.
- NLP encompasses a range of tasks, such as translating texts into other languages, answering questions based on specific sources, text analysis, sentiment analysis through texts, and others

### Computer Vision (CV)

- Aims to enable computers to understand and interpret visual information from images and videos.
- CV includes applications such as surveillance systems, autonomous vehicles, face recognition, and others



Fig. 1. Key domains of artificial intelligence.



## Applications of AI in nutrition

### *Diet and gut microbiota*

The examination of nutrients and gut microbiota interactions could probably be performed by the use of AI techniques [17–21]. Notably, the investigation of several probiotic effects can help develop more effective probiotics, and probiotics combinations [19] or synthesize probiotics with the help of synthetic biology approaches [20]. Moreover, several optimized personalized models have been developed, such as the “enbiosis model”, which has been considered adequately effective in designing personalized diets to improve microbiome [21]. In a clinical pilot study, this AI-assisted dietary scheme effectively improve irritable bowel syndrome-related symptoms compared to a control diet [21]. Interestingly, cardiovascular risk prediction models were considerably enhanced by the use of AI-empowered algorithms including gut bacteria [22].

### *Nutrigenomics and personalized nutrition*

The use of artificial intelligence in bioinformatics provides useful tools and techniques for collecting, organizing, and analyzing large biological datasets such as nutritional, genomic, and other related datasets [23]. AI algorithms can then be used for analyzing and integrating these datasets to extract useful patterns and relationships. More to the point, AI can be used to create prediction models based on biological data for purpose to get estimated outcomes or to obtain personalized predictions. For example, by integrating genomic information with nutrition databases, AI algorithms can provide personalized dietary recommendations based on an individual's genetic profile [24,25]. Also, by taking into account genetic variations associated with nutrient metabolism, AI can recommend specific nutritional interventions tailored to an individual's unique genetic profile. Thus, both bioinformatics and AI can combine genomic information, nutritional assessments, lifestyle factors, and health data to create personalized nutrition.

### *Personalized nutrition*

AI can help formulate individualized nutrition diet plans. A personalized approach implies that differences between individuals in biochemical, metabolic, and genetic factors, as well as gut bacteria, may explain different phenotypic changes to specific interventions [26]. Bioinformatics and AI can identify biomarkers associated with specific nutritional interventions or health outcomes [27]. The above can help understand the molecular mechanisms underlying nutrition-related conditions and guide the development of more targeted interventions. By combining the computational power of bioinformatics with the advanced algorithms and learning capabilities of AI, researchers can gain a deeper understanding of nutrition-related phenomena, develop personalized interventions, and make evidence-based recommendations to optimize individual health and human well-being. An example of a personalized nutrition database is the Nutri-Educ algorithm, which has been formed to drive dietary changes [28].

### *Food composition*

The accurate prediction of components in foods plays a crucial role in food safety, product development, and general nutrition. Traditional methods for determining food composition are often time-consuming, expensive, and require extensive laboratory analysis. However, recent advancements in AI highlight a promising opportunity to overcome these limitations and provide efficient and reliable predictions of food components. In a recent study, artificial neural networks (ANN) predicted the chemical composition of peach fruit with high accuracy, indicating that the implementation of AI in the food field is simultaneously effective and feasible [29]. Similar to these results, ANN exhibits higher accuracy in the prediction of phenolic and flavonoid content from garlic compared to response surface methodology [30]. ANN also finds application in the determination of physicochemical and rheological parameters of several foods such as honey [31], tomatoes [32], and cow milk [33].



### *Dietary assessment with the use of food images recognition techniques*

Dietary assessment has several pitfalls research and individual level [34]. Several analysis techniques have been developed, including principal component analysis to identify dietary [35,36] and meal patterns [36], but still these rely on self-reported data. Food image recognition is considered a novel method assisted by deep learning methodologies [37], with increasing capacity as food databases continue to enlarge [38]. For example, the “NutriNet” tool was introduced, being systematically tested on more than 225,000 images of 520 foods and beverages [39], while the GoCARB application was equally efficient in carbohydrate estimation compared to dietitians [40]. The goFOOD™ application was able to estimate the calorie and macronutrient content of a meal, based on smartphone photos [41]. These new technologies could therefore potentially improve dietary assessment in human studies [37].

### *Investigation of diet-disease relationships*

AI techniques have been used to diagnose cardiovascular disease (CVD) [42] and classify people with diabetes [43] by the use of hair samples and trace elements analysis. Moreover, AI can enhance the ability of healthcare professionals and dietitians to improve nutrition delivery and healthcare [44].

### *AI chatbots for lifestyle intervention*

As reviewed elsewhere, chatbots may enhance physical activity but no consistent data exist so far regarding diet and weight loss [45].

## **Positive aspects of AI in nutrition**

AI by its conceptualization can identify patterns that humans cannot distinguish, rendering complex data into “simpler”, and “deeper” ones [46]. Indeed, AI systems and brains, work differently and have different architectural designs [47]. AI benefits from big data and works in a feed-forward way, meaning that it starts with an input, and proceeds forward, to give the results and a deeper representation of them [47]. On the contrary, the human brain functions in a more predictive way, being evolved to help us deal with particular issues that we're likely to encounter in real life [47]. In this way, the reformulation of data achieved from AI could effectively be exploited for human health and other purposes.

Moreover, errors that are inherent in human nature can be minimized [48]. For example, in patients with type1 diabetes hypo- and hyper-glycemia can be reduced by “smart systems” regarding insulin doses [49]. This is particularly important given the threatening effects of insulin overdosing [50].

With the help of AI, the concept of individualized nutrition can be realized. As a first step, dietary assessment can be more accurately conducted [37] by the use of AI-assisted methodology. Then, the combination of a plethora of genetic, gut microbiota, dietary and other data can be combined in various interactions to deliver the best solutions for a particular subject. However, the currently available clinical trials have not shown very promising results in this direction [51]. Personalized nutrition reflects the parallel era of precision medicine, which exploits new research methods to address health problems [26]. In addition, AI can empower patients, caregivers, and society to get control over their problems and identify future needs [44].

## **Ethical and other concerns regarding the use of AI in nutrition**

As Stephen Hawking has said, implying the importance of ethics within science and technology, “Our future is a race between the growing power of technology and the wisdom with which we use it” [44]. Some general ethical aspects of AI as proposed by the Association for the Advancement of Artificial Intelligence [2] are summarized in Table 1. With regards to nutrition research and practice, some of these and additional points are currently further analyzed.

The lack of human judgment and emotional intelligence may be ignored in AI algorithms [44]. Although artificial intelligence systems are extremely effective at detecting patterns, they cannot easily



**Table 1**

General ethical aspects regarding AI.

- 
- AI should contribute to society and to human well-being.
  - AI should do no harm.
  - AI professionals should be honest and trustful.
  - Persons engaged in AI should be fair and not discriminate.
  - Persons engaged in AI should respect the work required to produce new ideas, inventions, creative works, and computing artifacts.
  - Privacy and confidentiality should be protected.
- 

Adapted from the Association for the Advancement of Artificial Intelligence [2].

understand patient care nuances that require subjective decision-making and empathy on the part of the treating physician. The recent document on the Code of Ethics of the Professional Practice Committee of the European Federation of the Associations of Dietitians (EFAD) in the field of AI underlines the possible “dehumanization” of care along with the potential benefits of AI that may be achieved [52]. Moreover, several patient-centered communication techniques, such as motivational interviewing, which are used to alter dietary behavior [53] and are cost-effective [54], are difficult to conduct through technology. It is also possible that promising technological solutions may be overestimated and pose additional problems [44].

It is important to consider about the privacy of personal data [44]. The sensitive and personal data of the patients are collected and analyzed. These data must be kept secure and confidential [44]. It is crucial to control who has access to an individual's data. Furthermore, these data should not be used to discriminate against subjects to decide insurance costs or hiring status [55]. The use of genetic data poses extra challenges since the drivers of prediction algorithms remain uncertain [56].

The safety of personal data should be also ascertained [2] and the protection of human rights should be ascertained along with the implementation of AI [52]. For example, a case of 1.6 million health records sharing (without patient consent) to Google was described in the UK national health service for the creation of AI models [57]. It is, however, noted that even in cases where patients have given their consent, such as in the 100,000 Genome Project aiming at analyzing whole-genome sequences of patients with rare diseases or cancer, they do not realize the complexity of the project and they do not recall their choices on several issues [58]. Another aspect to be considered is unauthorized access and the misuse of electronic medical records [59]. Unauthorized access to healthcare data can provoke privacy violations [59]. The evolving nature of health information technology may itself render AI systems “vulnerable” [60]. Nevertheless, in some cases, access to healthcare data by authorized entities is deemed necessary.

It's also critical to validate algorithms obtained from retrospective and single-center studies and encourage validation in other centers and in a prospective way because it helps to avoid bias and overfitting AI models [61]. In parallel, it helps to improve the generalizability and robustness of AI models, which reflects their ability to perform well under a variety of conditions [61].

Bias may exist in training AI models deriving from missing values, number of participants, misclassification, measurement error, and social disparity [62]. In this context, data crunching, which is the procedure of collecting, preprocessing, analyzing, and visualizing large datasets to extract meaningful information, may be problematic [63]. Data preprocessing contains methods like cleaning and transforming data to obtain a form suitable for the next steps of the procedure, which may pose additional bias.

Regarding the social dimension of bias, it should be noted that in the US patients using health care have insurance, while no representation exists for uninsured patients in the learning algorithms [64]. Unequal access to healthcare is a significant issue especially for marginalized communities. Many individuals face multiple issues accessing healthcare due to various reasons like socio-economic disadvantages, cultural, racial, or ethnic minority status, and geographic isolation [65]. Moreover, a portion of the population, especially the elderly, does not trust AI systems [3] and may be under-represented in respective algorithms. Language restrictions as well as the under-representation of most vulnerable groups may also be applied [44]. Inversely, it is possible that already working AI technologies could aggravate health disparities [44] and create stigma. Another serious concern deals



with the commercialization of AI “products” and their potential to change market balances [66]. To deal with this threat, dietary recommendations should be commercially neutral [66].

In cases of errors or malfunctions of an AI model, assigning responsibility becomes difficult, and clear regulations and guidelines are highly required to address these issues [44]. Additionally, in some cases (for example in loop systems for diabetes), patients should be ready to self-manage their condition (insulin injections, and appropriate calculations).

In the case of personalized nutrition approaches, the fluctuations of factors within the same individual over time used to design diets are not known and the initial algorithms may need update. Moreover, there are few data regarding the long-term efficacy of AI-assisted nutritional interventions [51].

If AI technology predicts who is likely to develop a disease, it could then help high-risk individuals and society [67]. This information, however, could be connected to stigma, over-medicalization, stress and anxiety, and product marketing [67].

There is also a concern that AI systems in the field of nutrition and dietetics may cause partial replacement dietitians [3]. However, this should be mostly viewed as a change in the interaction of dietitians and clients, rather than as a substitution of health professionals. Indeed, several AI protocols may be delivered and/or used by dietitians [40,41,68]. To minimize such risk, clear statements about what the product can do is strongly recommended as well as the identification of target users and non-indicated users [66]. In parallel, several points to be considered for the use of AI by dietitians are shown in Table 2. Moreover, a special note that all provided information should be discussed with the doctor and/or the dietitian would protect users and especially those with health problems [66]. Especially for persons with mental disease, eating disorders, or high vulnerability, this point is crucial [66]. For example, a weight reduction app by a teenager (without being supervised) could be connected to the start of an eating disorder [66]. Regarding dietary assessment with the use of food images, several differences may exist in the nutrient composition of photos vs real foods, since diet cultures and recipes may differ from each other [69]. In other words, the implementation of results from AI algorithms is a major issue. However, if properly implemented, patient outcomes are better, healthcare costs are reduced and positive health outcomes can be achieved [70,71].

Last but not least, the regulatory framework needs constant updates to keep up with scientific advancements [4]. Alarmingly enough, the technology is continuously growing and changing but the legislation incorporates ethical and political considerations rather slowly. This means that “if policy is not built to guide technology, then technology will guide policy” [72]. In parallel, several issues have to be addressed to benefit from the practical application of technology, such as the balance between copyright and public health as well as the balance between privacy and technology application in the wide public [73]. The most recent commitments and legislation in the US, Europe, and internationally are shown in Fig. 2.

## Future directions

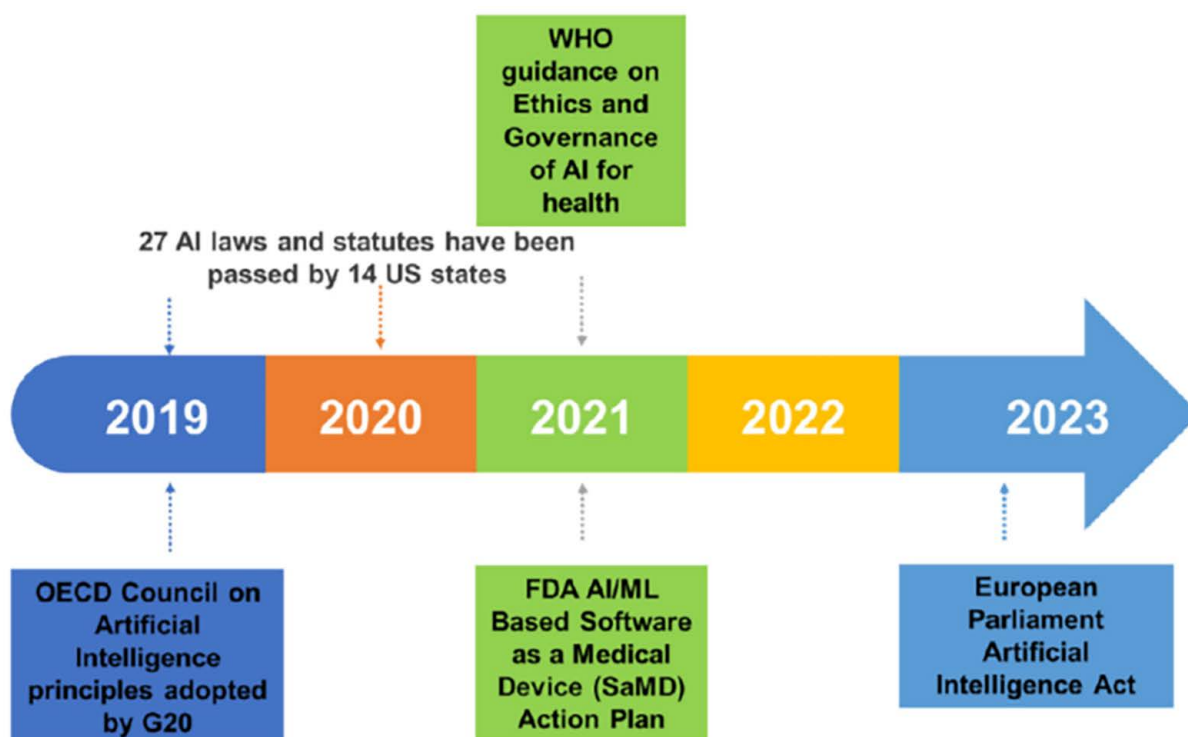
At the moment, AI-assisted interventions remain still at the research level and there is a strong need for their implementation in both individuals and populations [51]. To reach this level, the cost-effectiveness of AI-assisted personalized nutrition compared to standard therapy needs further justification [51], while legislation issues should be more clear [44]. Low- and middle-income countries should also be included in training data to create algorithms that accomplish well in these environments [44]. Moreover, the creation of a global network able to advise and support personalized interventions could be very helpful [55].

**Table 2**

Points to be considered for the use of AI by health-care providers including dietitians.

- They should be able to understand, interpret and explain the information provided by AI.
- They should realize potential risk and use AI only if benefits outweigh risks.
- They should use AI in a responsible way.





AI: Artificial Intelligence; FDA: Food and Drug Administration; ML: Machine Learning; OECD: Organisation for Economic Co-operation and Development; WHO: World Health Association

**Fig. 2.** Legislation and commitment steps in US, Europe and internationally.

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## ACTIVITY 1 - QUESTIONS

1. Artificial Intelligence (AI) systems are designed to perform specific tasks. These systems would possess the ability to
  - a. learn, understand, and apply the knowledge they have acquired
  - b. create new knowledge and behaviours for humans
  - c. understand the fine emotional nuances in human behaviour
  - d. a and b
2. AI systems can help to
  - a. develop more effective probiotics, and probiotics combinations
  - b. synthesise probiotics with the help of synthetic biology approaches
  - c. create needs for probiotics in humans
  - d. a and b
3. An example of an AI developed model in designing personalised diets to improve the microbiome is the
  - a. microbiome synthesiser model
  - b. gut synthesiser model
  - c. enbiosis model
  - d. microbiome health model
4. Integrating .....information with nutrition databases, AI algorithms can provide personalised dietary recommendations based on an individual's genetic profile.
  - a. individual dietary intake
  - b. genomic
  - c. health condition
  - d. preferences
5. AI can help formulate individualised nutrition diet plans. A personalised approach implies that differences between individuals in biochemical, metabolic, and genetic factors, as well as gut bacteria, may explain different ..... changes to specific interventions.
  - a. preference
  - b. nutrient
  - c. food group
  - d. phenotypic
6. An AI application that was developed to estimate the energy and macronutrient content of a meal, based on smartphone photos, in order to potentially improve dietary assessment in human studies, is called
  - a. goFOOD™
  - b. Food Finder III
  - c. NutriFood™
  - d. PhotoFood™

7. AI techniques have been used to diagnose cardiovascular disease and classify people with diabetes by the use of
  - a. blood samples and dietary analysis.
  - b. urine and blood samples.
  - c. hair samples and trace elements analysis.
  - d. all of the above.
8. AI may not always work well, as it may ignore
  - a. human judgment and emotional intelligence.
  - b. patient care nuances that require subjective decision-making.
  - c. empathy on the part of the treating health professional.
  - d. all of the above.
9. The procedure of collecting, pre-processing, analysing and visualising large datasets to extract meaningful information is called
  - a. AI.
  - b. data cleaning.
  - c. data crunching.
  - d. warehouse processing.
10. Some sections of the population, for example the elderly, may not trust AI systems. This may lead to
  - a. misuse of systems.
  - b. underrepresented sections of the population in data systems.
  - c. overuse of data systems.
  - d. a and b.
11. It is not always advisable to always rely on AI, even if it has very good applications, as
  - a. AI can make mistakes and that can cause problems in medication provision.
  - b. AI cannot give a personalised approach and it is one size fits all.
  - c. People do not learn to manage their conditions themselves and can run into trouble if there is a system failure.
  - d. No, AI can always be relied upon.
12. There is also a concern that AI systems in the field of nutrition and dietetics may cause partial replacement of nutritionists and dietitians. To minimise such risk,
  - a. clear statements about what the product can do is strongly recommended.
  - b. the identification of target users and nonindicated users will be necessary.
  - c. the use of AI systems should be limited to a few applications only.
  - d. a and b.
13. For dietitians and nutritionists to make good use of AI in health care, they should
  - a. be able to understand, interpret and explain the information provided by AI.
  - b. realise potential risk and use AI only if benefits outweigh risks.
  - c. use AI in a responsible way.
  - d. All of the above.
14. In AI, the term “machine learning” includes
  - a. training artificial neural networks with multiple hidden layers to process complex data.
  - b. generation of mathematical models for decision-making.
  - c. the ability of computers to understand, interpret and generate texts similar to human-natural language.
  - d. all of the above.
15. In which year has the WHO developed guidance and ethics and governance of AI for health?
  - a. 2019
  - b. 2020
  - c. 2021
  - d. 2022

## HOW TO EARN YOUR CEUs

1. Complete your personal details below.
2. Read the article: Artificial intelligence, nutrition, and ethical issues: A minireview; and answer the questions.
3. Indicate the answers to the questions by marking an "x" in the appropriate block at the end.
4. You will earn 2 CEUs (Level 1 - Ethics) if you answer 70% or more of the questions correctly. A score of less than 70% will unfortunately not earn you any CEUs.
5. Make a photocopy for your own records in case your answers do not reach us.
6. Scan and email or post your answers to: [Annelie.Gresse@mandela.ac.za](mailto:Annelie.Gresse@mandela.ac.za)

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## ANSWER SHEET ACTIVITY 1

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**E-mail address:** .....

**PLEASE ANSWER ALL THE QUESTIONS AND MARK THE APPROPRIATE BLOCK WITH AN "X"**

1. A ☐ B ☐ C ☐ D ☐
2. A ☐ B ☐ C ☐ D ☐
3. A ☐ B ☐ C ☐ D ☐
4. A ☐ B ☐ C ☐ D ☐
5. A ☐ B ☐ C ☐ D ☐
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9. A ☐ B ☐ C ☐ D ☐
10. A ☐ B ☐ C ☐ D ☐
11. A ☐ B ☐ C ☐ D ☐
12. A ☐ B ☐ C ☐ D ☐
13. A ☐ B ☐ C ☐ D ☐
14. A ☐ B ☐ C ☐ D ☐
15. A ☐ B ☐ C ☐ D ☐



## CEU Activity 2

You can obtain 2 CEUs ethics credits for reading the article **Artificial intelligence, nutrition, and ethical issues: A minireview**; and answering the included questions. Please submit your answer sheet to [Annelie.Gresse@mandela.ac.za](mailto:Annelie.Gresse@mandela.ac.za). by due date as indicated.

CPD Accreditation No: DT/A01/2024/0058

### Reference:

Health Professions Council of South Africa, Developed by the human rights, ethics and professional practice committee Pretoria, 2021.Guidelines for good practice in the Healthcare Professions.

Confidentiality: Protecting and providing information. HPCSA booklet 5.

## HOW TO EARN YOUR CEUs

1. Complete your personal details below.
2. Read the article: Health Professions Council of South Africa, Developed by the human rights, ethics and professional practice committee Pretoria, 2021.Guidelines for good practice in the Healthcare Professions. Confidentiality: Protecting and providing information. HPCSA booklet 5. The booklet is accessible via the following link: [https://www.hpcsa.co.za/Uploads/professional\\_practice/ethics/Booklet\\_5\\_Confidentiality\\_Protecting\\_and\\_Providing\\_Information\\_vDec\\_2021.pdf](https://www.hpcsa.co.za/Uploads/professional_practice/ethics/Booklet_5_Confidentiality_Protecting_and_Providing_Information_vDec_2021.pdf); and answer the questions.
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## ACTIVITY 2 - QUESTIONS

### CPD Questions for HPCSA Booklet 5: Confidentiality: Protecting and Providing Information

1. Which act states that private and sensitive information of patients must not be given to others, unless consent was obtained from the patients or unless there are justifiable reasons?
  - a. Health Professions Act No 56 of 1974
  - b. National Health Act No 61 of 2003
  - c. Promotion of Access to Information Act no 2 of 2000
  - d. Public Service Act no 103 of 1994
2. Which of the following may be included when anonymised data of a patient is provided to others?
  - a. Phone number so that the patients can be contacted
  - b. Medical aid number for billing purposes
  - c. Unique number used by the practice that provides the information
  - d. None of the above may be given out
3. At what age may a woman consent to the termination of pregnancy?
  - a. When she is 12 years or older
  - b. When she is 18 years or older
  - c. When she is 21 years or older
  - d. At any age
4. According to the Ethical and Professional Rules of the HPCSA, when may information about a patient be given out?
  - a. At the instruction of a court, even without consent of the patient
  - b. With the express consent of the patient
  - c. In the case of a deceased patient, with the written consent of the next of kin or the executor of the deceased's estate
  - d. In all of the above cases
5. Which of the following may be seen as an unintentional disclosure of information of the patient that is still not allowed?
  - a. Writing a letter to a doctor that you refer the patient to
  - b. When the dietitian/ nutritionist shares the office with another health professional who is present during the conversation and who can hear the conversation
  - c. When a patient is consulted in a closed consultation room but the room is not sound proof
  - d. Both b and c
6. Patients have the right to receive all the information about their condition and treatment. What should be included in such information?
  - a. diagnosis, prognosis and treatment options, outcomes of treatment,
  - b. common and serious side-effects of treatment,
  - c. likely time-frames of treatment, and the expected costs
  - d. a and b
  - e. a, b and c
7. A Masters' student wants to do research using identifiable patient records of medical practitioners to determine the relationship between various lifestyle factors and non-communicable diseases. The data may only be used after informed consent was obtained and the student had the duty of confidentiality or because of their registration with a statutory regulatory body.
  - a. True, if patients can be reached for consent
  - b. False, there is a duty of confidentiality and registration
  - c. False, informed consent is not necessary in any circumstances as the data will be anonymised and a research ethics committee will be informed
  - d. False, data of patients may not be used for research purposes



8. In cases where a patient withhold consent, personal information may be disclosed in the public interest where the benefits to an individual or to society of the disclosure outweigh the patient's interest in keeping the information confidential. An example of such a case is
  - a. A patient who is a secretary in a large company that does not want his/her HIV status to be known to his/her employer
  - b. A patient whose medication will remarkably influences his/her ability to safely work with equipment at the workplace\*
  - c. A patient with a treatable cancer that does not want to inform his/her spouse about it
  - d. All of the above
  
9. The automatic transfer of a patient's information to an electronic database of a registry, before the patient has given consent is acceptable.
  - a. True
  - b. False, it is only acceptable where a court has already decided that there is such an overwhelming public interest in the disclosure of information to a registry that rights of patients to confidentiality are overridden
  - c. False, in no circumstances is this acceptable, the practitioner must always get consent first
  - d. False, it is only acceptable if the patient is not able to give consent, e.g. the patient is unconscious
  
10. A healthcare practitioner does not have to obtain consent from a patient with a skin condition on his/her arm if only the arm will be used in a photograph in an article that the practitioner wants to publish in a journal.
  - a. True
  - b. False, must have consent in all cases
  - c. False, but if the patient is not able to give consent, then the other rules as stated in Booklet 5 is applicable
  - d. False, photographs of patients may not be published in articles
  
11. If a dietitian/ nutritionist is requested by a company to treat a patient, e.g. a diabetic patient or for obesity, and a progress report has to be given to the company
  - a. written consent to the disclosure is necessary from the patient.
  - b. the dietitian/ nutritionist must disclose only information relevant to the request for disclosure.
  - c. the dietitian/ nutritionist must show the report to the patient if the patient wishes to see the report before disclosure.
  - d. All of the above
  
12. When there is a conflict of interest between parties affected by a patient's death, disclosure of information can be an ethical dilemma. For example, if an insurance company needs to decide whether a payment under the life assurance policy has to be made and they need information from the health care practitioner,
  - a. the healthcare practitioner should only release information with consent of the executor of the deceased's estate and if the deceased had consented to such release before his or her death.
  - b. the healthcare practitioner should only release information with consent from the next-of-kin or the executor of the deceased's estate or if the deceased had consented to such release before his or her death.
  - c. only the executor can provide information, not the health practitioner.
  - d. informed consent is not necessary, the health care practitioner may give the information.
  
13. From what age may a person give consent to medical and surgical treatment?
  - a. 8 years, subject to being sufficiently mature to provide the consent
  - b. 12 years, subject to being sufficiently mature to provide the consent
  - c. 15 years, subject to being sufficiently mature to provide the consent
  - d. 18 years, subject to being sufficiently mature to provide the consent
  
14. Who is responsible to make sure that administrative staff keep information of patients confidential?
  - a. Administrative staff sign a confidentiality agreement and is responsible
  - b. Lawyer of the practice
  - c. Healthcare practitioner whose practice it is
  - d. Each individual in the practice
  
15. It is the patient's right to refuse health services.
  - a. True, even if implications and risks can for practitioner insurance reasons not be explained to the patient
  - b. True, but the health care practitioner must explain the implications, risks and obligations of such refusal.
  - c. False, a patient can be forced to undergo treatment if that is to his/her benefit.

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## ANSWER SHEET ACTIVITY 2

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5. A ☐ B ☐ C ☐ D ☐
6. A ☐ B ☐ C ☐ D ☐ E ☐
7. A ☐ B ☐ C ☐ D ☐
8. A ☐ B ☐ C ☐ D ☐
9. A ☐ B ☐ C ☐ D ☐
10. A ☐ B ☐ C ☐ D ☐
11. A ☐ B ☐ C ☐ D ☐
12. A ☐ B ☐ C ☐ D ☐
13. A ☐ B ☐ C ☐ D ☐
14. A ☐ B ☐ C ☐ D ☐
15. A ☐ B ☐ C ☐





# GENERAL INFORMATION

**For any information or assistance from the Council direct your enquiries to the Call Centre**

Tel: 012 338 9300/01  
Fax: 012 328 5120  
Email: [info@hpcsa.co.za](mailto:info@hpcsa.co.za)

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P.O Box 205  
Pretoria 0001

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Monday – Friday : 08:00 – 16:30  
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