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Original article

Training in infectious diseases across Europe in 2021 – a survey on training delivery, content and assessment

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ABSTRACT

Objectives: To define the status of infectious diseases (ID) as an approved specialty in Europe; to enumerate the number of specialists (in general and in relation to the overall population) and specialist trainees and describe the content, delivery and evaluation of postgraduate training in ID in different countries.
Methods: Structured web-based questionnaire surveys in March 2021 of responsible national authorities, specialist societies and individual country representatives to the Section of Infectious Diseases of the European Union for Medical Specialties. Descriptive analysis of quantitative and qualitative responses.
Results: In responses received from 33/35 (94.3%) countries, ID is recognized as a specialty in 24 and as a subspecialty of general internal medicine (GIM) in eight, but it is not recognized in Spain. The number of ID specialists per country varies from <5 per million inhabitants to 78 per million inhabitants. Median length of training is 5 years (interquartile range 4.0–6.0 years) with variable amounts of preceding and/or concurrent GIM. Only 21.2% of countries (7/33) provide the minimum recommended training of 6 months in microbiology and 30% cover competencies such as palliative care, team working and leadership, audit, and quality control. Training is monitored by personal logbook or e-portfolio in 75.8% (25/33) and assessed by final examinations in 69.7% (23/33) of countries, but yearly reviews with trainees only occur in 54.5% (18/33) of countries.
Conclusions: There are substantial gaps in modernization of ID training in many countries to match current European training requirements. Joint training with clinical microbiology (CM) and in multidisciplinary team working should be extended. Training/monitoring trainers should find greater focus, together with regular feedback to trainees within many national training programmes. **Ronja A. Brockhoff, Clin Microbiol Infect 2021;27:1693.e1–1693.e8**

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Introduction

The current coronavirus disease 2019 (COVID-19) pandemic has reinforced the need for infectious disease (ID) specialists and clinical microbiologists (CM) to collaborate across Europe, meeting the threats of emerging infections and future pandemics [1,2]. Recognition and management of infections acquired during travel or migration is increasingly important [2–4], as are countering antimicrobial resistance, with proven effectiveness of antimicrobial stewardship and specialist advice on patient management [4,5] and of infection prevention and control [6,7]. There is a wide range of provision of clinical specialists in infection in different countries, with significant overlap of many areas of professional practice [8]. The need for additional staffing, collaborative clinical work, training and research between ID and CM has been repeatedly emphasized over the past 20 years [8–11].

In 2018, the Section for Infectious Diseases of the European Union of Medical Specialists (UEMS-ID) published an updated European Training Requirement (ETR) recommending indicative training periods of a minimum of 2 years in general internal medicine (GIM) and 4 years of specialty ID training [12]. The development of the ETR and its predecessors has been summarized elsewhere [10,13]. In addition to curricula with details of professional competencies to be achieved by the trainee and methods of assessing trainees' progress, there is strong emphasis on adequate organization of training, accreditation of specialists as trainers, and approval and monitoring of training programs [13].

This article describes the status of ID training across Europe in 2021 including clinical assessment, curricular updates and governmental regulation. It examines early effects of the COVID-19 pandemic on training and its possible impact. Areas for future improvement are outlined, for countries to learn and adopt good practice from one another.

Materials and methods

Information was collected from practitioners throughout Europe in March 2021 using electronic questionnaires (see Supplementary material, Tables S1 and S2) sent out to UEMS representatives, national authorities and/or ID specialist societies of the 35 full or associate UEMS member states (Fig. 1). Respondents were then contacted electronically and by telephone up to five times for follow-up queries and validation of data (Fig. 2). The electronic case report forms were based on previous data collection at annual meetings of the UEMS-ID section, revised and then developed with the EFS Survey™ (Questback, Cologne, Germany). For further detail see the Supplementary material (Appendix S1).

Results

Statistical overview and recent development in terms of ID accreditation

Full responses were received from 33/35 (94.3%) countries (Table 1). ID is regarded as a specialty in 24 countries, as a subspecialty of GIM in eight and is not recognized in one (Fig. 1). ID was approved as an independent specialty in France in 2011 and in Germany in 2021, and as a subspecialty of GIM in Belgium in 2020. Official approval in Spain has been awaited for over a decade, despite training being well established in several university

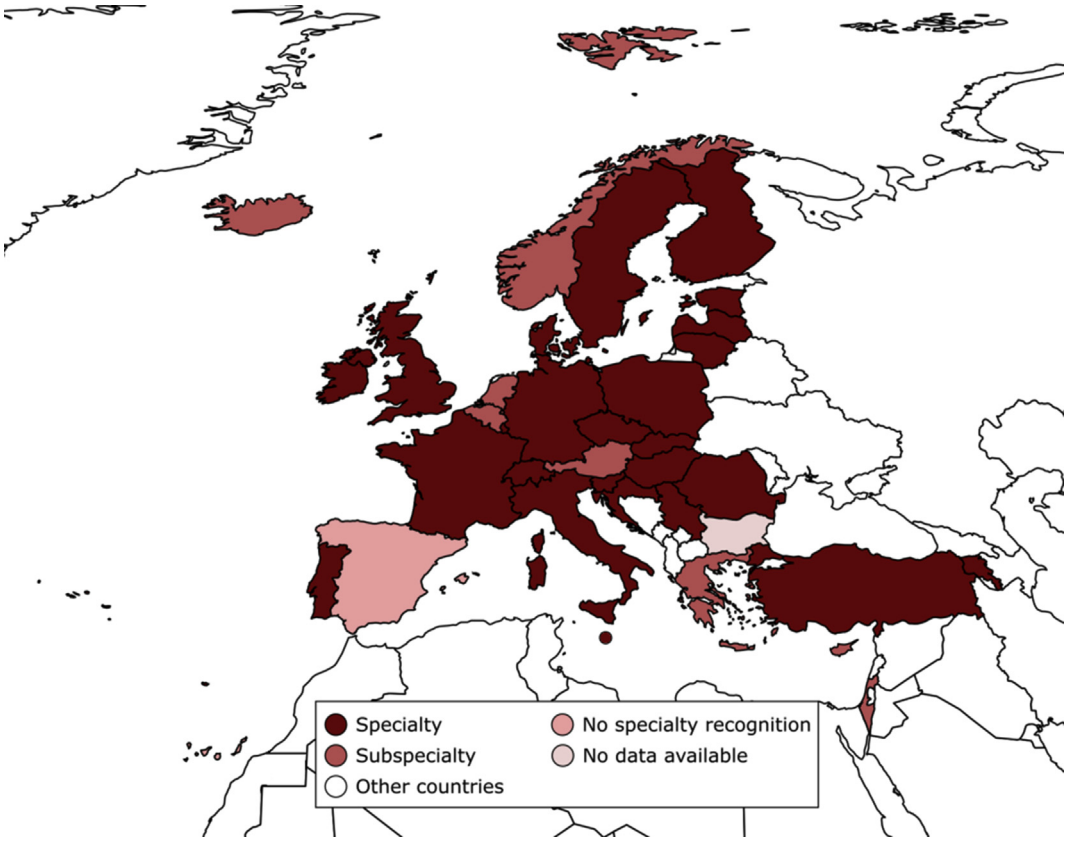

Fig. 1. Official approval status of infectious diseases in 35 full or associate UEMS member countries in 2021. No data was received for Bulgaria.

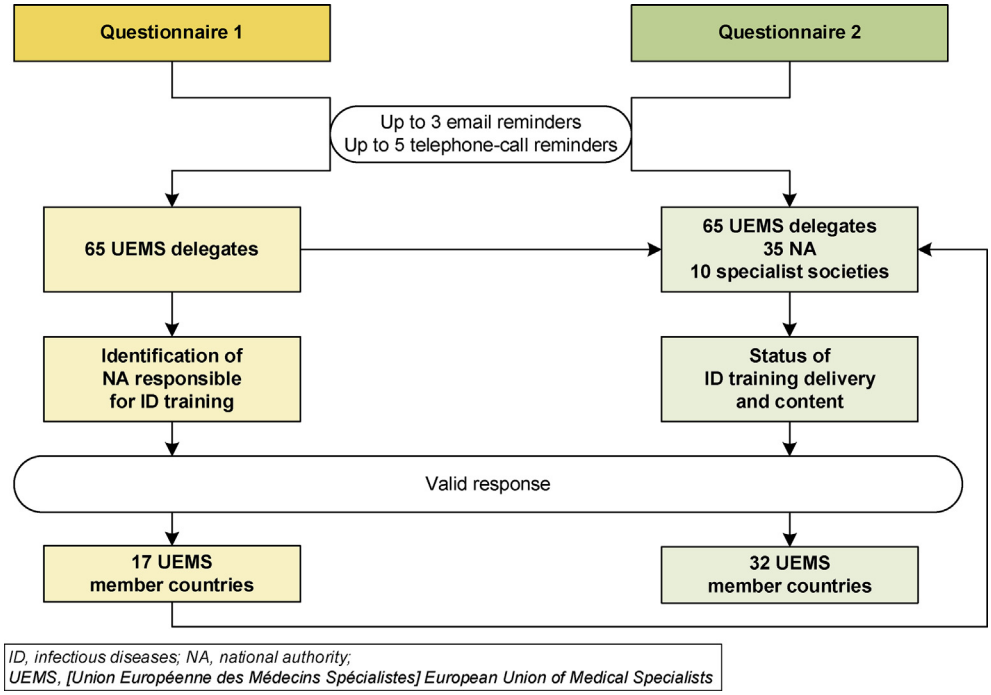

Fig. 2. Process of data acquisition for questionnaire 1 and 2. The first questionnaire (left side of flowchart) collected information on national authorities responsible for ID training and specialist societies. These were then contacted with the second questionnaire (right side of flowchart) to provide information on ID training delivery.

centres. Paediatric ID is recognized as a separate specialty or subspecialty of paediatric medicine in at least 17/33 (51.5%) countries.

The population-adjusted number of adult ID specialists varies from fewer than five per million inhabitants in Austria, Ireland and the UK to more than 40 per million in Iceland, Latvia and Lithuania, with 78 per million in Sweden (Table 1). Numbers tend to be higher in countries where ID is an independent specialty. There were similar wide variations in the number of trainees. Central workforce planning, i.e. matching trainee numbers to the anticipated need for future specialists, was recorded in 13/24 (54.2%) countries where ID is a specialty compared with 1/8 (12.5%) where it is a subspecialty.

ID specialist training—numbers, institutions, overall structure and areas of training

Specialist training is delivered in all countries except Luxembourg and Iceland. The ratio of trainers to the total number of specialists varies from <5% (30:800) in Sweden to almost 100% in Austria, Denmark, Ireland, Israel and Malta; there was similar variation in the number of available training centres. In some countries, access to training centres was limited because of insufficient numbers of trainers (Austria) or limited accreditation of training centres, as in Germany (Table 1) [15]. Funding and control of centres and trainees varies between countries and trainee salaries may not be centrally funded. Trainees receive some sort of salary everywhere but access to fully funded training rotations may be limited. For example, in Armenia, trainees must pay tuition fees if they are not accepted on a state-allocated residency.

Combinations of training patterns and their indicative length vary across Europe (Table 1). In countries where ID is a separate specialty, specialist training takes a median of 5 years (IQR 5–6 years; range 1–7 years), with a median of 1.8 years (IQR 1–3 years; range 0.3–5 years) initial 'common trunk' GIM training followed by ID training. However, some countries require concurrent or sequential accreditation in GIM for appointment as a specialist. Similar requirements are being introduced in 2021 in Ireland and in the UK for trainees who are not undergoing joint training in ID and medical microbiology (MM) or virology. In Estonia, the content of GIM training is being increased in 2022. Only three countries (Estonia, Turkey and the UK) provide concurrent specialist training in ID and MM/virology. This is being introduced in 2021 in Ireland and revised in the UK, where ID training will be combined for 7 years total with either GIM (3 years common trunk GIM training) or with MM/virology (2 years common trunk GIM training) [13,16]. In countries where ID is a subspecialty or not officially recognized, trainees usually complete 2.3–5 years of GIM training (median 4 years; IQR 3.3–4.5 years) before entering a median 2.5 years (IQR 2–5 years) of ID specialty training (range 2–6 years).

Overall, 54.5% of countries (18/33) provide training across all three main activities: direct inpatient care, consults and outpatient clinics (Table 2). Time allocation to these areas varies widely and may overlap throughout all training (the majority) or be performed in rotation. In Israel, there are no specific ID wards, and emphasis is on consult activity and infection prevention and control activity. There is greater focus on training and provision of dedicated inpatient care in southeast Europe. Although 29/33 (87.9%) countries include a training attachment in an MM laboratory, the duration varies from 1 to 12 months and only 7/33 (21.2%) allocate ≥6 months of training as recommended in the 2018 ETR [12].

ID specialist training—curricular contents

The main 'traditional' components of the ETR curriculum are delivered in most countries, with varying degrees of emphasis (Table 2). In Armenia, the Czech Republic, Hungary and Lithuania, care of non-HIV immuno-compromised patients and sexually transmitted infections are excluded. Some respondents mentioned the need for more extensive and practical training in microbiology.

Table 1
Status of infectious disease training and service provision in 33 European countries (full or associate members of UEMS)

	ID specialists (*n*)		Trainees/year (*n*)	ID trainers (*n*)	Training centres (*n*)	Workforce planning	Training in ID (total)		Training in GIM	Paediatric ID	Formal exam
Countries in which ID is a specialty	Total in 2020[h]	Total/million inhabitants [14]	Total in 2020[h]	In 2020[h]	Total in 2020[h]	National policy	Official curriculum	Duration (years)	Duration (years)	Specialty status	Form of exam
Armenia	55	18	10	15	2	—	Yes	3	—	Subspecialty	o, w
Croatia	130	32	30	10	4	—	Yes	5	2 CT*	Specialty	C
Czech Republic	350	33	10	45	27	—	Yes	5	3 CT	—	c, o
Denmark	140	24	9	110	5	Yes	Yes	5	1.75 CT	—	—
Estonia	40	31	3	10	6	Yes	Yes	4	0.5 CT	Subspecialty	o, w
Finland	50	9	5	5	5	—	—	6	3 CT*	Subspecialty	w
France	700	10	45	80	30	Yes	Yes	5	1 CT	—	—
Germany[a]	767 [26]	9	66 [27]	155 [27]	124[i] [27]	—	Yes [28]	1 [28]	5* [28]	—	o [28]
Hungary	200	20	8	30	13	Yes	Yes	5	0.5 CT	—	c, o
Ireland	19	4	6	18	7	Yes	Yes	7	3 CT* + 2 or 2 CT* only	—	—
Italy	1500	25	97	100	25	Yes	Yes	4	0.3 CT	—	o, w
Latvia	100	53	UNK	UNK	2	Yes	Yes	5	UNK*	Specialty	c, o, w
Lithuania	123	44	2[j]	12	2	Yes	Yes	4	2 CT*	Subspecialty	c, o, w
Luxembourg[b]	6	10	1	1	1	No	No	—	—	—	—
Malta[c]	7	14	1	8	1	Yes	Yes	6	2* +3 CT	Subspecialty	w
Poland	1131	30	130	45	76	—	Yes	5	0.7 CT	—	o, w
Portugal	300	29	18	90	12	Yes	Yes	5	1 CT	—	c, o
Romania	700	36	50	300	6	Yes	Yes	5	2 CT	—	c, o, w
Slovakia	80	15	5	—	3	No	Yes	5	1 CT*	—	o, w
Slovenia	105	50	40	24	5	Yes	Yes	6	1.1 CT	Specialty	c, o
Sweden	800	78	200	30	30	—	Yes	5	1 CT	—	—
Switzerland	300	35	15	40	5	—	Yes	6	3 CT*	Subspecialty	c, o, w
Turkey	1300	16	120	300	90	—	Yes	5	0.5	Subspecialty	o, w
UK	273	4	70	200	40	Yes	Yes	7	3 CT* + 2 or 2 CT* only	Subspecialty	w
Countries in which ID is a subspecialty											
Austria	7	1	2	7	42[k]	—	Yes	6	2.25 CT	—	o, w
Belgium[d]	100	9	20	40	10	—	Yes	4	3.5*	—	—
Cyprus[e]	10	8	—	—	—	—	Yes	2	5*	Subspecialty	o, w
Greece	70	7	10	20	6	—	Yes	2	5*	Subspecialty	o, w
Iceland[f]	20	50	—	—	—	—	—	3	3 CT*	Subspecialty	—
Israel	235	26	12	235	18	—	Yes	2	4 CT*	Subspecialty	o, w
Netherlands	150	9	20	10	7	—	Yes	2	4*	Specialty	—
Norway	175	33	14	100	4	Yes	Yes	6	4 CT	—	—
Countries in which ID is not a specialty											
Spain[g]	400	9	50	UNK	30	—	No	UNK	—	—	—

Abbreviations c, clinical examination; CT, common trunk; GIM, general internal medicine; ID, infectious diseases; o, oral examination; UNK, unknown; w, written examination; −, not applicable.
Data collected from representatives of the Infectious Disease Section of the UEMS and national health authorities in 2021. No response was received from Bulgaria or Serbia. Numbers are estimates based on statistics of the previous year.

* Training in GIM precedes ID training.

[a] In May 2021, ID was recognized as a specialty in Germany. The implementation of an official training curriculum with regards to the decree is anticipated.

[b] In Luxembourg, ID specialists are trained abroad (predominantly in Belgium; also, France and Spain). Trainees spend one year of training in Luxembourg. After that, training is continued abroad.

[c] In Malta, ID is considered a specialty in terms of training, but as a subspecialty within the working system of the Department of Medicine. Employment requires specialization in both, GIM and ID.

[d] Numbers for Belgium are based on estimates. ID was recognized as subspecialty for the first time in May 2020.

[e] In Cyprus, there are no official training centres. Based on a bilateral agreement between Cyprus and Greece. Cypriot, Greek and EU citizens can perform their ID residency in Cypriot hospitals, if accredited by the Greek Ministry of Health.

[f] In Iceland, there are no training institutions. ID training is performed abroad (Sweden, UK, USA).

[g] ID is not recognized as a specialty in Spain. Training delivery and duration are highly variable depending on local regulations and training institutions. Trainees participate in different courses/rotations.

[h] Current numbers are estimates supported by statistics of the previous year.

[i] Only 31 of 124 training centres are accredited by the German Society for Infectious Diseases and therefore comparable to European standards.

[j] In Lithuania, a decrease in numbers of trainees terminating ID training has been observed due to structural problems caused by the COVID-19 pandemic.

[k] In Austria, there is a total of 42 training centres. Training is only performed in eight of those centres because numbers of trainers are limited.

The questions on tropical and travel medicine were not answered consistently but these areas were included in 31/33 (93.9%) countries. It was unclear how many countries provide specific training and accreditation in 'tropical medicine' similar to that provided in the UK [13,16,17].

Newer aspects of the training curriculum are only delivered in 30% of countries, with training in palliative care in 11, quality improvement/audit in 13 and leadership/team management in 12. However, a new curriculum was approved in Slovenia in 2021, meeting the ETR criteria and foreseeing additional training in bedside ultrasound. Apart from Croatia, the Czech Republic and Slovakia, research methodology is part of the curriculum and encouraged in all countries and in 39.4% of countries, trainees may take time out of clinical training to focus on research. The revised Finnish curriculum foresees a 6-month funded rotation into clinical research, whereas French trainees defend a thesis before the end of the penultimate year.

Measures of training assessment for trainees, trainers and institutions

Trainee progress is monitored by personal logbook or e-portfolio in 25 countries (75.8%). Workplace-based assessments are used in 17 (51.1%) and knowledge-based assessments in 20 countries (60.6%) (Table 2). In some countries, regular assessments are formative and may be trainee-led, whereas in Portugal trainees must pass activity reviews and yearly examinations. Regular formal reviews of training are conducted in at least 18 countries (54.5%), with a penultimate year assessment in 4. At least 69.7% of countries require final examinations, usually written, with additional oral and/or clinical bedside components in some (Table 2).

Approval of centres and trainees is performed by bodies such as Ministries of Health, national medical bodies or colleges, specialist societies or individual universities. Supervisors are usually required to have been an accredited specialist for at least 3–5 years, and

Table 2
Infectious Diseases training delivery in 33 European countries in 2021 in comparison with the UEMS European Training Requirements (ETR) for the Infectious Diseases Specialty (2018) [12].

	Microbiology/Virology Lab	Patient care on wards	Consult activity	Outpatient clinic	Logbook	Workplace-based	Knowledge-based	Regular formal reviews	Penultimate year	Individual Trainers	Training Centres	Training Programmes	Antimicrobial Chemotherapy (ABS)	Chronic Infections (HIV/AIDS, Hepatitis, etc.)	Epidemiology/Public Health	CAI (inpatient/outpatient settings)	Critical Care/Intensive Care Medicine	HAI (inpatient/outpatient settings)	Infection Control	Leadership/Team Management	Medical Microbiology	Non-HIV IC Patient	Palliative/Terminal Care	Quality Improvement/Clinical Audit	Sexually Transmitted Diseases	Travel Medicine/Tropical Diseases	Research Methodology
Country	**Areas of Training Indicative length (months)**				**Training Assessment**					**Quality Assurance**			**Curricular Contents**														
Armenia	1*	24	5	1	–	–	X	X	–	X	X	X	X		X	X	X	X	–	–	–	–	–	–	X	E
Austria	3*	–	–	–	X	–	–	–	–	X	–	–	X	X	X	X	X	X	X	–	–	X	–	–	X	X	X
Belgium[a]	6	18	6	18	X	X	X	X	–	X	X	–	X	X	–	X	–	X	–	–	6	X	–	–	X	X	E
Croatia	5	–	–	–	X	X	X	–	–	X	X	X	X	X	X	X	X	X	X	–	3	X	–	–	X	X	–
Czech Republic	1	X	–	X	X	X	X	–	–	–	X	X	X	X	–	X	X	X	–	–	X	–	–	–	–	X	–
Cyprus[b]	1	X	X	X	–	–	–	–	–	X	X	X	X	X	X	X	X	X	X	–	1	X	–	X	X	X	e
Denmark	3	46	–	7	X	X	X	–	–	X	X	X	X	X	–	X	X	X	X	X	3	X	–	–	X	3	E
Estonia	3	40	12	6	X	X	–	–	–	X	X	X	X	X	–	X	–	X	6	–	3	X	X	X	–	X	e
Finland	3*	9	9	9	–	–	–	–	–	–	–	–	X	X	6	X	X	X	X	–	6	X	X	–	–	X	6, e
France	6	48	–	6	X	–	–	X	X	–	–	–	X	X	X	X	X	X	X	–	6	X	X	–	X	X	e
Germany [28]	–	12	12	–	X	–	–	X	–	X	X	–	X	X	X	X	X	X	X	–	–	X	–	–	X	X	E
Greece	1	14	3	14	X	–	–	–	–	X	X	X	X	X	X	X	X	X	3	–	X	X	–	X	X	X	e
Hungary	3	42	–	–	X	–	–	–	–	X	X	X	–	–	X	–	X	–	2	–	3	–	–	–	–	–	e
Iceland[c]	-	-	-	-	-	X	X	-	-	-	-	-	X	X	X	X	X	X	X	X	-	X	-	X	X	X	E
Ireland[d]	1	36	36	36	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	-	X	X	X	E
Israel	1	–	18	–	–	–	–	–	–	–	–	–	X	3*	–	X	X	X	3*	–	X	X	–	-	X	3*	3*, e
Italy	3*	24	12	12	X	–	X	–	–	X	–	–	X	X	X	X	–	X	X	–	–	X	–	–	X	X	E
Latvia	6	X	–	–	X	–	X	–	–	X	X	X	X	X	X	X	X	X	X	–	–	X	X	–	X	X	e
Lithuania	1	12	6	3	–	–	X	X	–	X	X	X	X	X	X	X	X	X	X	–	2	X	X	–	–	X	e
Luxembourg[e]	–	–	–	–	–	–	X	X	–	X	–	–	X	X	–	X	–	–	–	–	–	–	–	–	x	x	e

	Microbiology/Virology Lab	Patient care on wards	Consult activity	Outpatient clinic	Logbook	Workplace-based	Knowledge-based	Regular formal reviews	Penultimate year	Individual Trainers	Training Centres	Training Programmes	Antimicrobial Chemotherapy (ABS)	Chronic Infections (HIV/AIDS, Hepatitis, etc.)	Epidemiology/Public Health	CAI (inpatient/outpatient settings)	Critical Care/Intensive Care Medicine	HAI (inpatient/outpatient settings)	Infection Control	Leadership/Team Management	Medical Microbiology	Non-HIV IC Patient	Palliative/Terminal Care	Quality Improvement/Clinical Audit	Sexually Transmitted Diseases	Travel Medicine/Tropical Diseases	Research Methodology
Country	**Areas of Training Indicative length (months)**				**Training Assessment**					**Quality Assurance**			**Curricular Contents**													
Malta	1*	48	48	48	X	–	–	X	–	–	–	X	X	X	X	X	X	X	X	X	–	X	X	X	X	X	e
Netherlands	1	6	6	9	X	X	X	X	–	X	X	X	X	X	X	X	X	X	X	–	X	X	–	–	X	X	E
Norway	12	60	60	60	X	X	–	X	X	X	–	X	X	X	X	X	–	X	X	–	12	X	–	–	X	X	X
Poland	1	48	24	–	X	X	X	X	–	–	–	X	X	2	X	X	1	X	X	X	–	X	–	–	X	X	e
Portugal	3	30	3	3	–	X	X	X	–	–	X	–	X	X	–	X	X	X	X	X	3	X	–	–	X	X	e
Romania	3	24	30	–	X	–	X	X	–	–	–	–	X	X	X	X	X	X	3	X	3	X	X	X	X	X	e
Slovakia	1	30	2	6	X	–	–	X	–	–	X	–	–	–	–	–	–	–	X	–	X	–	X	X	–	–	–
Slovenia	5	45	12	3	X	X	X	X	–	X	X	X	X	X	X	X	X	X	3	X	5	X	X	X	X	X	E
Spain[f]	–	–	–	–	X	X	–	–	–	X	–	–	X	X	X	X	X	X	X	X	–	X	–	X	X	X	E
Sweden	6	18	12	4	X	X	X	X	–	–	X	X	X	X	X	X	X	X	X	X	6	X	X	X	–	X	E
Switzerland	3*	–	18	12	X	X	X	X	–	–	X	X	X	X	X	X	X	X	6*	X	6*	X	–	X	X	X	E
Turkey[d]	6*	24	20	4	X	X	X	–	–	–	X	–	X	X	X	X	–	X	X	–	6	X	–	–	X	X	e
UK[d]	6	18	30	30	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	6	X	X	X	X	X	E

No responses were received from Bulgaria or Serbia. All numbers are indicative or mandatory duration in month(s) (which may be concurrent/overlap).

Abbreviations: ABS, Antibiotic Stewardship; CAI, community-acquired infections; E, encouraged WITH possibility to take time off; e, encouraged WITHOUT possibility to take time off; HAI, healthcare-acquired infections; IC, immunocompromised; Lab, laboratory; unk, unknown; –, not applicable; x, applicable.

*Optional, duration in month(s)

[a]Infectious Diseases was recognized as a subspecialty in May 2020. The curricular specifications are the ones listed in law, still to be implemented practically by Recognition Committees.

[b]In Cyprus, there are no official training centres. Based on a bilateral Agreement between Cyprus and Greece. Cypriot, Greek and EU citizens can perform their ID residency in Cypriot hospitals, if accredited by the Greek Ministry of Health.

[c]ID training is performed abroad (i.e. Sweden, UK, USA).

[d]In Ireland, Turkey and the UK there will be additional laboratory-based training for those undertaking joint training with medical microbiology.

[e]In Luxembourg, ID specialists are trained abroad (predominantly in Belgium; also, France and Spain). Trainees spend 1 year of training in Luxembourg. After that, training is continued abroad.

[f]ID is not recognized as a specialty in Spain. Training delivery and duration are highly variable depending on local regulations and training institutions. Trainees participate in different courses/rotations.

training centre approval requires the presence of sufficient clinical activity and/or ID bed base, and enough specialists (typically at least two). Renewal of approval of centres, typically in a 5-year cycle, is required in some countries. Some respondents suggested the need for more structured and frequent quality control of mentors/trainers.

Influence of the COVID-19 pandemic

There has been an increase in ID trainees in six countries and further increase is expected in 13. Due to the ongoing COVID-19 pandemic, the Lithuanian government increased funding of ID residency positions. The University of Tartu (Estonia) is applying for additional residency positions and is considering increasing epidemiology studies within the curriculum. Some respondents thought that the pandemic would improve the external perception of ID as a specialty, but others were concerned about loss of trainees due to physician exhaustion and 'burn out'.

Discussion

This paper provides important insights into the status of ID training programmes across Europe, relying primarily on reports and opinions from senior physicians in each country. Previous reviews have shown variations in format and duration of training, supervision and examinations between countries, and 20% of

countries lacked formal training programmes in 2005 [9–11]. The situation has now improved with only one country in 35 awaiting specialty recognition, but there is still substantial variability in the numbers of ID specialists per million inhabitants and in the central regulation of the number of future specialists in training. As highlighted previously [9–11], a recent internet-based survey of ESCMID members and affiliates found that only 58% of hospitals had a specialized ID ward and that there was an average of one ID or CM physician per 100 hospital beds [8]. Although practice varies across Europe, all trainees have to achieve general competence in both inpatient care and outpatient and consult practice to become a specialist. Any further subspecialization occurs informally or formally after specialist accreditation [18].

Investigation of the number of specialist trainees in each country proved difficult, emphasizing the need for central national databases to track numbers of trainees and their progress. However, in some countries the approval of training centres, funding of training and control of training content and delivery are functions of different ministries/national authorities.

The length of training varies from 1 to 7 years. There is an increasing trend towards double training in ID and GIM, in keeping with the general trend seen in UEMS across all specialties allied to GIM. Very few countries provide dual training in ID with MM or virology and such programmes tend to have shorter GIM components. Only 21.2% of countries provide the minimum 6 months of microbiology training recommended in the ETR [12], which seems disappointing given the emphasis on the need for improved training in antimicrobial stewardship, infection control and joint ID/MM training recommended more than 15 years ago [9]. Familiarity with laboratory practice improves interpretation of results and reports and also underpins better antimicrobial stewardship. Detailed surveys of training needs have led to the introduction of new European standards of practice and training programmes in antimicrobial stewardship and infection prevention and control [8,19–21]. These could be incorporated more explicitly in the next iteration of the ETRs of both ID and CM as a benchmark of modernizing training programme content [13]. New areas of the ID curriculum such as palliative care, team leadership and quality improvement have yet to be implemented in many countries. However, these are important because of the increasing emphasis on multidisciplinary team working as part of everyday ID practice.

In all countries that responded, trainees were paid some form of salary during specialist training, although previous studies have found great variability of yearly gross salary across Europe [22]. This will have a financial impact on clinicians and may deter some from training in those countries, and physicians may choose to emigrate to find better working conditions.

A standardized training programme detailing each rotation should be given to trainees before commencing training, which should be provided from accredited training centres with independent reviews of educational supervisors. This should ensure that time is allowed for adequate experience in each area and that training meets the desired European standard. However, free text comments revealed confusion about accreditation of specialists as trainers on the basis of clinical seniority, rather than specific training in supervision and mentoring of postgraduate trainees. It is a great concern that only half of countries conduct annual reviews of trainee progress and that even fewer conduct a more global review to identify unmet training needs just before the last year of training. These shortcomings echo the findings of previous ESCMID surveys, in which only 34% of trainees received regular constructive feedback from their supervisor and there were notable differences in supervision of trainees in different European regions [23]. Only 36% of ID/CM European trainees were assigned an official mentor during their training and of these, only 60% received constructive feedback on their work [24]. More than one-quarter did not consider their relationships with mentors to be confidential and 22% felt they could not talk with their mentor if treated unfairly at work [24]. Trainee feedback is an important factor in developing and improving curricula and training programmes [21,23]. Our findings support the need for improvement in postgraduate education in ID in many European countries. Further innovative approaches to delivering such training could also be considered [25].

Research opportunities vary among countries depending on priorities and prior experience. Extra time is needed, often out of training, and funding may or not be available from training fellowships, charities or governmental organizations. Protected time spent in a research rotation allows trainees to further define their skills in terms of international comparison and finding new niches within their chosen specialty.

This study was limited by the personal response of each clinician completing the questionnaire on behalf of their country and slight ambiguity of interpretation of a few questions. Efforts have been made to validate the data, but it was not possible for all countries.

Conclusion

The COVID-19 pandemic has gathered international attention to ID as a specialty and was cited by several countries as a stimulus to train more ID specialists. It has highlighted the need for more ID specialists across Europe and the importance of unity and collaboration among countries and between the infection specialties in managing such. The specialty should strive to improve training in areas such as antimicrobial stewardship and infection prevention and control. In many countries, improvement and modernization of the framework for delivery of postgraduate training is needed to enhance the training experience and maintain enthusiasm among our excellent trainees. Ideally, ID trainees will benefit from a harmonized curriculum offering equivalent standards of training and professional opportunity across the continent with equitable working conditions encouraging free movement of specialists between European countries.

Collaborators

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Author contributions

DD developed the first draft of surveys 1 and 2. Subsequent drafts were further developed and finalized by RAB, JS-G, NJB and OAC. RAB, RSH, JS-G, JPS, NJB and OAC collected data, and analysed and interpreted the findings. All authors contributed to all sections relevant to their experience and helped finalize the text and content. RAB and SRH, as junior authors, and NJB and OAC, as senior authors, contributed equally to this manuscript.

Transparency declaration

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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.2021.07.033.

References

[1] Koehler P, Bassetti M, Chakrabarti A, Chen SCA, Colombo AL, Hoenigl M, et al. Defining and managing COVID-19-associated pulmonary aspergillosis: the 2020 ECMM/ISHAM consensus criteria for research and clinical guidance. Lancet Infect Dis 2021;21:e149–62.
[2] Petersen E, Petrosillo N, Koopmans M, ESCMID Emerging Infections Task Force Panel. Emerging infections-an increasingly important topic: review by the Emerging Infections Task Force. Clin Microbiol Infect 2018;24:369–75.
[3] Schlagenhauf P, Weld L, Goorhuis A, Gautret P, Weber R, von Sonneburg F, et al. EuroTravNet. Travel-associated infection presenting in Europe (2008–12): an analysis of EuroTravNet longitudinal, surveillance data, and evaluation of the effect of the pre-travel consultation. Lancet Infect Dis 2015;15:55–64.
[4] Bloom DE, Cadarette D. Infectious disease threats in the twenty-first century: strengthening the global response. Front Immunol 2019;10:549.
[5] Schmitt S, McQuillen DP, Nahass R, Martinelli L, Rubin M, Schwebke K, et al. Infectious diseases specialty intervention is associated with decreased mortality and lower healthcare costs. Clin Infect Dis 2014;58:22–8.
[6] Tsioutis C, Birgand G, Bathoorn E, Deptula A, Ten Horn L, Castro-Sánchez E, et al. Education and training programmes for infection prevention and control professionals: mapping the current opportunities and local needs in European countries. Antimicrob Resist Infect Control 2020;9:183.
[7] Brouqui P, Puro V, Fusco FM, Bannister B, Schilling S, Follin P, et al. Infection control in the management of highly pathogenic infectious diseases: consensus of the European Network of Infectious Disease. Lancet Infect Dis 2009;9:301–11.
[8] Dickstein Y, Nir-Paz R, Pulcini C, Cookson B, Beovic B, Tacconelli E, et al. Staffing for infectious diseases, clinical microbiology and infection control in hospitals in 2015: results of an ESCMID member survey. Clin Microbiol Infect 2016;22:812. e9–e17.
[9] Cooke FJ, Choubina P, Holmes AH. Postgraduate training in infectious diseases: investigating the current status in the international community. Lancet Infect Dis 2005;5:440–9.
[10] McKendrick MW, European Union of Medical Specialties. The European Union of Medical Specialties core training curriculum in infectious diseases: overview of national systems and distribution of specialists. Clin Microbiol Infect 2005;11:28–32.
[11] Read RC, Cornaglia G, Kahlmeter G. European society of clinical microbiology and infectious diseases professional affairs workshop group. Professional challenges and opportunities in clinical microbiology and infectious diseases in Europe. Lancet Infect Dis 2011;11:408–15.
[12] European Union of Medical Specialists (UEMS). Training requirements for the specialty of infectious diseases - European standards of postgraduate medical specialist training. 2018. Available from: https://www.uems.eu/__data/assets/pdf_file/0004/72265/ETR-in-Infectious-Diseases-2018-corrected-1.pdf. [Accessed 28 June 2021].
[13] Beeching NJ, Rautelin H, Stahl J-P, Leegard TM. Training and assessment of medical specialists in clinical microbiology and infectious diseases in Europe. Clin Microbiol Infect 2021. https://doi.org/10.1016/j.cmi.2021.07.009.
[14] The World Data Bank. Popular indicators. 2019. Available from: https://databank.worldbank.org/indicator/SP.POP.TOTL/1ff4a498/Popular-Indicators. [Accessed 28 June 2021].
[15] Deutsche Gesellschaft für Infektiologie. Weiterbildungsstellen "Infektiologie" Deutschland. XXX; 2020. updated 27.10.2020). Available from: https://www.dgi-net.de/wp-content/uploads/2020/10/Weiterbildungsstellen-Deutschland-2020-10-27-1.pdf. [Accessed 28 June 2021].
[16] Joint Royal Colleges of Physicians Training Board. Infectious diseases and tropical medicine. 2021. Available from: https://www.jrcptb.org.uk/specialties/infectious-diseases-and-tropical-medicine. [Accessed 28 June 2021].
[17] Beeching NJ, Borysiewicz LK. Training in infectious diseases and tropical medicine in Britain. Clin Microbiol Infect 2000;6:432–4.
[18] Bonura EM, Armstrong WS. Increasing subspecialization in the field of infectious diseases: evaluating challenges and strategies to move forward. J Infect Dis 2017;216:S594–9.
[19] Zingg W, Mutters NT, Harbarth S, Friedrich AW. Education in infection control: a need for European certification. Clin Microbiol Infect 2015;21:1052–6.
[20] Maraolo AE, Ong DSY, Cimen C, Howard P, Kofteridis DP, Schouten J, et al. Organization and training at national level of antimicrobial stewardship and infection control activities in Europe: an ESCMID cross-sectional survey. Eur J Clin Microbiol Infect Dis 2019;38:2061–8.
[21] Yusuf E, Ong DS, Martin-Quiros A, Skevaki C, Cortez J, Dedic K, et al. A large survey among European trainees in clinical microbiology and infectious disease on training systems and training adequacy: identifying the gaps and suggesting improvements. Eur J Clin Microbiol Infect Dis 2017;36:233–42.
[22] Tacconelli E, Poljak M, Cacace M, Caiati G, Benzonana N, Nagy E, et al. Science without meritocracy. Discrimination among European specialists in infectious diseases and clinical microbiology: a questionnaire survey. BMJ Open 2012;2:e001993.
[23] Palacios-Baena ZR, Zapf TC, Ong DSY, Maraolo AE, Ronnberg C, Cimen C, et al. How are trainees in clinical microbiology and infectious diseases supervised in Europe? An international cross-sectional questionnaire survey by the Trainee Association of ESCMID. Eur J Clin Microbiol 2018;37:2381–7.
[24] Ong DSY, Zapf TC, Cevik M, Palacios-Baena ZR, Barac A, Cimen C, et al. Current mentorship practices in the training of the next generation of clinical microbiology and infectious disease specialists: an international cross-sectional survey. Eur J Clin Microbiol 2019;38:659–65.
[25] Cervantes J. The future of infectious diseases education. Med Sci Educ 2020;30:1783–5.
[26] Ärztinnen/Ärzte mit Bundesärztekammer. Zusatz-Weiterbildungen nach Tätigkeitsarten. 2019. updated 31.12.2019). Available from: https://www.bundesaerztekammer.de/fileadmin/user_upload/downloads/pdf-Ordner/Statistik2019/Stat19Tab11.pdf. [Accessed 28 June 2021].
[27] Liste der Landesärztekammern Bundesärztekammer. updated 09.01.2018). Available from: https://www.bundesaerztekammer.de/service/adressen/landesaerztekammern/. [Accessed 28 June 2021].
[28] Bundesärztekammer (Arbeitsgemeinschaft der deutschen Ärztekammern). Muster-) Weiterbildungsordnung; 2018. updated 13.11.2020). Available from: https://www.bundesaerztekammer.de/fileadmin/user_upload/downloads/pdf-Ordner/Weiterbildung/20201112_13_MWBO-2018.pdf. [Accessed 28 June 2021].