Elective Subject

(Academic Course 2025-2026)

Subject title: Technology and Innovation applied to health, nutrition and sport

Code: Subject: Elective Responsibility Center: Faculty of Nursing, Physiotherapy and Podiatry Credits: 3 ECTS Number of places offered: 30

	Total (30% attendance)	Theory	Seminars	Practices	Others
		20	2	6	2
Classroom activities	30				

Course schedule: (semester, day and schedule): 2 semester. Tuesday from 1:30 p.m. to 2:30 p.m. Theoretical classes; Practical classes: Tuesday and/or Thursday morning and/or afternoon and Friday morning, depending on the availability of the Exercise Physiology Laboratory, School of Sports Medicine. Classroom I of the School of Sports Medicine (Faculty of Medicine, Pavilion VI – 5th Floor)

STUDENT PROFILE (University degrees for which they are offered, if applicable)

3rdand 4rd year degree students in nursing; They will also be able to opt for other degrees such as Physiotherapy and Podiatry

BRIEF DESCRIPTOR

Technological development applied to health has undergone a spectacular boom in the 21st century, both due to the rise of digital knowledge and the development of technology.

The future of medicine is increasingly destined to be understood with technology. Tech companies know this and are making efforts to create health-related solutions. Patients are increasingly open to the use of technology to improve their lives and companies take advantage of this fact as a source of economic growth. In recent years we are seeing launches of wearables and apps aimed at measuring and diagnosing aspects related to people's health.

5G communication, artificial intelligence, big data or supercomputing are transforming healthcare systems. These technologies will allow us in the future to make diagnoses faster, more effective and with fewer side effects.

There are more and more companies dedicated to technological development in the health field, but it is necessary to know what the limitations of the treatment of patient data are, and with what security guarantees it is necessary to work with them.

The development of technology applied to health also requires the integration of activities such as research, analysis, synthesis and dissemination of the results of the evaluation and verification of their applicability.

OBJECTIVES

A) Emphasize the interdependence of knowledge, emphasizing the connection between research, development, practical application and development of health technology.

B) Achieve increased operational capacity at all levels for the development of the application of technology in the medical field.

C) Recognize and value the contributions of the guidelines of good clinical practice in the achievement of previous medical studies for the development of technologies applied to the health field.

D) Appreciate the importance of scientific training to adopt a critical attitude about the problems that arise about technology applied to health.

E) Value scientific knowledge as a process of continuous change that adapts to the needs of new technologies applied to health.

KNOWLEDGE, SKILLS AND COMPETENCES

KNOWLEDGE:

NURSING

□ Know and assess the Health Sciences needs of healthy people and those with health problems throughout the life cycle, to promote and reinforce healthy behavior patterns.

□ Know and value information technologies to improve adult health disorders. Identify care needs derived from health problems.

□ Know and Innovation and Entrepreneurship, in Medical Devices and Diagnostic Technologies for health, apply the principles that support comprehensive nursing care.

□ Know and apply Emerging Technologies to apply them to Health care in a comprehensive manner in nursing.

□ Know the Regulation and Ethics in Digital Health, in Telemedicine and Digital Health, in Health Data Management for comprehensive patient care by nursing.

PHYSIOTHERAPY

□ Understand the fundamental concepts of health and the function that the physiotherapist performs in the health system.

□ Know and value information technologies to improve adult health disorders. Identify care needs derived from health problems in Physiotherapy.

□ Know and Innovation and Entrepreneurship, in Medical Devices and Diagnostic Technologies for health to apply the principles that support comprehensive care and the problems related to Physiotherapy in the areas of Primary, Specialized and Occupational Health Care.

- Know and apply quality Emerging Technologies in the practice of Physiotherapy, adjusting to the criteria, indicators and quality standards recognized and validated for adequate professional practice.

□ Know the Regulation and Ethics in Digital Health, in Telemedicine and Digital Health, in Health Data Management of the profession to carry it out within a social context. *CHIROPODY*

□ Understand the fundamental concepts of health and the function that the podiatrist performs in the health system.

□ Know and value information technologies to improve adult health disorders. Identify care needs derived from health problems in Podiatry.

□ Know and Innovation and Entrepreneurship, in Medical Devices and Diagnostic Technologies for health to apply the principles that support comprehensive care and problems related to Podiatry in the areas of Primary, Specialized Care and Occupational Health.

- Know and apply quality Emerging Technologies in the practice of Podiatry, adjusting to the criteria, indicators and quality standards recognized and validated for adequate professional practice.

□ Know the Regulation and Ethics in Digital Health, in Telemedicine and Digital Health, in Health Data Management of the profession to carry it out within a social context.

- Know the fundamentals of biomechanics and kinesiology. Supporting theories. The human march. Structural alterations of the foot. Postural alterations of the musculoskeletal system with repercussions on the foot and vice versa. Biomechanical analysis instruments through new technologies.

SKILLS: NURSING:

□ Promote healthy lifestyles, self-care, supporting the maintenance of preventive and therapeutic behaviors.

- Protect the health and well-being of the people, family or groups served, guaranteeing their safety. *PHYSIOTHERAPY*

□ Capacity for analysis and synthesis.

- Problem solving.

- Decision making.
- Teamwork.

- Work in an interdisciplinary team.

Critical reasoning.

- Autonomous learning.

□ Creativity.

 \Box Analyze, program and apply movement as a the rapeutic measure, promoting the participation of the patient/user in their process.

CHIROPODY

- Design of prevention protocols and their practical application. Public health. Concept, method and use of epidemiology.

COMPETENCÉS:

NURSING:

- Establish effective communication with patients, family, social groups or groups served, guaranteeing their safety.

□ Apply knowledge, skills and competencies in a global, multidisciplinary and integrative way in the

practical and systematized development of a project, final degree project in the field of biomedicine.

□ Ability to develop an R&D&I project in the field of biomedicine that contains the most appropriate methodology, that complies with current regulations and legislation and that complies with the principles of medical ethics.

□ Ability to describe and distinguish the characteristics, advantages, and disadvantages, limitations and possibilities of medical devices and health technologies, in the context of patient care and monitoring of healthy athletes.

PHYSIOTHERAPY

□ Promote healthy lifestyle habits through health education.

□ Apply quality mechanisms in the practice of Physiotherapy, adjusting to the criteria, indicators and quality standards recognized and validated for adequate professional practice.

Analyze the management processes of a Physiotherapy service or unit.

□ Apply knowledge, skills and competencies in a global, multidisciplinary and integrative way in the practical and systematized development of a project, final degree project in the field of biomedicine.

□ Ability to develop an R&D&I project in the field of biomedicine that contains the most appropriate methodology, that complies with current regulations and legislation and that complies with the principles of medical ethics.

□ Ability to describe and distinguish the characteristics, advantages, and disadvantages, limitations and possibilities of medical devices and health technologies, in the context of patient care and monitoring of healthy athletes.

CHIROPODY

□ Develop the factors that influence the health-disease phenomenon.

□ Acquisition of the ability to perform a comprehensive evaluation of the foot and gait, ability to apply therapeutic techniques for podiatric conditions, competence in educating patients about preventive foot care, in educating patients about preventive foot care and application of ethical and legal principles in podiatric clinical practice.

□ Apply knowledge, skills and competencies in a global, multidisciplinary and integrative way in the practical and systematized development of a project, final degree project in the field of biomedicine.

□ Ability to develop an R&D&i project in the field of biomedicine that contains the most appropriate methodology, that complies with current regulations and legislation and that complies with the principles of medical ethics.

□ Ability to describe and distinguish the characteristics, advantages, and disadvantages, limitations and possibilities of medical devices and health technologies, in the context of patient care and monitoring of healthy athletes.

LEARNING OUTCOMES

Provide knowledge about technology and its use in the health area and obtain skills in the field of technological entrepreneurship.

The knowledge and skills they achieve are the following: Knowledge in Health Sciences, in Information and Communication Technologies (ICT), in Innovation and Entrepreneurship, in Medical Devices and Diagnostic Technologies for health, in Emerging Technologies, in Regulation and Ethics in Digital Health, in Telemedicine and Digital Health, in Health Data Management and learning from interdisciplinary collaboration.

TEACHING ACTIVITIES (theoretical, practical, seminars, workshops, etc.)

- 1.- Theoretical classes
- 16 theoretical hours of development of the proposed syllabus.
- 2.- Practical classes:

6 practical hours in the Effort Physiology laboratory of the School of Medicine of Physical Education and Sports. 2 Hours of presentation of technological proposals applicable to health by each working group.

CONTENT TOPICS

Topic 1. The influence of technology and innovation in health. History of its development.

Topic 2. Applicability of technology to health care. Myths and realities. The market for the technological business in health and its future evolution.

Topic 3. Technology applied to sport (1): Apps, Apps for health

Topic 4. Technology applied to sport (2): Wearables; application for recording biomedical variables.

Topic 5. Technology applied to sport (3): Other medical devices for recording biomedical variables used in sport and nutrition.

Topic 6. Technology applied to health (4): Use of generative AI for searching for biomedical data, solving medical diagnoses, etc.

Topic 7. How research and clinical trials with humans should be. Biobanks. Data collection notebooks. Monitoring of clinical trials. Use of biological samples of human origin for research purposes

Topic 8. Ethical and legal aspects in the development of clinical trials with medical technology. Ethics committees, where to request authorizations. Informed consent models for clinical trials in healthy individuals and patients.

Topic 9. Treatment of biomedical data, data hosting and security standards according to the law. Statistical treatment of biomedical data.

Topic 10. How is the Protection of the results of R&D&I? Patents, Utility Models and Trademarks.

Topic 11. ETBS, Start-up; how is the creation of a Technology-based company?

EVALUATION

REGULAR CONVOCATION					
EVALUATION	WEIGHTING	REMARKS	MAXIMUM		
ACTIVITY			SCORE		
Test	40%		10		
Presentation	40%		10		
.Practices class	20%		10		
EXTRAORDINARY CALL					
EVALUATION	WEIGHTING	REMARKS	MAXIMUM		
ACTIVITY			SCORE		

BIBLIOGRAPHY - INTERNET Resources

1. A'Naja, M. N., Batrakoulis, A., Camhi, S. M., McAvoy, C., Sansone, J. S., & Reed, R. (2024). 2025

2. ACSM Worldwide Fitness Trends: Future Directions of the Health and Fitness Industry. ACSM's Health & Fitness Journal, 28(6), 11-25.

3. Ash, J. S., Berg, M., & Coiera, E. (2004). Some unintended consequences of information technology in health care: the nature of patient care information system-related errors. Journal of the American Medical Informatics Association, 11(2), 104-112.

4. Cabanas, A. M., Fuentes-Guajardo, M., Latorre, K., León, D., & Martín-Escudero, P. (2022). Skin pigmentation influence on pulse oximetry accuracy: a systematic review and bibliometric analysis. Sensors, 22(9), 3402.

Cabanas, A. M., Fuentes-Guajardo, M., Sáez, N., Catalán, D. D., Collao-Caiconte, P. O., & Martín-Escudero, P. (2024). Exploring the Hidden Complexity: Entropy Analysis in Pulse Oximetry of Female Athletes. Biosensors, 14(1).
Cabanas, A. M., Martín-Escudero, P., & Shelley, K. H. (2023). Improving pulse oximetry accuracy in dark-

skinned patients: technical aspects and current regulations. British Journal of Anaesthesia.

7. Cabanas, A. M., Sáez, N., Collao-Caiconte, P. O., Martín-Escudero, P., Pagán, J., Jiménez-Herranz, E., & Ayala, J. L. (2024). Evaluating AI Methods for Pulse Oximetry: Performance, Clinical Accuracy, and Comprehensive Bias Analysis. Bioengineering, 11(11), 1061.

Cardinale, M., & Varley, M. C. (2017). Wearable training-monitoring technology: applications, challenges, and opportunities. International Journal of Sports Physiology and Performance, 12, 52-55. DOI: 10.1123/ijspp.2016-0423.
Chaudhry, B., Wang, J., Wu, S., Maglione, M., Mojica, W., Roth, E., ... & Shekelle, P. G. (2006). Systematic review: impact of health information technology on quality, efficiency, and costs of medical care. Annals of Internal Medicine, 144(10), 742-752.

10. Donabedian, A. (1997). The quality of care: how can it be assessed? Archives of Pathology & Laboratory Medicine, 121(11), 1145.

11. Gil, C. (2012). Utilización de muestras biológicas de origen humano con fines de investigación. Revista de Bioética y Derecho, (25), 19-32.

 Hicks, J. L., Boswell, M. A., Althoff, T., Crum, A. J., Ku, J. P., Landay, J. A., ... & Delp, S. L. (2022). Leveraging Mobile Technology for Public Health Promotion: A Multidisciplinary Perspective. Annual Review of Public Health, 44.
Kercher, V. M., Kercher, K., Bennion, T., Levy, P., Alexander, C., Amaral, P. C., ... & Romero-Caballero, A. (2022). 2022 Fitness Trends from Around the Globe. ACSM's Health & Fitness Journal, 26(1), 21-37.

14. León-Valladares, D., Barrio-Mateu, L. A., Cortés-Carmona, N., Fuentes-Lizana, G., Cabanas, A. M., Latorre-Progulakis, K., ... & Martín-Escudero, P. (2024). Determining factors of pulse oximetry accuracy: A literature review. Revista Clínica Española (English Edition).

15. Li, R. T., King, S. R., Salata, M. J., Cupp, S. A., Sheehan, J., & Voos, J. E. (2016). Wearable performance devices in sports medicine. Sports Health, 8, 74-78. DOI: 10.1177/1941738115616917.

16. Mamdiwar, S. D., Shakruwala, Z., Chadha, U., Srinivasan, K., & Chang, C. Y. (2021). Recent advances on IoTassisted wearable sensor systems for healthcare monitoring. Biosensors, 11(10), 372.

17. Martín-Escudero, P., Cabanas, A. M., Dotor-Castilla, M. L., Galindo-Canales, M., Miguel-Tobal, F., Fernández-Pérez, C., ... & Giannetti, R. (2023). Are activity wrist-worn devices accurate for determining heart rate during intense exercise? Bioengineering, 10(2), 254.

18. Martín-Escudero, P., Cabanas, A. M., Fuentes-Ferrer, M., & Galindo-Canales, M. (2021). Oxygen saturation behavior by pulse oximetry in female athletes: breaking myths. Biosensors, 11(10), 391.

19. National Center for Health Statistics (US). (2010). Health, United States, 2009: With special feature on medical technology.

20. Peake, J., Kerr, G. K., & Sullivan, J. P. (2018). A critical review of consumer wearables, mobile applications and equipment for providing biofeedback, monitoring stress and sleep in physically active populations. Frontiers in Physiology.

 Scalise, L., & Cosoli, G. (2018). Wearables for health and fitness: Measurement characteristics and accuracy. In 2018 IEEE International Instrumentation and Measurement Technology Conference (I2MTC). IEEE: 1-6. DOI: 10.1109/I2MTC.2018.8409635.

22. Stuart, S., Mason, R., Pearson, L., Barry, G., Young, F., Lennon, O., & Godfrey, A. (2022). Wearables for Running Gait Analysis: A Systematic Review. Sports Medicine.

23. Tamura, T., Maeda, Y., Sekine, M., & Huang, M. (2017). The Role of Wearable Monitor for Healthcare. Advances in Science & Technology, 100.

24. Thompson, W. R. (2023). Worldwide survey of fitness trends for 2023. ACSM's Health & Fitness Journal, 27(1), 9-18.

25. Thompson, W. R. (2017). Worldwide Survey of Fitness Trends For 2018: The Crep Edition. ACSM's Health & Fitness Journal, 21(6), 10-19. DOI: 10.1249/FIT.00000000000341.

26. Thompson, W. R. (2018). Worldwide survey of fitness trends for 2019. ACSM's Health & Fitness Journal, 22, 10-17. DOI: 10.1249/FIT.000000000000438.

27. Thompson, W. R. (2019). Worldwide survey of fitness trends for 2020. ACSM's Health & Fitness Journal, 23(6), 10-18.

Thompson, W. (2016). Worldwide survey of fitness trends for 2017. ACSM's Health & Fitness Journal, 20(6), 8-

29. Walker, R. K., Hickey, A. M., & Freedson, P. S. (2016). Advantages and limitations of wearable activity trackers: considerations for patients and clinicians. Clin J Oncol Nurs, 20, 606-610.

TEACHING STAFF *(It should be indicated whether teachers have completed all their teaching dedication or not)

Teacher Responsible (coordinator): Professor in charge (coordinator): Name: Pilar Martín Escudero (pmartinescudero@med.ucm.es) Department: Department of Radiology, Rehabilitation and Physiotherapy

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