ES9ZW-15 Modern Approaches to Diagnostics

26/27

Department
School of Engineering
Level
Taught Postgraduate Level
Module leader
Dimitris Grammatopoulos
Credit value
15
Module duration
10 weeks
Assessment
Multiple
Study location
University of Warwick main campus, Coventry

Description

Introductory description

Diagnostics is a core pillar of modern medicine. It is widely recognised that more than 70% of clinical decisions are informed by diagnostic investigations and laboratory testing. The delivery of contemporary healthcare, including precision medicine and population health approaches, depends on the ability to generate, interpret and apply diagnostic information effectively. This includes the use of blood and tissue biomarkers, laboratory and pathology-based investigations, molecular and genomic analyses, physiological monitoring, point-of-care diagnostics, and imaging to support the prevention, diagnosis, stratification and monitoring of disease.
This core module introduces students to the role of diagnostics in modern medicine, with a particular focus on the UK healthcare system and the technologies and approaches that underpin innovation in diagnostics delivery. Students will explore how advances in diagnostics support precision medicine, integrated care, and digitally enabled healthcare pathways.
Specifically, students will examine innovative diagnostic approaches and applications including multi-omics, genomic medicine, predictive analytics, pathology and digital pathology, point-of-care diagnostics, and imaging-based diagnostics, and develop an understanding of key preclinical and clinical science principles, biomarker discovery and validation, and the role of diagnostic data in prevention, diagnosis and treatment stratification. Students will also be introduced to the application of multi-omics in translational diagnostics through linked teaching sessions and a

dedicated activity associated with the multi-omics facility at UHCW. They will achieve this through specialist lectures and workshops covering topics such as current challenges in diagnostics globally and in the UK, precision medicine and the 4D concept (data, devices, diagnostics and drugs), national priorities in healthcare, -omics technologies, integration of genomics in disease phenotyping, pathology, imaging and digital pathology, AI and data science in medical diagnostics and treatment selection, and industry perspectives on biomarker pipelines and disruptive innovations with the potential to transform diagnostics delivery and improve healthcare outcomes. The sessions will be delivered by academics with expertise in routine diagnostics and the development of innovative diagnostic solutions, including clinical academics associated with UHCW, the Innovation Hub and Warwick's translational diagnostics activity, alongside external speakers from the diagnostics industry. Students will be assessed through an essay that evaluates their understanding of the diagnostics landscape, regulatory frameworks, and relevant scientific and clinical concepts, and through a case study presentation based on the UNIVANTS Healthcare Excellence Awards programme, focusing on translational diagnostics, service innovation, and impact on healthcare outcomes.

Module aims

The module aims to provide:

- an understanding of the diagnostics landscape in the UK and globally, including current challenges, opportunities and post-pandemic developments;
- an understanding of the role of diagnostics in precision medicine, population health, integrated care, and service transformation;
- an advanced understanding of contemporary technologies and methodologies used in translational diagnostics, including multi-omics, genomic medicine, data science, artificial intelligence, pathology and digital pathology, point-of-care diagnostics, imaging, and digital health approaches that contribute to the 4D concept of data, devices, diagnostics and drugs;
- exposure to the application of multi-omics technologies in translational diagnostics, including their role in biomarker discovery, disease stratification and service innovation;
- exposure to the clinical, laboratory, pathology and innovation environments in which diagnostics are developed, evaluated and delivered, including NHS diagnostic services;
- an understanding of translational pathways from discovery science through preclinical evaluation to clinical implementation and routine practice.

Outline syllabus

This is an indicative module outline only to give an indication of the sort of topics that may be covered. Actual sessions held may differ.

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The module will examine the diagnostics landscape in the NHS and internationally across primary, community, secondary and tertiary care settings. It will explore the role of diagnostics in precision medicine, population health, integrated care pathways and community diagnostics, including the roles of NICE, relevant innovation and research infrastructures, and regulatory bodies in supporting diagnostics research, evaluation and translation.

The module will cover innovative technologies and methodologies used in modern diagnostics, including multi-omics for biomarker discovery, genomic medicine, pathology and digital pathology, point-of-care testing, imaging, biosensors, and data science and artificial intelligence approaches for diagnosis, risk stratification and clinical decision support. Applications will be illustrated through examples such as cancer, liver disease, infection and sepsis, obstetric care, and other areas of unmet clinical need.
The module will also include linked teaching on the application of multi-omics technologies in translational diagnostics, supported by a dedicated activity introducing students to the multi-omics facility at UHCW. This will provide insight into the practical, analytical and translational considerations involved in using multi-omics approaches for biomarker discovery, disease stratification and implementation within contemporary diagnostic pathways.
Students will also examine emerging approaches to data acquisition and translational research, including whole-body physiological measurements, organ-on-chip methodologies, and multimodal diagnostics that integrate laboratory, pathology, imaging and digital data. The syllabus will also include the industry perspective on biomarker and diagnostic technology pipelines, from discovery and validation through to implementation in routine clinical practice.
Representative examples from Warwick and partner organisations will be used to illustrate interdisciplinary translational diagnostics research and innovation. These may include laboratory medicine and pathology services, digital pathology, artificial intelligence applications for precision diagnostics, clinical decision support tools, analytical devices such as biosensors, imaging-enabled diagnostics, and biomarker development for early disease diagnosis and risk stratification.
Lectures will also explore concepts in which diagnostics plays a central role, including precision medicine, P4 diagnostics, genomic medicine, non-invasive prenatal testing, point-of-care and near-patient testing, pathology-supported diagnostic pathways, imaging-supported diagnostic pathways, and multi-omics-enabled approaches to disease stratification, together with the regulatory and implementation environment that supports translation into routine practice.
Students will also have the opportunity to visit real-world NHS diagnostic services, including the multi-omics facility, at UHCW NHS Trust.

Learning outcomes

By the end of the module, students should be able to:

- Critically explain the role of diagnostics in modern healthcare, including their contribution to prevention, diagnosis, prognosis, treatment selection and monitoring within contemporary healthcare systems.
- Critically evaluate analytical, clinical and operational challenges in diagnostic service delivery, and appraise emerging technologies and innovations, including point-of-care diagnostics and imaging-based approaches, for their potential to improve healthcare outcomes.
- Assess and apply examples of novel diagnostic approaches, including genomics, multi-omics, imaging and digital diagnostics, in relation to population health and personalised medicine.
- Critically discuss the regulatory, quality assurance and implementation frameworks that govern the adoption of new diagnostic technologies and concepts into routine practice.
- Evaluate the key drivers of high-quality diagnostic services, including innovation pathways, interdisciplinary working, clinical utility, and service readiness for translation into practice.

Indicative reading list

Reading lists can be found in Talis

Interdisciplinary

The modern diagnostic services require input and scientific expertise from a wide range of specialties. The module will introduce this concept to students and enable them to develop multidisciplinary skills in order to answer common operational, methodological, analytical and clinical pathway problems.

Subject specific skills

The skills students should acquire are:

- current knowledge and awareness of the diagnostics landscape, current drivers of healthcare transformation, and future directions in modern diagnostics;
- understanding of suitable techniques and approaches used in translational diagnostics, including biomarkers of disease, pathology and laboratory-based approaches, genomic and multi-omics methods, point-of-care diagnostics, imaging, and digitally enabled diagnostic systems;
- ability to recognise the added value of multidisciplinary approaches and critically appraise current technologies used to address contemporary medical questions, healthcare pathways, and translational challenges;
- understanding of the multi- and interdisciplinary tools available for translational diagnostics, and recognition of barriers to adoption, implementation and scale-up in routine practice.

Transferable skills

- an understanding of diagnostics, the healthcare landscape and the key drivers of healthcare delivery;
- an ability to recognise the relative strengths and weaknesses of various methodological approaches;
- an ability to understand the translation pathway of method development and its application to routine practice;
- an ability to recognise the need for staff upskilling and the continuous development of expertise in cutting-edge methodologies;
- an understanding of the crucial role of interdisciplinarity in delivering high-quality diagnostics and continuous service evolution.

Study

Study time

Type	Required
Lectures	10 sessions of 3 hours (20%)
Seminars	10 sessions of 1 hour (7%)
Tutorials	5 sessions of 1 hour (3%)
External visits	1 session of 4 hours (3%)
Private study	51 hours (34%)
Assessment	50 hours (33%)
Total	150 hours

Private study description

It is expected that during their private study time, students will study additional material around innovations, regulatory elements, clinical pathway development, and the role of diagnostics, and methodological advances, and refine knowledge as required for preparation and submission of their formative assessments (see assessment time).

Costs

No further costs have been identified for this module.

Assessment

You must pass all assessment components to pass the module.

Assessment group A1

	Weighting	Study time	Eligible for self-certification
Essay on Diagnostics technologies and models of delivery	50%	25 hours	Yes (extension)
A 2,000- word essay to demonstrate advanced understanding of complex scientific concepts in a chosen diagnostics medicine field or multi-omics technique, and their added value and impact.			
UNIVANTS Case study and poster presentation	50%	25 hours	No
To assess that learning outcomes on the principles of diagnostics and measures of success are met. The Case will involve group work and will be presented as a poster.			

Assessment group R1

	Weighting	Study time	Eligible for self-certification
Essay on Diagnostics technologies and models of delivery	100%		No

Feedback on assessment

Marking of essays and feedback will be based on standardised rubrics; the module lead will moderate marks and provide feedback. Also, the in-class test will be marked and moderated. Feedback will be available on request. In case of assessment failure, the module lead will offer a face to face feedback.

Availability

Courses

Course availability information is based on the current academic year, so it may change.
This module is Core for:

- TESA-H1CA Postgraduate Taught Diagnostics, Data and Digital Health
  - Year 1 of H1CA Diagnostics, Data and Digital Health
  - Year 1 of H1CB Diagnostics, Data and Digital Health (Medical Diagnostics)
  - Year 1 of H1CC Diagnostics, Data and Digital Health (Medical Imaging)