turers work with a focus group of RGC individuals to identify colors or combinations of colors that are indistinct so that future versions of this software could eliminate certain colors or "lock-out" certain color combinations. It is hoped that this information will raise awareness of this problem and result in a change that will make slide presentations more informative for all.

Marc S. Williams, MD
Gundersen Lutheran Medical Center
La Crosse, Wisconsin

Janet L. Williams, MS
La Crosse Regional Genetics Services Project
La Crosse, Wisconsin

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To the Editor:

In recent years, computer technology has seen advances which have had a major impact on the practice of medicine. Telemedicine in particular has been revolutionary, allowing efficient and fast transfer of text and image data for consultation, collaboration, diagnosis, and other aspects of patient care to geographic areas without on-site resources for specialized services.

Clinical genetics has been one of the beneficiaries of computer advances and Internet development. A wealth of resources is available on the Internet for the clinical geneticist; a vast number of sites display specialized information, including search engines, list servers, patient support services, and online conferencing.

Clinical cytogenetics has also recently moved into the area of telemedicine consultation and imaging.¹ Internet transmission of high-resolution karyotypes and FISH images provides a valuable electronic tool. Pictures can be downloaded from an imaging system onto a floppy disk and e-mailed after removal of patient identifiers. They can be viewed with a simple graphics program and the results quickly reported via return e-mail or telephone. This remote case review by the laboratory director or a designee solves the majority of laboratory coverage programs and maintains turnaround time and efficiency. In addition, it provides immediate karyotypes or FISH images when consultation is needed. E-mailing of images allows shar-

ing of data among colleagues regardless of differences in computerized image software. This is a particularly welcome innovation, as coverage for cytogenetics services when the director is absent has historically been problematic and a cause of increased turnaround time and laboratory costs. Moreover, future diagnostic services (including genetics) may require the collaboration of geographically separate centers involved in the care of individual patients² and certainly will include electronic transfer of images such as karyotypes into the patient chart.³

Our laboratories have used e-mail transmission of karyotypes and FISH images for two purposes: providing remote laboratory coverage when the director is off-site and providing remote consultation for karyotype interpretation. This transmission can be accomplished easily and inexpensively in any laboratory using a digital imaging system, regardless of differences in computerized image software. Images from a given case, with patient accession number only (other identifiers are removed), are downloaded from the imaging system to a floppy disk or other portable media in a widely readable format such as a tagged image file format (.tiff) file. The disk is then inserted into a personal computer and the graphics files are sent to the recipients as attachments to an e-mail message. Relevant clinical information is included in the e-mail text, also with patient identifiers removed or encoded. We have also found it useful to fax a copy of the "count sheet" for each case when practical, although such data could also be incorporated electronically.

To speed transmission, files can be compressed using a program such as WinZip. Problems opening files on the recipient personal computer or Macintosh are easily resolved with a conversion program or small graphics program, both of which can be downloaded from Internet shareware sites without charge (e.g., www.bsoftware.com; www.shareware.com). A graphics program also allows on-screen editing and manipulation of chromosomes when solving structural and numerical questions. No specialized software or Web site access is necessary. When a case requires further microscope work, additional or partial karyotypes can be prepared and e-mailed. These, along with telephone consultation, allow resolution of almost all cytogenetic diagnostic problems. In addition, results are reported via return e-mail, telephone, or fax. In our laboratories, files of all e-mailed cases are reviewed when the director returns.

In our experience, image resolution on a standard computer monitor is comparable with that of a printed digitized image from a karyotyping system and allows chromosome visualization at the 500- to 600-band level. A high-resolution monitor is not necessary. FISH images transmit with equally good clarity. In three years of utilizing this system and reviewing several hundred cases, no diagnostic errors have been found.

Remote case review by the laboratory director or designee solves the majority of laboratory coverage problems and maintains turnaround time and efficiency. In addition, it provides immediate karyotypes or FISH images when consultation is needed. Internet access is not necessary, although future tele-

medicine diagnosis may involve Web-based real-time conferencing nationally or internationally with expert cytogenetics consultants and access to reference cytogenetics databanks.

The world of "cybercytogenetics" is expanding and necessitates quality assurance guidelines for diagnosis, privacy, and liability. These should be addressed by the ACMG/CAP in a manner similar to that suggested by the American Telemedicine Association Special Interest Group for Telepathology.⁴ In addressing electronic multimedia communication between pathologists for the purpose of primary diagnoses and diagnostic consultation, they defined:

- Responsibilities of the pathologist (referring and consultation).
- Responsibilities of the technologist and technicians.
- Training and quality control.
- Documentation and archiving.
- Data integrity and security.

Because of the improvement in cytogenetic imaging systems, computer conferencing, lowered prices of computer components, and e-mail access, "cybercytogenetics" will play an increasing role in diagnosis and sharing of cytogenetics information. This will enhance access to genetics services in medicine and provide for efficient, cost-effective coverage and consultation in these times of escalating professional demands and diminishing resources. Guidelines for quality control, le-

gal issues, and medical issues should be addressed by appropriate national and international agencies.

Kathleen Harrison, PhD

AHS/Morristown Memorial Hospital
Morristown, New Jersey
Columbia College of Physicians & Surgeons
New York Presbyterian Hospital
New York, New York

Dorothy Warburton, PhD

Columbia College of Physicians & Surgeons
New York Presbyterian Hospital
New York, New York

Angela Retano, MA

College of St. Elizabeth
Convent Station, New Jersey

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