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American Gastroenterological Association Future Trends Committee Report: The Application of Genomic and Proteomic Technologies to Digestive Disease Diagnosis and Treatment and Their Likely Impact on Gastroenterology Clinical Practice

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The American Gastroenterological Association (AGA) Future Trends Committee was created in 2004 to further the AGA Strategic Plan by identifying and characterizing important trends in clinical practice and scientific-technological developments in the world in general and medicine and gastroenterology in particular that potentially will impact the AGA and/or its members in the coming 3–5 years or beyond and to make strategic recommendations to the Governing Board on how AGA should deal with those trends and developments. These trends and developments may be economic, demographic, practice-based, scientific/technological or political in nature.

Specifically, the committee is charged with preparing a report (or reports) for the AGA Governing Board that describes the trends or developments it has identified, postulates their impact on gastroenterology practice and/or research as appropriate, and presents specific recommendations for action by the AGA in terms of policy and programs. The committee is also asked to monitor these trends and technologies as they play out over time.

In July 2004, the AGA Leadership Cabinet suggested several topics that the Future Trends Committee should address. Realizing that the Future Trends Committee could not realistically consider all of them, criteria were developed to prioritize the topics and others that might be added in the future. These criteria were as follows:

- Time variable, that is, "when will gastroenterology be affected?"
- Scale and magnitude
- Does the trend or development represent a threat or opportunity (or both) to gastroenterology?
- Effect on patient care quality and safety
- Effect on AGA members and the AGA per se
- Implications to reimbursement
- Impact on gastroenterologists' training and education.

In October 2004, a crude Delphi process was used to determine the trends and developments that should be the focus of the committee's work. Committee members were asked to assign priority scores to the items in the following list, which was based on the suggestions of the Leadership Cabinet and supplemented by AGA staff and others. This process was done via the mail.

- The application of genomic and proteomic technologies to digestive disease diagnosis and treatment
- Major changes in the US health care system and reimbursement
- Increased median age of the population
- Changes in the ethnic and racial makeup of the US population
- Patients' involvement in their own care
- New colorectal cancer screening and diagnostic technologies
- Biomedical research funding changes
- Changes in academic health centers
- Changes in physician education and training
- Obesity-related disease incidence and prevalence
- Computerization and digitization of gastroenterology practice

Abbreviations used in this paper: AGA, American Gastroenterological Association; BE, Barrett's esophagus; CS, celiac sprue; CUC, chronic ulcerative colitis; FAP, familial adenomatous polyposis; GI, gastrointestinal; HGP, Human Genome Project; IBS, irritable bowel syndrome; kb, kilobase; LD, linkage disequilibrium; MALDI-TOF, matrix-assisted laser description ionization-time-of-flight; MS, magnetic sectors; NHGRI, National Human Genome Research Institute; PCR, polymerase chain reaction; PSC, primary sclerosing cholangitis; SNP, single nucleotide polymorphism.

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Committee members were asked to score each item against each of the priority criteria noted previously using a scale in which 1 represents large effect and 3 represents small effect (on gastroenterology practice and research). The total scores of each topic were then summed and ranked. The 4 highest priority scores that resulted from this ranking were as follows:

New colorectal cancer screening and diagnostic technologies
Obesity-related disease
Aging of the population
Genomic and proteomic technologies.

Because the AGA was already investigating the ramifications of the obesity epidemic, the Future Trends Committee decided to concentrate on the other 3 topics.

The committee determined that preparing the 3 reports on its own was not feasible. Hence, it decided that it would solicit proposals from potential qualified authors to draft the reports and would modify and supplement the drafts as necessary. A request for proposal was prepared and disseminated in December 2004. The authors, who were paid for their work, were chosen by the committee from among the responses to the request for proposal. The manuscripts submitted by the authors were reviewed by the committee in February 2005. Among the changes to the draft reports were recommendations for action by the AGA; these were developed primarily by the committee. At its review meeting, the committee also developed a uniform format for the 3 reports. Revised manuscripts based on the committee's critiques were completed in March 2005. The committee also had each report evaluated by an outside expert reviewer for completeness and to ensure that the authors had not made any egregious error that may have been overlooked.

This report represents the committee's recommendation for action by the AGA on this important topic. However, it is not the committee's final word on the topic. Genomic and proteomic technologies will advance rapidly over the coming years, and the committee will revisit this subject periodically.

Executive Summary

Medicine is on the verge of an unprecedented prospect as a result of advances in the discipline of genomics and recent progress in the emerging field of proteomics. Human genomics is the study not just of single genes but also of the functions and interactions among all genes in the genome of humans. The significant evolution that has occurred in genomic science over the past 5 years holds promise to change our ability to better understand, diagnose, treat, and potentially prevent human illness. This unique opportunity stems from the completion of the Human Genome Project (HGP) and the development of novel technologies, several of which involve high-throughput automated assay systems (ie, genotyping platforms) and the application of bioinformation science (ie, bioinformatics). In a similar vein, the discipline of human proteomics is the study of the interactions among the various constituents of the entire proteome of humans. Human proteomics represents an extension of traditional biochemistry coupled with novel technologies (ie, tandem mass spectrometry) that seeks to take a more global approach to the assessment of the library of proteins specific to humans and understanding these proteomic relationships to health and disease.

Because of the inevitable interconnection of the genome and proteome, genomics and proteomics should be viewed as complementary, rather than antagonizing, scientific fields. Nevertheless, the structure and function of the human proteome are far more complicated than those of the human genome. Simply stated, the genome (ie, genomic DNA) is a static, unwavering entity regarding its sequence and own duplication. In contrast, the proteome is a dynamic, ever-changing unit. For instance, the protein expression profiles in different human cells are highly variable, dependent on external or internal stimuli, not to mention the unique protein expression during the distinct stages of a person's life cycle. In contrast, the genome of each human cell remains, in general, steady and unaltered over generations.

To date, genomic science has mainly dissected the single-gene inherited diseases known as Mendelian disorders. Yet, the greatest promise and impact of genomic and proteomic research lie in their future application to complex or multifactorial diseases. In antithesis to Mendelian disorders, complex diseases arise due to the interplay of multiple genetic variants with environmental factors. Currently, the science and technology of human genomics greatly exceed the discipline of proteomics with respect to research discoveries and applications on science and influence on medical practice. The ultimate question addressed in this report is whether genomics, along with proteomics, will have an impact on future gastroenterology and hepatology clinical practice. Although we are unable to easily articulate a comprehensive answer to this vital and multifaceted question, we believe that genomics and proteomics hold vast potential and almost certainly will shape the way we diagnose and treat patients with digestive and hepatic disorders in years to come.

For eons, humans have understood that heredity, along with the environment, shape our phenotypic diversity and contribute to disease. Yet, it was not until 2003 that the