

ES9ZW-15 Modern Approaches to Diagnostics

24/25

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 behind-the-scenes backbone of medicine. It is accepted more than 70% of medical decisions are based on the results of diagnostics and laboratory tests. Delivery of modern population healthcare and personalised medicine would be impossible without diagnostics and appropriate medical laboratory testing. Ability to capture and implement the right innovations and methodologies is key to use information from blood or tissue samples, in order to assess kidney, liver or heart function, or if a person has an infection or cancer.

The core module intends to introduce students to the role of diagnostics in modern medicine focusing on the UK healthcare system as well as the technologies and approaches used, to advance and deliver concepts such as precision medicine.

Specifically, the students will have the opportunity to explore cutting-edge innovative diagnostic approaches and applications such as multi-omics, genomic medicine and predictive analytics and develop an understanding of key preclinical and clinical science principles and the role of diagnostic biomarkers underpinning prevention, diagnosis and stratification of disease. They will achieve this through a series of specialist taught lectures and workshops covering topics such as current challenges for diagnostics worldwide and in the UK, precision medicine and the 4D (data, devices, diagnostics and drugs) concepts, national priorities in healthcare, -omics technologies,

integrating genomics in definition of disease phenotype, novel whole body pathophysiology experimental approaches for data acquisition, use of AI and data science in medical diagnostics and treatment selection, industry perspectives for biomarker pipelines and relevant disruptive innovations with potential to revolutionise diagnostics delivery and meet national priorities .

The sessions (lectures, seminars and tutorials) will be delivered by academics with expertise in practising routine diagnostics or developing innovative solutions, including clinical academics members of the Innovation Hub at UHCW and the Institute of Precision Diagnostics and Translational Medicine and external speakers from the Diagnostics Industry. Students will be assessed by an in-class essay to assess their understanding of the diagnostics landscape and regulatory elements, the role of diagnostics in healthcare delivery, scientific as well as cutting-edge methodological and clinical concepts, and will present a case study derived from the UNIVANTS Healthcare excellence awards programme in a particular topic of translational diagnostics and innovation focusing on the impact to improve healthcare outcomes.

Module aims

The module aims to provide:

- An understanding of the diagnostics landscape in the UK and globally focusing on challenges and opportunities especially post-pandemic;
- An understanding of the key roles in delivering precision medicine and population healthcare;
- An advanced understanding of new technologies and methodologies focusing on the multidisciplinary approaches around data science and multi-omics in biomarker discovery and validation, digital health and devices that deliver the 4D concept (drugs, diagnostics, devices and data) that comprise the latest trend in the translation of discovery science especially around diagnostics; and
- Expose students to the physical environment of diagnostic providers such as NHS pathology departments; a wide range of diagnostics-related research and innovation at Warwick and train students in clinical research and the understanding of the stages of the translational pathways (i.e., the transition between basic science, preclinical and clinical studies).

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 content will focus on the landscape of diagnostics in the NHS in the UK and abroad in specialist secondary and tertiary care settings and primary care; the role of NICE, AHSN and clinical research networks (CRN) in diagnostics research and innovation translation; the impact of diagnostics and laboratory medicine on fulfilling the promise of precision diagnostics as well as other models of healthcare delivery integrated care pathways and community diagnostics; innovative technologies and methodologies such as multi-omics for biomarker discovery especially around cancer, liver disease and obstetric care; the role of genomic medicine as well as examples

of data science and artificial intelligence based innovations to improve patient care using cancer as an example and also diagnosis and management of sepsis with emphasis on efforts to digitalise healthcare and transform delivery of care. The module will include lectures around emerging approaches of multi-source data acquisition and analysis such as use of metabolic chambers for whole body measurements and also novel approaches based on organ-on-chip methodologies. Finally, the module will bring the industry perspective on biomarker pipelines from discovery to routine clinical practice. The syllabus will include examples from Warwick groups pursuing interdisciplinary research in translational diagnostics and NHS incubators and accelerators of innovation testing and delivery. Representative examples include digital pathology; artificial intelligence applications for precision diagnostics and clinical decision support tools; analytical devices (e.g.; biosensors) and biomarker development for early disease diagnosis and risk stratification.

Lectures will also explore novel concepts where diagnostics is expected to play a key role such as precision medicine and the role of P4 diagnostics, point of care testing and innovations around genomic medicine and NIPT; the regulatory environment and role of NICE and UK Medicines and Healthcare products Regulatory Agency (MHRA), as well as clinical research infrastructure (AHSNs and CRNs) in promoting translation of research in diagnostics routine practice. The students will also have the opportunity to visit real world NHS diagnostic services, at UHCW NHS Trust.

Learning outcomes

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

- Demonstrate a good understanding of the role of diagnostics in modern healthcare
- Demonstrate a good understanding of analytical and operational gaps and an advanced knowledge of technologies and innovations that have the potential to improve diagnostics service delivery and have an impact on healthcare outcomes.
- Use examples that critically evaluate novel diagnostic approaches such as genomics and assess suitability for population health or personalised medicine approaches;
- Demonstrate an advanced knowledge of the regulatory frameworks that govern the uptake of new technologies and concepts into routine practice.
- Understand key quality drivers of successful diagnostic services operating in modern healthcare and pathways to establish innovation pathways

Indicative reading list

The indicative reading list is based on influential reports and 'white papers' published by relevant stakeholders and recognised societies and industry around current status quo and challenges of diagnostics, future trends and direction. Examples include:

- Developing an advanced diagnostics ecosystem in Europe: a proposal for change
<https://www.eucope.org/wp-content/uploads/2021/03/eucope-advanced-diagnostics-white-paper.pdf>
- White paper on rapid diagnostic technologies to tackle antimicrobial resistance
<https://healthfirsteurope.eu/wp-content/uploads/2015/05/White-Paper-on-rapid-diagnostic->

technologies-to-tackle-AMR.pdf

- Siemens Healthineers Insights Series: Leveraging health information exchange to enable patient-centered care https://marketing.webassets.siemens-healthineers.com/2ae5eff7bd4f3ee8/e72cc7045abb/siemens_healthineers_insights_case_study_he
- Siemens Healthineers Insights Series: How to achieve Precision in the Diagnosis? https://marketing.webassets.siemens-healthineers.com/1800000006640948/f86f5c003f29/Siemens-Healthineers-Article-for-Journal-of-Precision-Medicine-July-2019_1800000006640948.pdf

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:

1. current knowledge and awareness of the diagnostics landscape, current drivers for development of modern healthcare systems and future directions
2. understanding suitable techniques and approaches to deliver precision medicine and biomarkers of disease, methodologies and approaches in translational diagnostics
3. Ability to recognise added value of multidisciplinary approaches and critically appraise current technologies to answer modern medical questions and healthcare pathways and routes to achieve translation of basic science to preclinical and clinical research;
4. Understanding the multi and interdisciplinary tools available for translational diagnostics and recognise barriers to adoption and translation

Transferable skills

1. An understanding of diagnostics, the healthcare landscape and the key drivers of healthcare delivery
2. An ability to recognise the relative strengths and weaknesses of various methodological approaches
3. An ability to understand the translation pathway of method development and its application to routine practice
4. An ability to recognise the need for staff upskilling and the continuous development of expertise in cutting-edge methodologies
5. An understanding of the crucial role of interdisciplinarity to deliver world-class diagnostics and continuous evolution of service

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 A

	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 R

	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

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)