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Original Article

Specialist training in infectious diseases in Europe

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ABSTRACT

Objectives: The objectives were to determine the structure of training programmes and assessment of physicians training to become infectious disease (ID) specialists in Europe in early 2024 and to document the provision of specialists, trainees and training centres in each country.
Methods: Delegates to the ID Section and Board of the European Union of Medical Specialists entered national data on a web-based survey tool in late 2023–early 2024. Results were compared with European Union of Medical Specialists recommendations on the structure and content of postgraduate training in ID in Europe (2018), and to results of a similar survey in early 2021.
Results: Responses were received from all 35 countries; 27/35 (77%) recognize ID as an independent speciality and 7/35 (20%) as a subspeciality. Spain does not officially recognize the speciality. In Cyprus, Iceland, and Luxembourg, despite official recognition of the sub-/speciality, ID training must be completed abroad. Paediatric ID was recognized in 16/35 (46%) countries. The number of adult ID specialists varied from 78.8 per million inhabitants in Sweden to 0.6 in Germany. Only 7/31 (23%) national programmes provide the minimum recommended 6 months of training in medical microbiology. Assessment methods included logbooks/portfolios in 25/31 (81%), final examinations in 25/31 (81%) and workplace-based assessments in 21/31 (68%).
Discussion: There has been little change since 2021 in speciality status or in structure and content of training programmes across Europe. There have been large increases in training position numbers in

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several countries, possibly in response to COVID-19. Continued low compliance with the 2018 recommendations to increase exposure to medical microbiology during training highlights the slow pace of change. Logistic barriers to change and to harmonization across Europe remain and are discussed in the context of published concerns of trainees. **Jon Salmanton-García, Clin Microbiol Infect 2025;▪:1**

Introduction

Infections significantly threaten global public health, necessitating specialized medical expertise and resilient healthcare systems. Continuing challenges include emerging infections, potential pandemics [1–3], and increasing antimicrobial resistance [4]. The recognition of infectious diseases (ID) as a distinct speciality and harmonization of specialist training are crucial for enhancing the consistent resilience and response capacity of European healthcare systems. The COVID-19 pandemic demonstrated the critical importance of cross-border collaboration for ensuring optimal ID care during health crises.

Within Europe, clinical ID practice has evolved from isolation hospital-based practice to more complex integration with clinical microbiologists and public health specialists in general hospitals and in the community [5–11]. The European Union of Medical Specialists (UEMS), established in 1958, promotes harmonization of training and assessment of all specialists. The Infectious Diseases (UEMS-ID) and Medical Microbiology (MM) sections were established in 1987 and 2008, respectively. A core European ID curriculum was agreed by UEMS-ID in 1998 and revised annually thereafter [5]. In 2018, a much-expanded European Training Requirement (ETR), including a comprehensive curriculum, syllabus and assessment recommendations in domains of knowledge, attitude and practice during and at the end of specialist training, was introduced [12]. A 2021 survey revealed considerable variation across Europe in the provision of ID specialists and adherence to the ETR recommendations [10].

That survey was a snapshot of the situation over a year after the ETR was approved and at the beginning of the COVID-19 pandemic, which curtailed many aspects of medical planning and impacted on ID practice [10]. The current study re-examines contemporary trends and disparities in postgraduate training in ID across Europe in the post-COVID-19 era. It specifically addresses gaps identified in previous studies, including variation in the duration and structure of ID training programmes, inconsistencies in assessment methods, and disparities in training capacity influenced by different healthcare systems. Additionally, it explores how emerging infections, like COVID-19, have shaped training needs and the response capacity of healthcare systems. The aim is to inform policy-making and design strategic actions to strengthen preparedness and response to infections.

Methods

Data were gathered from delegates of member and associated countries in UEMS-ID section (Fig. 1) between November 2023 and March 2024, after an initial email contact and two follow-up emails. The electronic case report form (Table S1) was available online at https://www.clinicalsurveys.net/uc/UEMS_ID_Trainingship_2023/ (TIVIAN, Cologne, Germany). The survey, developed by the Executive Committee of the UEMS-ID section, was structured and based on a previously established format [10]. It allowed for additional details as needed. The survey was divided into two comprehensive sections. The first focused on the recognition of ID as a speciality and the structure and content of training programmes and methods used to assess the competence of trainees in each country. The second section included national data on the numbers of ID specialists, trainees and training centres. Although data were collected through self-reported surveys, which may introduce biases or variability in responses, we took steps to minimize these limitations by ensuring clarity in the questions and providing opportunities for further elaboration. Data were collected from pre-identified UEMS-ID representatives in the respective participating countries. To ensure the completeness and accuracy of the responses, any incomplete or incoherent data were queried and clarified until full and consistent answers were obtained.

Categorical variables were presented with frequencies and percentages, whereas continuous variables were presented with median, interquartile range (IQR), and absolute range. Countries were grouped by ID status (speciality or subspeciality) and healthcare system type (Beveridge [National Health Service] or Bismarck model [social security]) [13], excluding those with mixed characteristics. Comparisons used Mann–Whitney's *U* test for (a) authorized hospitals providing ID training, (b) physicians undergoing ID training, and (c) practicing ID physicians. Proportions were compared with Fisher's exact test. Statistical significance was set at $p \leq 0.05$. Statistical analyses were performed using SPSS v25.0 (IBM Corp., Chicago, IL).

Results

The survey achieved 100% response from 35 European countries. The majority (77.1%, 27/35) designated ID as an independent speciality and less than a quarter (20.0%, 7/35) as a subspeciality. In Spain, ID was not recognized as a speciality or subspeciality (Table 1, Fig. 1(a), and Table S2).

In-country ID training was provided in 88.6% (31/35) countries but was not offered in three countries—Cyprus, Iceland, and Luxembourg. In Cyprus, an agreement with the Greek Ministry of Health allows for ID training in Greece, with one centre in Cyprus pending accreditation. In Iceland, physicians typically relocate to other Nordic countries, the United Kingdom, or the United States for ID training. Similarly, trainees from Luxembourg often obtain ID training in Belgium or France (Table S2).

The duration of ID training varied, with a median of 5 years (IQR: 3–5, range 2–7 years). The shortest durations were observed in Armenia, Czechia, Greece, Israel, the Netherlands, and Ukraine and the longest in the United Kingdom. Duration of ID training in countries with ID speciality (median 5 years, IQR: 4–5, range: 2–7) was longer than in those with ID subspeciality (median 2 years, IQR: 2–4, range 2–4) (p 0.004) (Table 1 and S2).

Internal medicine is a component of all programmes (100%, 31/31), with a median training duration of 2 years (IQR: 1–3, range: 0.2–6). MM was included in 54.8% (17/31) of programmes, with a median training duration of 1 year (IQR: 0.25–3.5, range: 0.08–5). Only 25.8% (8/31) countries included at least 6 months of MM training, as recommended in the ETR. Two countries (Turkey and the United Kingdom) recognize combined training to specialist level in both ID and MM. Recognition and management of imported

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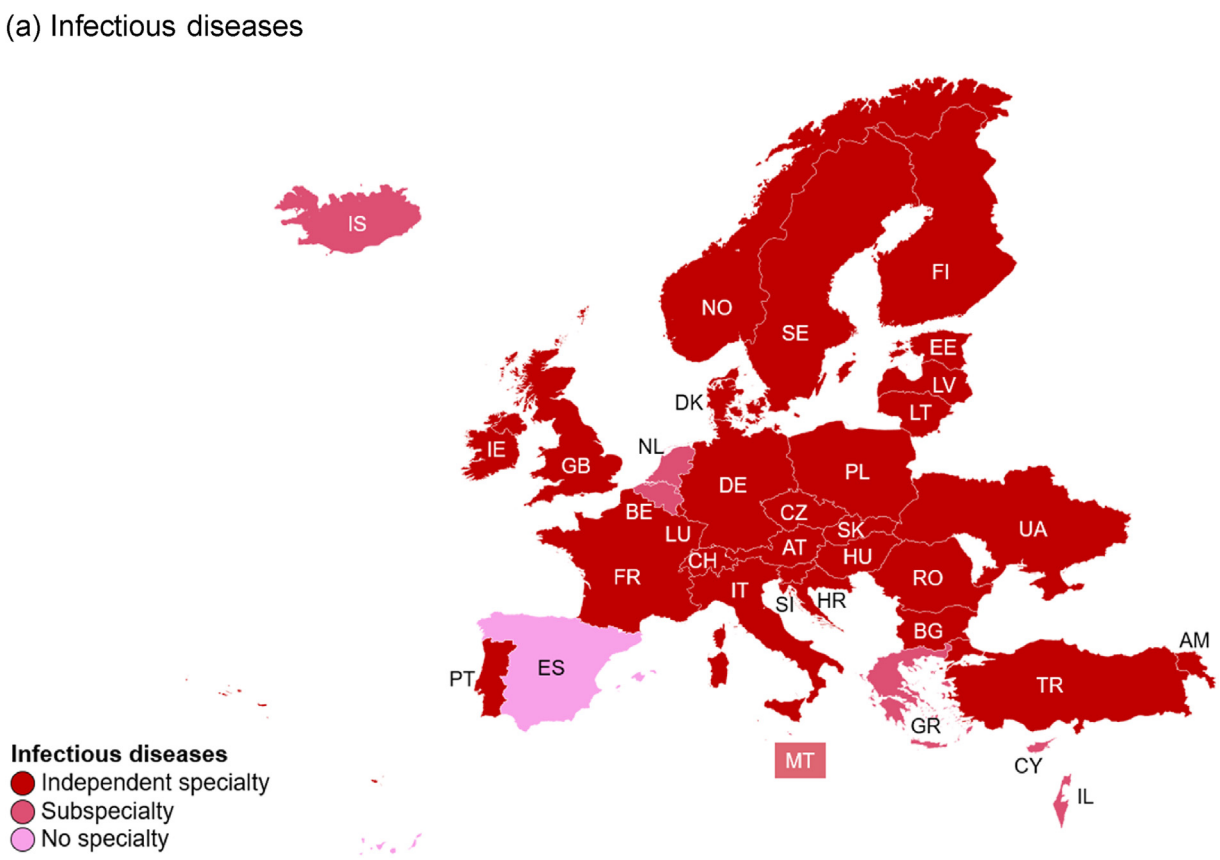

Fig. 1. Official status of infectious diseases speciality in 36 full or associate UEMS member countries in 2023/2024. (a) Infectious diseases. (b) Tropical medicine. (c) Paediatric infectious diseases. AM, Armenia; AT, Austria; BE, Belgium; BG, Bulgaria; CH, Switzerland; CY, Cyprus; CZ, Czech Republic; DE, Germany; DK, Denmark; EE, Estonia; ES, Spain; FI, Finland; FR, France; GB, United Kingdom; GR, Greece; HU, Hungary; HR, Croatia; IE, Ireland; IL, Israel; IS, Iceland; IT, Italy; LT, Lithuania; LV, Latvia; LU, Luxembourg; LV, Latvia; MT, Malta; NL, Netherlands; NO, Norway; PL, Poland; PT, Portugal; RO, Romania; SE, Sweden; SI, Slovenia; SK, Slovakia; TR, Turkey; UA, Ukraine; UEMS, European Union of Medical Specialists. (a) Infectious diseases, (b) Tropical medicine, (c) Paediatric infectious diseases.

tropical infections are included in all programmes, but tropical medicine is only recognized as an independent speciality in Slovakia, Switzerland and the United Kingdom. Paediatric ID was reported as a speciality in 17.1% (6/35) of countries, as a subspeciality in 28.6% (10/35) of countries, and was not recognized as either in 54.3% (19/35) of countries, including Spain (Table 1, Fig. 1(b) and (c), and Table S2).

Most ID training programmes (87.1%, 27/31) included trainee evaluation mechanisms such as workplace-based assessments (67.7%, 21/31) and/or knowledge-based assessments (51.6%, 16/31). Only Armenia and the United Kingdom included a formal review with the trainee at the end of the penultimate year of training. Logbooks or e-portfolios were reported in 80.6% of programmes (25/31). Compulsory summative formal exams were present in 80.6% of programmes (25/31), with either oral (61.3%, 19/31) or written (41.9%, 13/31) formats. Encouragement of research during training was widespread (77.4%, 24/31), but only 45.2% (14/31) of countries allowed trainees to take time out for research (Table 1 and S2).

Across Europe, there were a median of 1.1 hospitals per million inhabitants authorized for ID training (IQR: 0.7–2.3, range: 0.3–4.5). Most centres authorized for ID training were in Turkey ($n = 87$) and the United Kingdom ($n = 80$), compared with only one centre in each of Armenia, Luxembourg, or Malta. The highest rates of authorized centres per million inhabitants were observed in Nordic and Baltic countries: Estonia had 4.52 hospitals per million inhabitants, Norway 3.21, Latvia 3.15, and Sweden 2.76 (Tables 1 and S3).

The number of ID physicians in training varied from 0.3 to 26.2 per million inhabitants, with a median of 4.6 (IQR: 2.5–8.3). Latvia and Sweden had the highest rates, with 26.2 and 24.6 per million, respectively. The largest absolute numbers were in Turkey ($n = 705$) and Italy ($n = 326$) (Table 1 and S3).

Specialist ID physicians per million inhabitants ranged from 0.6 to 78.8, with a median of 20.5 (IQR: 10.4–29.8). Sweden had the most per capita, with 78.8 ID physicians per million inhabitants. The largest absolute numbers were in Turkey ($n = 2752$) and Italy ($n = 2700$) and the lowest in Iceland ($n = 8$) and Luxembourg ($n = 6$) (Table 1 and S3).

Countries following Beveridge (tax-funded) healthcare system models tended to have higher median rates of hospitals authorized for ID training (1.5), ID physicians in training (8.1) and ID physicians on duty (23.8) per million inhabitants, compared with Bismarck (insurance-funded) model countries (1.3 hospitals, 3.8 ID trainees, and 19.4 ID physicians per million inhabitants) (Table 1 and S3).

Comparing countries by their recognition of ID status as speciality vs. subspeciality, those with ID speciality had more specialist ID physicians per capita (median 25.2 physicians per million inhabitants) compared with countries with ID subspeciality (median 11.7 physicians). However, there were no statistically significant differences (Table 1, S1, and S3).

Discussion

All but one of 35 UEMS full and associate member countries recognized ID as either an independent speciality or a subspeciality of general internal medicine; Spain remains the exception. The duration of ID training varies, with a median of 5 years. Evaluation

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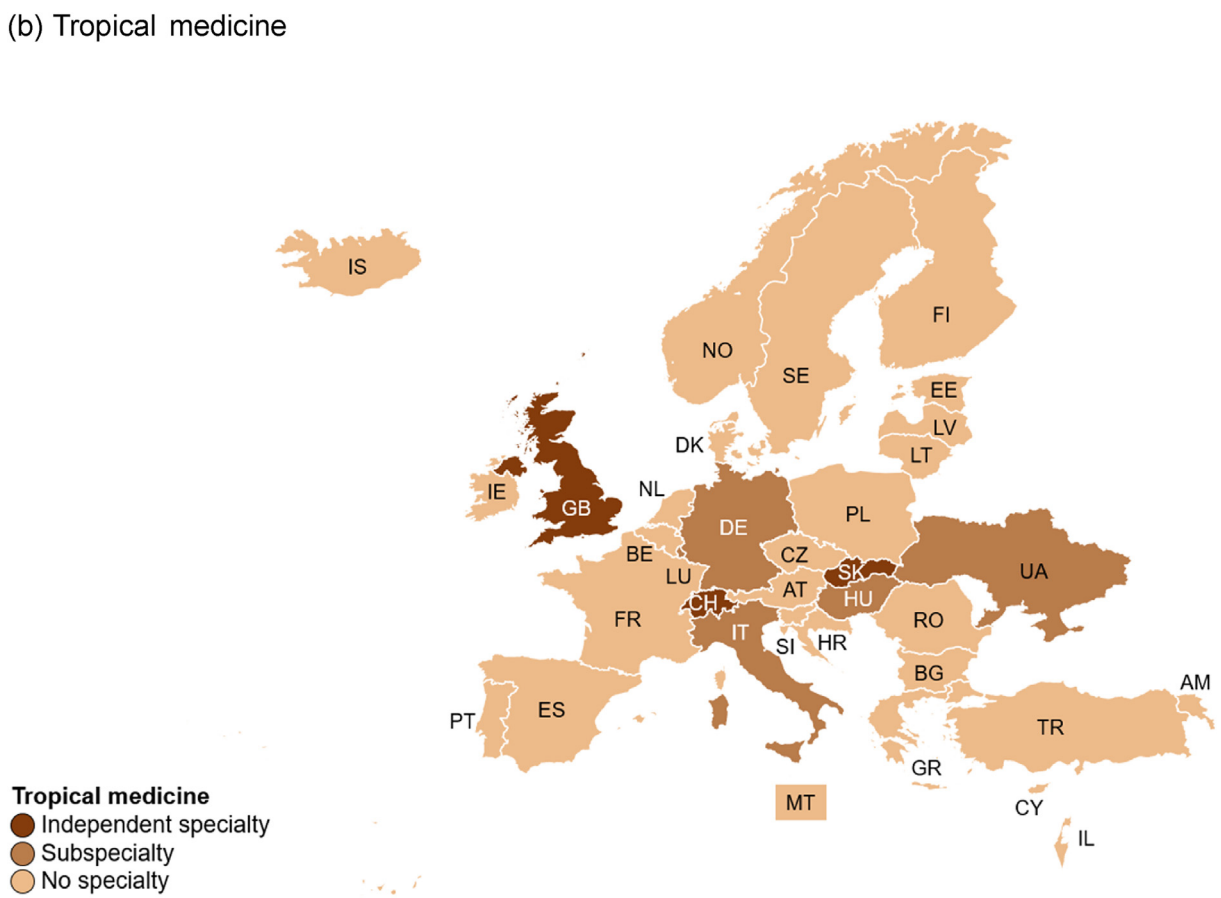

Fig. 1. (*continued*).

processes were rigorous, often with a strong emphasis on research. Hospital and physician capacity varied substantially between countries, with Nordic and Baltic countries reporting the highest rates per capita. Countries designating ID as a speciality tended to have more ID physicians per capita compared with those designating it as a subspeciality. In a few countries, there has been a substantial increase in the numbers of both trainees and specialists in ID, probably in response to demand during the COVID-19 pandemic.

Current findings show little change from the previous peri-pandemic analysis [10]. In 2021, only Spain did not recognize ID as a sub-/speciality, a stance that remains unchanged. Local physicians responsible for managing ID have persistently called for the establishment of the ID speciality [14], with recent support in principle from the Spanish Government [15], but an official initiation date has yet to be confirmed. This is particularly frustrating as Spanish contributions to ID are recognized worldwide, consistently ranking highest in membership of continental ID societies and accepted communications in ID conferences [16], and ranking among the top five European and top ten countries worldwide in publications in the field of ID [17].

In countries where ID is recognized as a sub-/speciality but without in-country training (Cyprus, Iceland, and Luxembourg), efforts are underway to enable local hospitals to provide on-site ID training, with little recent change. There continue to be wide disparities in training capacity across Europe, including the number of centres available for ID training, approved training positions and established ID physicians as trainers. Compared with 2021 [10], there has been a general increase in numbers of funded positions for ID trainees and established ID physicians, with a greater than 75% increase in absolute numbers of ID physicians in Finland, Greece, Ireland, Italy, and Turkey (Table S1). Some of this increase is likely a response to the COVID-19 pandemic and perceived national needs for more ID specialists. Conversely, there has been a greater than 50% reduction in the number of ID physicians in countries such as Latvia and Poland, which cannot all be explained by economic challenges or migration.

Countries with full ID recognition as a speciality invested, on average, additional years in ID training (5 years) compared with those where it is a subspeciality (2 years). Countries with a Bismarck system (Central and Eastern Europe) tended to have a higher proportion of ID as a speciality compared with those with a Beveridge system (Mediterranean and Nordic Europe). This difference likely stems from the characteristics of each system. For example, the Beveridge model is typically characterized by healthcare funded primarily through general taxation. This centralized approach allows for more uniform healthcare access and integrated service delivery, where healthcare services, including ID training, are often delivered through public health systems that emphasize accessibility and preventive care. Conversely, the Bismarck model relies on employer–employee contributions to various health insurance funds, resulting in a system with multiple, often competing, insurance providers. This system enables more flexible and specialized training, such as dual roles in ID and MM, which may lead to increased competition for resources across different sectors. These systemic differences may affect how ID training programmes are structured and funded. Beveridge systems, with their centralized funding, tend to provide more integrated and standardized training

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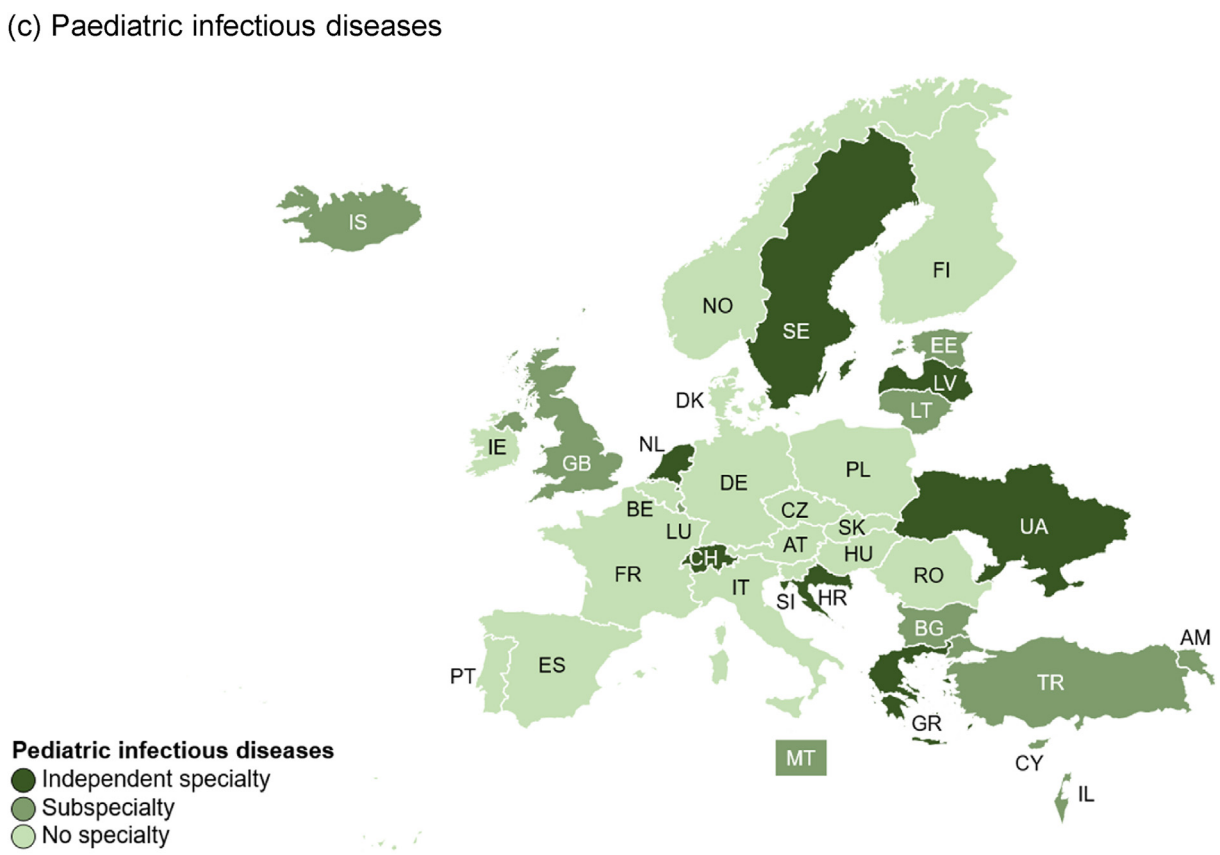

Fig. 1. (*continued*).

across regions, whereas Bismarck systems, with their fragmented funding sources, often lead to more regionally varied training opportunities and specialized service provision. The differences also influence public health responses in Beveridge system countries; the emphasis on universal care ensures that public health infrastructure, including ID management, is more equally distributed, whereas in Bismarck system countries, regional variations may mean some areas experience higher levels of resource allocation for ID specialists. These systemic distinctions underscore the need for tailored approaches when revising training curricula to consider each country's specific healthcare structure and needs [13].

Countries where ID is recognized as a speciality tend to include training rotations in MM and virology services more frequently, which can be considered core for the ability to correctly interpret results and translating these into diagnostic considerations and treatment recommendations. There has been no significant improvement over the past 3 years, as only 16/31 (51.6%) provide such experience, compared with 29/33 (87.9%) in 2021. The difference may reflect how this question was answered in the two surveys. Only 7/31 (22.6%) provided at least 6 months of laboratory experience, as recommended in the ETR, comparable with 7/33 (21.2%) in 2021. This is disappointing, as laboratory rotations enhance understanding of antimicrobial stewardship and collaboration with laboratory-based specialists, namely clinical microbiologists, and infection control [6,7,9,18]. Barriers to implementing changes include the physical separation of clinical laboratories and ID services, competition for microbiology training slots, and differences in the national provision of MM as a clinical speciality or as part of generic pathology laboratory services provided by non-medical laboratory specialists [11]. A recent survey of trainees and specialists in Germany found that 84.6% (n = 254/300) favoured the inclusion of 3–12 months of MM in the residency programme, but noted challenges because of increasing laboratory centralization [19].

Tropical medicine is a discrete speciality in only three countries (Slovakia, Switzerland and the United Kingdom), although diagnosis and management of tropical infections are included in all national ID curricula. The interpretation of tropical medicine varies, as exemplified by a recent survey of 500 students and physicians from 27 countries [20]. It usually refers to specialist practice (including relevant laboratory and public health competencies) in infection and general medicine in resource-limited settings and additional expertise in the recognition and management of rarer imported infections in a European context [21]. However, it is frequently confused with the overlapping disciplines of travel medicine, migrant health, and global health or is used to refer to the practice of general medicine in the tropics, or just imported infections [9,10,20]. A more focused review about the provision of specialists in tropical medicine and their training needs is warranted, in conjunction with the relevant European Specialist Societies.

Few European countries still permit adult ID physicians to look after children without special provisions. Training in paediatric ID is usually linked to general paediatrics and the unique physiological characteristics of children entail significant implications across various domains, including immune-inherited conditions, pathogen exposure, treatment responses and public health management including vaccination [22,23]. There has been no change in paediatric ID speciality recognition in 50% of countries across Europe since 2021.

There has been little change in methodologies used to assess and support trainees over the past 3 years. Various formative and

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Table 1
Summarized baseline characteristics of infectious diseases training in the UEMS-ID section member and associated countries

Characteristic	*n*	%
Status ID speciality		
Independent speciality	27/35	77.1%
Subspeciality	7/35	20.0%
Neither a speciality nor subspeciality	1/35	2.9%
Training duration, y, median (IQR) (range)	5 (4–5) (2–7)	
In-country ID training possible	31/35	88.6%
ID training content		
Internal medicine	31/31	100.0%
Training duration, y, median (IQR) (range)	2 (1–3) (0.2–6)	
Medical microbiology	16/31	51.6%
Training duration, y, median (IQR) (range)	1 (0.3–3) (0.08–5)	
Status tropical medicine		
Independent speciality	3/35	8.6%
Subspeciality	5/35	14.3%
Neither a speciality nor subspeciality	27/35	77.1%
Training duration, y, median (IQR) (range)	3 (2–5) (1–7)	
Status paediatric ID		
Independent speciality	6/35	17.1%
Subspeciality	10/35	28.6%
Neither a speciality nor subspeciality	19/35	54.3%
Training duration, y, median (IQR) (range)	4 (2–5) (1–7)	
Formal ID in training assessment	25/31	80.6%
Knowledge-based assessment	16/31	45.7%
Penultimate year assessment	2/31	6.5%
Workplace-based assessment	21/31	67.7%
Trainee logbook/e-portfolio	25/31	80.6%
Compulsory summative formal exam	26/31	83.9%
Clinical	11/31	35.5%
Written	13/31	41.9%
Oral	19/31	61.3%
Research encouraged during ID training	24/31	77.4%
Possible to take time/the training programme	14/31	45.2%
Not possible to take time/the training programme	10/31	32.3%
Authorized hospitals for ID training in 2023		
Overall, median (IQR) (range)	8 (6–27) (1–87)	
Per million inhabitants, median (IQR) (range)	1.1 (0.7–2.3) (0.3–4.5)	
ID physicians in training in 2023		
Overall, median (IQR) (range)	35 (20–118) (1–705)	
Per million inhabitants, median (IQR) (range)	4.6 (2.5–8.3) (0.3–26.2)	
ID physicians overall in 2023		
Overall, median (IQR) (range)	160 (60–280) (6–2752)	
Per million inhabitants, median (IQR) (range)	20.5 (10.4–29.6) (0.6–78.8)	

ID, infectious diseases; IQR, interquartile range; UEMS-ID, European Union of Medical Specialists Infectious Diseases.

summative assessment methods used include workplace-based assessments in 67.7% of countries compared with 51.1% in 2021; knowledge-based assessments in 51.6% compared with 60.6%; logbooks (of varying complexity) in 80.6% compared with 75.8%; penultimate year reviews in two compared with four; and final year examinations in 80.6%, compared with 69.7%. Superficially, this suggests that high-quality supervision and assessment are provided in the majority of European ID programmes. However, trainees have voiced concerns about standards of supervision and mentoring, overwork and inadequate access to dedicated research time [24–26]. Established specialists need specific training on their performance as trainers and as examiners [10]. There is often a disconnection between the way established specialists and national authorities perceive the quality and delivery of training compared with those of the trainees. The work pressures caused by the COVID-19 pandemic exacerbated these disparities and trainee dissatisfaction in Croatia [27], whereas the earlier popularity of ID training in France [28] was rapidly reversed during the COVID-19 years [29]. Training programmes must accommodate changes in family responsibilities and work patterns to ensure equitable training access and promotion for all trainees. In the USA, it has become increasingly difficult to fill ID training positions, partly because of low remuneration for ID specialists compared with most other specialities [30]. Although this rarely applies in European national health systems, it is vital to maintain the enthusiasm and opportunities for ID trainees to protect the future of the speciality. This should include access to adequate time for research during or alongside training, as only 14/31 training programmes currently allocate time for research purposes.

This study has limitations, including potential sampling bias because of reliance on self-reported data and variability in the interpretation of terminology, particularly definitions of speciality vs. subspeciality practice, knowledge-based assessments and provision of MM experience. Although data were collected through self-reported surveys, which may introduce biases or variability in responses, we took steps to minimize these limitations by ensuring clarity in the questions and providing opportunities for further elaboration. Data underwent screening to ensure completeness and coherence, with any incomplete or incoherent data queried and clarified until full and consistent answers were obtained. The study has not reviewed training delivery in different infection practice domains, as tabulated in the previous survey [10], or details of workplace-based assessments. Alternative educational methods, such as self-directed and supervised distance learning or simulation-based training, were not explored. The study also did not examine equity of access to training programmes within countries, where variations in practice and availability of specialist resources may exist. These limitations call for caution in generalizing findings beyond Europe.

Going forward, the ETR is due for revision over the next 2 years, and UEMS-ID is also preparing to deliver the first pan-European specialist knowledge test (a multiple-choice examination) in January 2025. Efforts to standardize and enhance ID training programmes, promote research integration, and address disparities in training capacity across countries are essential to maintain preparedness and response measures against ID. To implement ID programme changes effectively, countries should tailor curricula, gather local data, engage stakeholders, assess resource availability, foster regional collaboration, and allow flexibility in training to address their unique healthcare needs and circumstances.

Author contributions

All authors contributed to study design and study supervision. JS-G did the statistical plan and analysis and wrote the initial version of the manuscript, which he revised with NJB. All authors interpreted the data, provided local data, critically read, reviewed and agreed to publish the manuscript.

Transparency declaration

JS-G has received payment or honoraria for lectures, presentations, speakers' bureaus, manuscript writing or educational events and support for attending meetings and/or travel from AstraZeneca, outside of the submitted work. JMM has received consulting honoraria and/or research grants from Angelini, Basilea, Contrafect, Genentech, Gilead Sciences, Jansen, Lysovant, MSD, Pfizer, and ViiV Healthcare, outside the submitted work. AV reports other financial interests from ViiV Healthcare, outside of the submitted work. OAC reports grants or contracts from BMBF, Cidara, DZIF, EU-DG RTD, F2G, Gilead, MedPace, MSD, Mundipharma, Octapharma, Pfizer, Scynexis; Consulting fees from AbbVie, AiCuris, Basilea, Biocon, Boston Strategic Partners, Cidara, Seqirus, Gilead,

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Data availability

The corresponding author can provide the data supporting the findings of this study on a reasonable request.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.cmi.2024.12.026.

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