

REVIEW

IMMUNOLOGY FOR CLINICIANS: A 'TROJAN HORSE' APPROACH*

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A South African website imparts basic immunology information to clinicians and other health care workers.

To determine how a program for learning immunology could be most useful for clinicians in South Africa, we consulted with the country's 20 leading HIV specialist pediatricians. They told us that immunology and its underlying concepts were perceived to be complex and arcane and that there was a need for immunology to be better integrated into "real-life" clinical practice. Most saw immunology as predominantly a laboratory science with little application to clinical practice; this highlighted a gap between clinical management of patients and theoretical understanding of the etiology and immunopathogenesis of disease. We speculated that one of the possible reasons for this perception and knowledge gap is that immunology is not an independent discipline within the South African medical curriculum. Instead, it is diffusely integrated into disciplines such as pathology or internal medicine and is not specifically provided for during post-degree training.

We initially developed the project Immunopaedia (www.immunopaedia.org) to help bridge the knowledge gap between laboratory research and pediatric HIV clinical science. The rationale for Immunopaedia was based on the paradox between the void in knowledge of immunology among HIV infectious disease clinicians and the need to understand and treat the HIV epidemic in South Africa. South Africa has one of the fastest-growing HIV epidemics with over 5.5 million people living with HIV, many of whom are young children and women (1). The 2008 national population-based surveys estimated HIV prevalence at 16.9% (2). Provision of treatment and care for such a large population makes it hard for HIV clinicians to stay informed about the latest developments in infectious disease. Immunopaedia was thus created to provide an easy-to-understand summary of the effects of HIV infection on the immune system, which could facilitate improvement in clinical practice. Immunopaedia has since progressed to include more general immunology knowledge that is relevant to other disease conditions. We use a clinical case-based perspective to target interns in multiple clinical specialities. Immunopaedia is an alternative to more advanced online immunology studies that target the basic-science student (3). Information and educational materials are available through open access, and the site can be used as an adjunct to more formal courses or as a stand-alone learning tool.

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Trojan Horse approach. Immunopaedia uses a case study to lure clinicians into learning immunology. Shown are the steps followed for each case before posting on the Web site. The case is used to underpin an immunology concept.

Our main method is what we have termed the "Trojan Horse" approach. Derived from the Greek *Iliad*, "Trojan Horse" has come to mean any ploy or scheme used to insinuate a rival into a securely protected stronghold. We use clinical case studies as our Trojan Horse to tempt clinicians, most of whom consider immunology to have little application to clinical needs, to engage with immunological concepts relevant to diagnosis and treatment (see the figure, above). We explain the key immunological points related to the cases by means of a series of graphics.

The Web site consists of three key components: Clinical Cases, Immunology Learning, and Treatment and Diagnostics. At present, 34 clinical cases are available on the site. In addition to HIV, clinical cases span topics such as hypersensitivity, tuberculosis (TB) immunopathology, primary and secondary immunodeficiencies, drug responses, gastrointestinal disorders, autoimmunity, and malignancies. Each of our cases is used to examine an immunological concept that leads to greater understanding of the human immune system. For example, a case of a 14-year-old boy presenting with severe hip pain allowed us to discuss ankylosing spondylitis and to explore the concept of mimicry and the "arthritogenic peptide" hypothesis. The case of repeated apnea and infections in a premature infant allowed us to highlight "physiological immunodeficiency" caused by impaired humoral and cellular responses in premature infants, a situation that leaves such infants vulnerable to both viral and bacterial pathogens. Another presenting case was an 8-month-old boy with recurrent infections. We explored the most likely hypothesis, that the mother had a primary HIV-1 infection during pregnancy in the third trimester and that the child was infected perinatally before maternal seroconversion. These are real-life cases, and in the last-mentioned case, as often in real life, the underlying immunological problem may not be clear.

Each case discussion provides, in consecutive windows, patient presentation, history, differential diagnosis, examination, investigations,

discussion, treatment, and a final outcome. Related case studies are cross-referenced. Users then evaluate their knowledge and understanding of the concepts in the case study by means of questions accompanied by explanations. To earn the full quota of continuing medical education (CME) points, the user can complete five multiple choice questions for each case study that are freely available but require log-in information. Integral to our approach with each case study is the use of clear graphics to explain the immunological basis and mechanisms underlying the condition. The graphics can be downloaded freely as a PDF and used for offline reference or for further teaching tools.

The second key component, Immunology Learning, is divided into three main areas: "Immunology" (dealing with the basics), "Childhood Diseases and Vaccinations" (dealing with hypersensitivity reactions and immune reconstitution, for example), and "Infections" (dealing with a range of infections from rickettsia to Guillain-Barré syndrome).

The third key component, Treatment and Diagnostics, covers information related to TB and antiretroviral (ARV) drugs, modes of drug action, the HIV life cycle, and specific guidelines for treatment. The "Diagnostic Tools" section provides laboratory assay information, such as enzyme-linked immunosorbent assays (ELISAs), polymerase chain reactions (PCRs), and flow cytometry.

Immunopaedia provides links to other Web sites that focus on medical and general aspects of HIV, pediatrics, and treatment guidelines. The design of the Web site is such that the user can easily find a source of information in the form of a case study, a graphic, or a scientific article on specific immunological conditions. In addition, breaking scientific news on clinical immunology is posted on the home page and is updated daily. Registered users are sent a monthly newsletter that coincides with a monthly clinical case study posting.

For the clinical case component, medical practitioners submit case studies from their clinics. Our team of clinical and immunology experts reviews and modifies these case studies for presentation on the Web



Workshop participants evaluate case study material. Participants of workshops come from tertiary teaching hospitals within South Africa and include interns specialising in paediatrics, pathology, and internal medicine.

site (see the first figure). The rationale behind this approach is that case studies from, or closely related to, real situations are effective learning tools (4). The case-study approach is a form of experiential learning; it integrates practice, knowledge, and skills that further equip clinicians in their professional work (5). As the user reads through the case study on the site, dividing the case study into stages in separate windows, the user is challenged to think about and predict a possible diagnosis based on the clinical evidence he or she has just read. This process is similar to the way a clinician might operate on the job, and the approach fosters lateral and critical thinking, as well as self-guided learning (6).

Immunopaedia also includes a workshop component as a follow-up to the online material (see the second figure). We use the workshops to evaluate our new case-study material before posting it on the Web site, and our teaching team travels to medical schools within South Africa to hold 3-hour sessions for medical interns who are specializing in pediatrics, pathology, or internal medicine. The aim of the workshops is to create greater awareness and increased use of Immunopaedia as a learning site for clinical immunology.

The monthly average number of unique users was 320 in 2007; 1518 in 2008; 2326 in 2009; and 1723 in 2010 (through June). Since the site first went live, we have received a total of 87,550 visitors, of which 11,520 have spent more than 5 minutes on the site. Each user who completes a case study earns three CME points, and in total, we have awarded 699 CME points over 3 years. We currently have 892 registered users.

Future directions for Immunopaedia involve the expansion of our user base to include point-of-care clinicians for the ARV drug roll-out in South Africa. We will use clinical case studies to highlight common diagnostic decision points as a mechanism to educate clinicians on laboratory tools and interpretation of results. Immunopaedia is an immediate source of information for professionals and represents an effective means for learning and dissemination of immunology information. Our aim is to integrate immunology into clinical options for patient management.

ABOUT THE AUTHORS

Clive Gray, founder of Immunopaedia, has a PhD in immunology and conducts research on HIV/AIDS in South Africa. He received the Elizabeth Glaser Pediatric AIDS Foundation International Leadership Award, which has allowed the development of Immunopaedia. Shayne Loubser writes the immunology materials and produces the computer-generated graphics for each case study. Carina Kriel is the curator and coordinator of the Web site and oversees all administrative aspects. Monica Mercer (not pictured) holds an MD and is a clinical materials writer and leads the development of educational materials. Heather Brookes (not pictured) has a PhD in language, literacy, and culture and is a consultant for Internet learning. From left to right: Shayne Loubser, Clive Gray, and Carina Kriel.



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7. Immunopaedia (www.immunopaedia.org/) initially received funding through the Elizabeth Glaser Pediatric AIDS Foundation International Leadership Award to C.M.G. in 2004. We have also received funding through South African educational grants, as well as grants for implementing new learning technology, through the National Institute of Allergy and Infectious Diseases, NIH. Immunopaedia is a result of collaborative ventures with many clinicians and scientists.