

GRACE and the development of an education and training curriculum

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Abstract

Antimicrobial resistance is a serious threat and compromises the management of infectious disease. This has particular significance in relation to infections of the respiratory tract, which are the lead cause of antibiotic prescribing. Education is fundamental to the correct use of antibiotics. A novel open access curriculum has been developed in the context of a European Union funded research project *Genomics to combat Resistance against Antibiotics in Community-acquired lower respiratory tract infections in Europe* (GRACE <http://www.grace-lrti.org>). The curriculum was developed in modular format and populated with clinical and scientific topics relevant to community-acquired lower respiratory tract infections. This curriculum informed the content of a series of postgraduate courses and workshops and permitted the creation of an open access e-Learning portal. A total of 153 presentations matching the topics within the curriculum together with slide material and handouts and 104 webcasts are available through the GRACE e-Learning portal, which is fully searchable using a 'mindmap' to navigate the contents. Metrics of access provided a means for assessing usage. The GRACE project has permitted the development of a unique on-line open access curriculum that comprehensively addresses the issues relevant to community-acquired lower respiratory tract infections and has provided a resource not only for personal learning, but also to support independent teaching activities such as lectures, workshops, seminars and course work.

Keywords: Antibiotic resistance, curriculum, education, Europe, medical, respiratory infection

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Introduction

Antimicrobial resistance is a universal characteristic of human pathogenic microorganisms and compromises the therapeutic effectiveness of anti-infective medicines. Antimicrobial resistance has particular importance with regard to the treatment of infections of the respiratory tract because such infections are not only the cause of much morbidity, significant mortality and significant economic cost to individuals, healthcare

delivery systems and society, but also the leading cause of antibiotic prescribing. It is therefore essential that these drugs are used appropriately.

There is wide variation in both the rate of antibiotic prescribing in European countries and in the incidence of antibiotic resistance [1]. There is evidence that such differences in prescribing practices may be linked to cultural issues [2,3]. Education concerning the nature and management of respiratory infections is therefore of major importance to undergraduate and postgraduate healthcare professionals to support sound prescribing practices and the control of antibiotic resistance through antimicrobial stewardship programmes [4].

The Genomics to combat Resistance against Antibiotics in Community-acquired lower respiratory tract infections in

Europe (GRACE) project [5] is a research network (2007–2011) funded by the European Commission under Framework Programme 6 (FP6). The programme of activities is delivered through collaborative and integrated research networks, designated Work Packages. Work Package 12 (WP12) is responsible for delivering a programme of education and training based on the focus of the GRACE project. Membership of WP12 is drawn from the two partner organizations, namely the European Society of Clinical Microbiology and Infectious Diseases (ESCMID) (<http://www.escmid.org>) and the European Respiratory Society (ERS) (<http://www.ersnet.org>), which are the two leading European societies with a major professional, educational and research interest in infection and respiratory diseases. WP12 is jointly led by representatives of these two societies (RF for ESCMID and FB for ERS), with support from the Educational Officers and permanent administrative and scientific staff of these two organizations. Primary-care expertise to WP12 is provided by an academic general practitioner (TV). We here report on the development, delivery and assessment of a novel open access curriculum that addresses the major clinical and scientific topics captured within the boundaries of the GRACE project.

GRACE WP12 Curriculum

The education and training programme of WP12 has been based on a purpose-designed curriculum. This has been constructed in a modular format to cover topics dealing with basic science, specialist knowledge and elements of clinical practice relevant to community-acquired lower respiratory tract infection [6]. The curriculum specifically focuses on the educational and training needs of healthcare professionals and biomedical scientists involved in primary care, infectious diseases, clinical microbiology and respiratory medicine.

The curriculum has been divided into ten modules (Table 1) with themes that include topics dealing with basic and clinical science as well as those relevant to clinical practice as determined by the breadth of issues encompassed in

the GRACE project. It has been designed as a 'living' curriculum to permit refinement of the topics and to accommodate emerging knowledge in antimicrobial resistance. The topics within the ten modules are drawn from the key areas covered by the GRACE project. These include the epidemiology and clinical expression of adult lower respiratory tract infections as they occur in the community; the human and microbial genomics that impact on disease susceptibility or pathogenicity; the treatment and prevention of such infections and finally the resultant healthcare burden as it affects individuals, society and healthcare systems. Research questions and, where appropriate, research methodologies were integral to the selection, design and delivery of the various topics. Furthermore, the research outputs from the GRACE project were deliberately incorporated into the educational programme and appear as a separate module. This provides a dynamic dimension to the curriculum and in turn ensures rapid dissemination and integration of the activities and outputs of the various Work Packages.

Educational Programme

The curriculum was used to inform the design and content of the WP12 educational programme, which was delivered through a combination of postgraduate courses (PGCs) and workshops (WSs), which have been delivered throughout the 5-year period of the GRACE project. The PGCs were primarily organized in conjunction with the annual congresses of the two partner societies namely the European Congress of Clinical Microbiology and Infectious Diseases (ECCMID) and the ERS Annual Scientific meeting. The PGCs and WSs were open to attendance by scientists, clinicians and other professionals regardless of membership of these two societies; both societies provide a number of educational grants to selectively support delegate attendance.

Postgraduate courses

The content of the PGCs was designed to be relevant to postgraduate practitioners and trainees in the disciplines of

TABLE 1. GRACE education and training curriculum

Module	Title	No. of topics in module
1	Pathogens and the respiratory tract (bacteria and fungi)	13
2	Pathogens and the respiratory tract (viruses)	9
3	Host–pathogen interaction and the lung	7
4	Lower respiratory tract infections—epidemiology, economic and social impact	8
5	Community lower respiratory tract syndromes	13
6	Defining the high-risk patient (host, microbe and environmental factors)	6
7	Basic and applied aspects of antimicrobial chemotherapy	16
8	Current approaches to investigations and severity assessment	8
9	Policy, guidelines and care pathways to support community and hospital practice	9
10	GRACE research topics	11

respiratory medicine, microbiology, infectious diseases, primary care and, to a lesser extent, infection control, pharmacy and therapeutics. The PGCs were structured as whole-day or half-day events with invited faculty providing a largely lecture-based format, with some case-based discussion and ample time for discussion of the topics presented. Controversial issues were also included in the form of 'Pro' and 'Con' presentations designed to ensure that opposing views were adequately aired and discussed.

Workshops

In contrast, the WSs were organized as events independent of the programmed activities of the two societies, lasted for 1–2 days and were often residential in nature. The format was less formal than the PGCs and encouraged delegate and faculty interaction through in-depth discussion of topics. Some WSs adopted a plenary and parallel session structure. The topics were deliberately selected to provide a balance of basic science and clinical practice on the topics presented.

The GRACE curriculum (<http://www.grace-edut.org/pages/default.aspx?id=1617>) was used to build the content of the PGCs and WSs. An overall theme for each event was selected and the topic content was drawn flexibly from the various modules of the curriculum. This had the dual purpose of not only ensuring that each event had depth and breadth relevant to its theme, but that it also provided material for the creation of the GRACE e-Learning portal [6]. Faculty were invited to contribute to the PGCs and WSs on the condition that they provided a full set of slides, handout and key references and other supporting materials. These were made

available to delegates at the time of the educational event and subsequently linked to the GRACE e-Learning portal.

GRACE e-Learning Portal

Initially, the GRACE educational website was constructed using a format established by ERS. It was shaped as an online library/repository giving users access to all materials produced for PGCs and WSs in a chronological fashion, which reflected the content and structure of each individual educational event organized by WPI2. This enabled users to browse educational content by date/event.

In 2008, the content management system and the underlying database used to build and maintain this educational website were both replaced, allowing for greater flexibility in the way the information was presented to the users. In addition to the chronological browsing function, a thematic access to all available materials was introduced through a mindmap design, enabling learners to browse materials according to specific topics of interest (Fig. 1).

From its inception, the website was designed to allow access to all educational materials in different formats, including POWERPOINT slides and PDFs as well as webcasts and podcasts, so matching the needs of different types of audiences, from learners wishing to listen to an entire presentation to teachers looking for specific slides to include in their lectures.

To date, a total of ten PGCs and six WSs have taken place and have provided a total of 156 presentations. Most

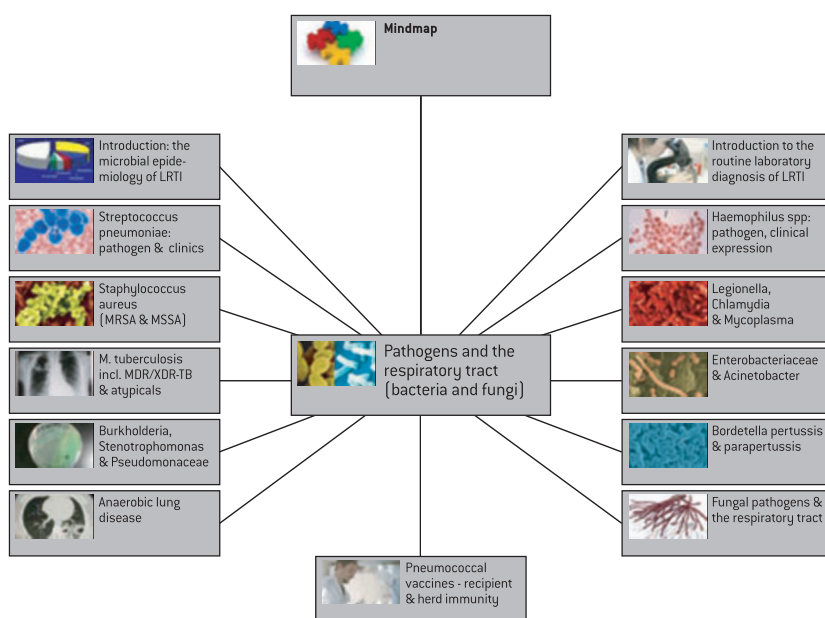


FIG. 1. Example of e-Learning webpage showing the 'Mindmap' design for topics included in one of the modules from the GRACE curriculum dealing with topic 'Pathogens and the respiratory tract (bacteria and fungi)'.

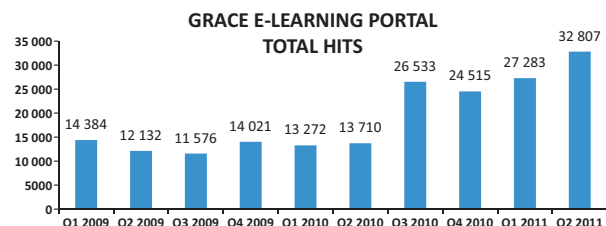


FIG. 2. Hits on the e-Learning portal (2009–2011).

have been webcast (109) and all have either supporting slide material, handouts or reference resources.

In relation to the curriculum, all 103 topics included in the ten modules have been delivered. To date, 11 research presentations arising from the GRACE project are also available online. All material is available by open access and is free to the user without restriction.

Promotion, Dissemination and Metrics

Each PGC and WS was advertised and promoted extensively through the websites of the GRACE project, ESCMID (c. 4000 members) and ERS (c. 11 000 members). In addition, relevant national scientific and professional societies also co-operated in promoting specific events. Printed promotional material was made available at the annual congresses of ESCMID and ERS. The e-Learning portal has been similarly promoted.

The GRACE newsletter (*GRACE news* [7]) has been used as a vehicle for dissemination by regularly featuring material based on the PGCs and WSs. Because the GRACE project has a particular focus in primary care, the e-Learning facility has been presented and promoted at the yearly congresses

of WONCA-Europe (the World Organization of National Colleges, Academies and Academic Associations of General Practitioners/Family Physicians for Europe)

To quantitatively assess the uptake of the resources on the GRACE portal, a range of metrics have been developed to provide data on the use of this e-Learning portal. These include hits by country and downloads from either the GRACE e-Learning or the linked host ERS websites. These were recorded cumulatively for the GRACE e-Learning portal and Fig. 2 shows the total hits on this portal for the years 2009–2011. Table 2 identifies the ranking for the top viewed or downloaded files (webcasts, POWERPOINT slides and PDF documents combined). Fig. 3 gives the number of hits for a single WS to illustrate the chronology of hits over a 12-month period following the WS as an indicator of topicality. Other analyses (not shown) were able to provide data on the geographic distribution of attendance by event and demonstrated the pan-European nature of this educational initiative.

Discussion

The issue of antibiotic resistance has resulted in considerable international concern. e-Learning resources that focus on this topic to stress the importance of good prescribing practice are few and largely directed at undergraduates in medicine [8]. The GRACE project has created a unique multidisciplinary and cross-disciplinary research collaboration around the theme of antibiotic resistance in the community. The active engagement of two professional societies enabled the development of a platform for a novel and sustainable educational platform, designed around an innovative

TABLE 2. Most popular downloads (Webcasts, PowerPoints and PDF documents combined)

Title	Author	Date of event	Hits
The impact of environmental pollutants on lung infections	G. Viegj (Pisa, Italy)	22.10.2007	4801
CAP and HAP guidelines: treatment indications and more	M. Woodhead (Manchester, UK)	02.09.2006	4336
Acute and chronic cough syndromes differential diagnosis: infections or not?	L. Mc Garvey (Belfast, UK)	15.09.2007	4191
Clinical management of COPD: recommended practice including the place of antibiotics	F. Blasi (Milan, Italy)	04.10.2008	2804
Debate: antibiotic treatment is contraindicated in acute bronchitis—'Pro'	T. Verheij (Utrecht, the Netherlands)	04.10.2008	2586
Guidelines for the management of adult lower respiratory tract infections	ERS/ESCMID	01.08.2005	2555
COPD guidelines in relation to infections: a critical analysis	A. Torres (Barcelona, Spain)	04.10.2008	2296
Cystic fibrosis in children and adults: is the social and economic impact changing?	M. Bakker (Rotterdam, the Netherlands)	22.10.2007	1982
Acute bronchitis and exacerbations of COPD: different patients, different risks	F. Blasi (Milan, Italy)	24.10.2009	1973
Epidemiology of community-acquired pneumonia and nosocomial pneumonia	R. Pistelli (Rome, Italy)	02.09.2006	1558
<i>Mycobacterium tuberculosis</i> —genetic and molecular markers of infection	F. Drobniewski (London, UK)	22.10.2007	1478
Bacterial quorum sensing and lung infection	M. Camara (Nottingham, UK)	22.10.2007	1410
Antibiotic resistance and clinical outcomes: the CAPNETZ experience	T. Welte (Hannover, Germany)	02.09.2006	1343
Detecting chronic underlying disease in patients with acute cough syndrome	A. Sachs (Utrecht, the Netherlands)	19.09.2008	1235
Introduction to host defences of the lung in health and disease	C. Greene (Dublin, Ireland)	22.10.2007	1223
How pharmacokinetic/pharmacodynamic science informs dosage recommendations?	F. Pea (Udine, Italy)	18.09.2010	1158
The changing epidemiology of MDR-TB in Europe	G. B. Migliori (Tradate, Italy)	23.10.2009	1151
Non-antibacterial management of LRTI	A. Sachs (Utrecht, the Netherlands)	19.09.2008	1108
Does hygiene have a place in the prevention of LRTI?	J. Enstone (Nottingham, UK)	20.09.2008	1088
Debate: bacteria are a cause of acute bronchitis—'Con'	R. Wilson (London, UK)	04.10.2008	1039

COPD, chronic obstructive pulmonary disease; LRTI, lower respiratory tract infections; MDR-TB, multi-drug-resistant tuberculosis

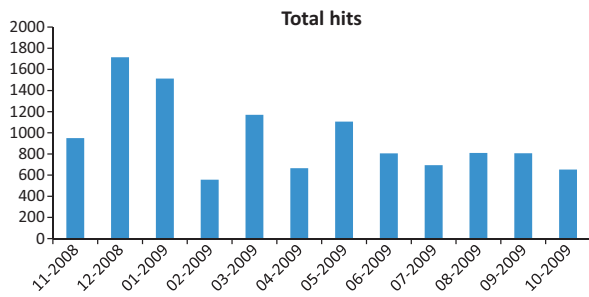


FIG. 3. Chronology of hits for Third GRACE Workshop, Cambridge, UK (September 2008).

educational curriculum. Indeed, the collaboration of these two professional societies in topics of common interest has helped to create greater awareness of the complex nature of LRTI within both societies and has led to unanticipated synergies relevant to the science and practice base for its management.

The e-Learning platform has extended the reach of the GRACE educational programme far beyond the numerical attendance by delegates. It has also provided a resource that has the potential for multiple applications. These include individual access and downloads for personal learning; free access to resources to support independent teaching activities such as lectures, WSs, seminars, course work and case discussions; the content can also be used to develop articles for translation and publication in non-English-language journals.

By including original research outputs from the GRACE project, new information can be promptly and widely disseminated and also be debated and contextualized within the various areas of science and clinical practice linked to the broad focus of this European Union-funded project.

With regard to the future, the GRACE consortium will continue to function within the recently launched TRACE project (TRACE, Translational Research on Antimicrobial resistance and Community-acquired infections in Europe 2011–2016, www.esf.org/trace), which is funded by the European Science Foundation [7]. This will enable the GRACE researchers to continue to collaborate and build on the results of the GRACE database. Hence, the experience gained from the educational activities described in this paper will be important in furthering fresh insights into the field of lower respiratory tract infections, their treatment and the interrelated topic of antimicrobial resistance.

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Author Contributions

RGF was co-director of the education and training project and contributed to curriculum development, manuscript preparation, and WS and postgraduate course development. FB was co-director of the education and training project; lead link with European Respiratory Society and e-Learning portal and contributed to curriculum development, and workshop and postgraduate course development. TV was primary-care research lead for the project and contributed to curriculum development, and workshop and postgraduate course development. HG was GRACE project coordinator and *Newsletter* development and content supervisor. SC was responsible for *Newsletter* editorship and was key link with outputs of the GRACE Work package 12. KL was responsible for GRACE project management and administration. GR contributed to workshop and postgraduate course development and e-Learning portal development. HS was workshop and postgraduate course co-ordinator and contributed to organizing the e-Learning portal and creation of the 'Mindmap' search tool. MA was lead link with the European Society of Microbiology and Infectious Diseases and contributed to curriculum development and workshop and postgraduate course development.

Transparency Declaration

None to declare.

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