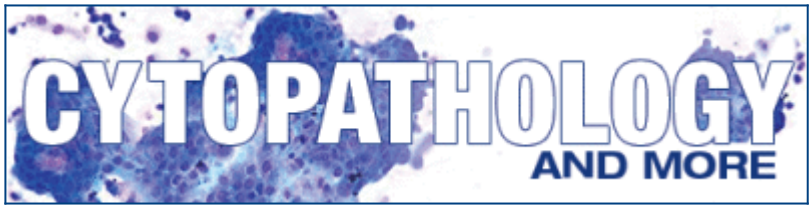
Cytopathology and More | Cytopathology at the tipping point



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May 2014—A tipping point implies a point of no return, a monumental change in the status quo, a transformation that leads to a new paradigm. Malcolm Gladwell, in *The Tipping Point: How Little Things Can Make a Big Difference*, popularized the term and defined it as "the moment of critical mass, the threshold, the boiling point."[1] Tipping points bring both positive and negative consequences; they are a time of change and opportunity. Such is the position that cytopathology finds itself in today.

A major factor presaging the future in cytopathology practice is the closure of cytotechnology schools. With the economic crisis and amid high unemployment rates and tightened budget belts, universities and hospitals that once sponsored cytotechnology and other laboratory science programs to provide a continuing supply of trained laboratorians have taken a second look at the cost of training and decided to cease investment in laboratory allied health education. Cytotechnology programs are often small and especially vulnerable, some with fewer than three students annually. Some administrators have incorrectly deduced that since changes in cervical cancer screening algorithms and use of HPV testing have reduced the volume of Pap tests in the United States, the need for cytotechnologists is less critical. The recent FDA application for an HPV platform by Roche to be used for primary cervical cancer screening may perpetuate this myth, but there is currently no consensus recommendation to switch to HPV tests without Pap tests. Executives and educators may be under the mistaken impression that Pap tests will be replaced by molecular testing, contrary to recent consensus guidelines for cervical cancer screening.[2] This has left several states critically short of cytotechnologists and some states without any cytotechnology programs at all. There are now only 30 active programs, down from a peak of more than 140 schools in the early 1980s, with 10 programs having closed since 2007 (Deborah MacIntyre Sheldon, cytotechnology education coordinator, American Society of Cytopathology, e-mail communication, October 2013).

Despite this radical reduction and low program recruitment (on average, 65 percent of positions are filled), student attrition is less than 10 percent, ASCP Board of Certification pass rates are over 95 percent, and student placement into positions is greater than 90 percent. Clearly these programs are doing something right. ASC's Deborah Sheldon says there is also a trend in cytotechnology toward higher education and more sophisticated training programs—only 11 programs offer a certificate-only program whereas 10 offer a certificate and a degree, and 10 offer degrees only, with five of these offering a master's-level degree.

Cytotechnology programs are not alone in the attrition of facilities dedicated to training laboratory personnel. Medical technology programs have seen a loss of more than 400 programs over the past three decades. Histotechnology has been similarly affected. Streamlined funding models and tighter budgetary control by institutions have meant that programs could not be easily maintained by the largess of one or two senior people in a hospital or academic program. With progressive computerization of departmental finances, all numbers are on the table and education is an easy target for those seeking to make up shortfalls in other areas. Deans and chairs

in medical schools have been seeing diminished revenue from state and federal sources for more than a decade. They feel pressure to cut allied health programs to preserve the primary mission of educating physicians. Some programs have been saved by moving them from ancillary operations in academic or private hospitals to positions as actual programs in undergraduate/graduate college biology programs.

Weighing on the closure of cytotechnology schools is the perception that primary screening for human papillomavirus will replace the Pap test. However, the American Cancer Society, American Society for Colposcopy and Cervical Pathology, and American Society for Clinical Pathology guidelines for the prevention and detection of cervical cancer using Pap test screening,[2] and similar guidelines promulgated by other organizations,[3] have shied away from replacing the Pap test with molecular testing. Many patient advocate organizations, including the American Medical Women's Association and Our Bodies Ourselves, are urging caution regarding replacement of the inexpensive Pap test with more expensive HPV tests.[4] Although HPV tests are more sensitive, they are less specific, and could result in overtreating women for benign lesions (low-grade squamous intraepithelial lesion, or LSIL). HPV testing and surrogate molecular tests impart a statistical probability of having a high-grade squamous intraepithelial lesion or cancer. They do not detect these lesions. Molecular tests are dependent on sufficient cellular sample for detection of abnormalities, as are Pap tests, but have less well-defined adequacy controls. Factors such as blood and inflammation can skew molecular test results. Li, et al., have shown there is a nine percent false-negative rate for certain HPV tests in cervical cancer.[5] Finally, a positive molecular test might triage a patient to colposcopy, but colposcopy is much less sensitive for the detection of high-grade lesions than previously believed, and cannot detect precursor glandular lesions. Pathologists performing cytologic-histologic correlations recognize that biopsies often do not sample the lesion and are not an ideal gold standard for proof of disease.

"Triage" to a Pap test after a positive HPV test has also been suggested as an algorithm and might help identify glandular abnormalities, but the Pap test owes its success to short screening intervals, providing multiple chances to detect subtle and small squamous lesions in early stages of development. HPV tests should have greater than 90 percent sensitivity for detecting CIN2, 3 before being implemented for primary screening, but not all HPV tests are created equal, nor can they be expected to perform in a similar manner.

The literature on HPV testing is controversial and should be evaluated in light of costs to users and financial gain to manufacturers that promote such testing, in addition to the purely scientific benefit that such testing brings. Currently, FDA approval of HPV tests is not required and not all HPV tests are FDA approved, but the bar for high quality should be raised if implemented for primary screening. HPV tests are expensive, and inappropriate use of these tests and other molecular tests in conjunction with the Pap test have increased health care costs to society and the burden to the patient, sometimes resulting in a $1,000 Pap test.[6] Furthermore, Pap tests are recommended as the appropriate followup in women with colposcopic or confirmed low-grade squamous intraepithelial lesions, so in some situations, HPV testing cannot replace Pap tests.

A final argument for reducing cytotechnologist training is that HPV vaccines will eliminate cervical cancer. There is evidence from studies in Australia, where vaccine penetrance in the proper age group (sexually inactive girls) is high, that cervical cancer incidence is decreased.7 However, more than 40 HPV subtypes cause cervical cancer, and vaccines currently target only two high-risk types: 16 and 18. It is not yet known whether other HPV types will emerge to fill the ecologic niche left by reducing prevalence of HPV 16 and 18.

All of these arguments overlook the value of cytotechnologists in the laboratory as a pathologist's

extender. Cytotechnologists were the first technologists trained to visually inspect slides and detect cellular changes to free the pathologist of the need to do so. Screening is time-consuming and mentally fatiguing. Even with the implementation of longer cervical cancer screening intervals in women, HPV vaccines, and further reduction of cervical neoplasia, millions of Pap tests will still be performed annually in the United States, far more than pathologists alone could absorb. CLIA imposes restrictions on laboratories for cytology that prohibit individuals other than cytotechnologists and pathologists from performing these tests. The loss of cytotechnologists would shift their workload to the pathologists, who as "primary screeners" would be susceptible to the "100 cytology slides in 24 hours" CLIA restriction.8 Pathologists would have to assume the role of primary reviewer of these cases in the absence of cytotechnologists, even with the use of digital imaging. Evidence from the CAP Pap proficiency program has consistently demonstrated that pathologists are less skilled at detecting abnormalities on Pap tests than cytotechnologists, and primary screening pathologists are the most likely to fail initial proficiency testing.[9] It is increasingly evident that cytotechnologists add value in prescreening cytology and other specimens for the identification of abnormalities. In the CAP nongynecologic and fine-needle aspiration interlaboratory comparison programs, cytotechnologists perform as well as pathologists in identifying most lesions. In some cases, such as identifying small cell carcinoma on pulmonary specimens, cytotechnologists perform slightly better.[10]

Cytotechnologists are also increasingly employed to perform rapid on-site assessment, or ROSE, for specimen adequacy because the reimbursement for pathologists performing adequacy assessments has declined. (See "Rapid on-site evaluation—how practice varies.") When cytotechnologists perform on-site adequacy evaluation for thyroid aspirations, they demonstrate accuracy rates comparable to those of cytopathologists.[11] The importance of ROSE is increasing as more specimens require triage to molecular tests, such as EGFR, ALK, and BRAF, that allow for targeted therapies. With the evolution of molecular testing in surgical pathology and cytopathology, cytotechnologists remain the best equipped to assist pathologists in screening and evaluating tests that require enumeration of cellular details, such as evaluation of probe signals in fluorescence in situ hybridization, or FISH, studies.

Laboratories are expanding the role of cytotechnologists to enhance the pathologist's efficiency in other ways as well, including screening for and locating microorganisms on special stains, grossing small biopsies, evaluating adequacy of renal biopsies, enumerating tumor purity for Sanger sequencing, capturing and annotating digital images, and selecting slides for molecular tests. Digitization of cytological and histological samples is in our future. Pathologists have few other individuals to help them obtain, maintain, and control images. No other group of individuals has the morphologic training to know what constitutes a reasonable diagnostic image. Pathologists cannot rely on untrained information technology personnel to make critical decisions on images they cannot understand. If predictions about pathology are realized, pathologist practice requirements will increase while the supply of pathologists will remain the same. Cytotechnologists can fill in the practice gaps to ensure that quality pathology practice is maintained.[12]

What is the current situation for the cytotechnology workforce? According to the 2012 ASCP Vacancy Survey, the overall vacancy rate for cytotechnologist positions now averages five percent and the retirement rate is eight percent, one of the higher rates in the laboratory.[13] Anatomic pathology had the second highest anticipated retirement rate (nine percent) after immunology (10 percent) for overall employees, and cytology had one of the highest anticipated supervisor retirement rates (11 percent, with the rates by department ranging from four to 24 percent). The trend in consolidating Pap tests in larger laboratories has mitigated the impact of the dwindling cytotechnologist population, as has image-guided screening, changes in screening algorithms, and HPV testing. Corporate laboratories typically focus on Pap test screening alone without involving cytotechnologists in other duties, but this environment may not produce the highest job satisfaction and probably affects retention. The job market for cytotechnologists tends to be saturated around training centers, where graduates prefer to live. With changing algorithms for cervical cancer screening and greater ease of HPV testing, smaller laboratories have the opportunity to reclaim regional Pap tests. With needs for other functions, these smaller facilities will have a greater need for cross-trained technologists. Labs without cytotechnologists may find themselves seeking their services.

Five years ago, the cytopathology community recognized the impending crisis and predictable critical shortage of cytotechnologists due to school closures and sent out alarms to the pathology community through newsletters and editorials.[14-16] Some programs responded to fill national gaps by producing satellite programs in other states or by offering portions of their curricula online. Many universities have discontinued certificate programs, so cytotechnology programs were reformatted as degree-granting programs. Master's degrees provide cytotechnology graduates with opportunities for a broader scope of practice, including anatomic pathology laboratory management. Other programs partnered or combined with histotechnology, medical technology, or pathologists' assistant programs. Despite these heroic changes, cytotechnology training programs remain endangered.

In 2012, the CAP, recognizing the changing roles of cytotechnologists, partnered with the American Society of Cytopathology, American Society for Clinical Pathology, and American Society for Cytotechnology through the Cytotechnology Programs Review Committee to reform the cytotechnology curriculum. These organizations collaboratively formulated new core competencies that were approved by the Commission on Accreditation of Allied Health Education Programs on Oct. 23, 2013, to take effect July 1, 2014. The new competencies move well beyond Pap test screening and interpretation. Some of the new areas of emphasis are rapid on-site evaluation and triage of specimens; collection of clinical data pertinent to specimen interpretation; use of telecytology, image-based analysis, and informatics; theory and principles of molecular signaling detection and diagnostic oncology; use and application of companion diagnostics such as immunocytochemistry, flow cytometry, HPV testing, and in situ hybridization; and quality assurance, laboratory management, and process improvement. An ad-hoc resource subcommittee composed of representatives from these organizations convened to identify educational gaps and program resource deficiencies, oversee development of a shared educational Web site, and develop an implementation plan and timeline for programs to integrate new competencies.
One outcome of these efforts was the formation of an online Cytology Education Learning Laboratory (CELL) that contains learning modules on digital photography, billing and coding, FISH/CISH, HPV testing, IHC interpretation and troubleshooting, core biopsy interpretation, review of medical records, ultrasound-guided collection procedures, rapid on-site evaluation of specimen, workload recording, specimen triage, screening tissue for microorganisms, and proficiency testing preparation. The CELL will be available to cytotechnology schools to complement their curricula and fill curriculum gaps.

Cytotechnology programs have already made strides in transformation, mirroring the efforts of pathologists to remain relevant in the molecular era. Laboratories and pathologists can participate in this transformation by supporting local cytotechnology programs: provide educational resources, serve as a clinical training site, contribute financially, or serve as a political advocate to prevent program closure. Pathologists have a voice in state governments through their local state societies and through national organizations such as the CAP. Finally, laboratories can continue to expand the role of cytotechnologists through on-the-job training and continuing education. If you are interested in contributing educational materials to the CELL, contact Kelly Goodrich at kgoodri@cap.org.

Have we reached a tipping point in cytopathology? Probably, but probably for the best. Laboratories may have fewer cytotechnologists, but with a wider scope of practice, they will be more qualified to partner with pathologists to provide an efficient, cost-effective work environment to usher in the molecular era.

1. Gladwell M. *The Tipping Point: How Little Things Can Make a Big Difference.* Boston: Little, Brown and Co, 2000.
2. Saslow D, Solomon D, Lawson HW, et al. American Cancer Society, American Society for Colposcopy and Cervical Pathology, and American Society for Clinical Pathology screening guidelines for the prevention and early detection of cervical cancer. *J Low*

Genit Tract Dis. 2012;16(3):175–204.
3. Moyer VA. U.S. Preventive Services Task Force. Screening for cervical cancer: U.S. Preventive Services Task Force recommendation statement. *Ann Intern Med.* 2012;156(12):880-891, W312.
4. Perrone M. DNA alternative to Pap smear sparks medical debate. Associated Press, Washington; April 15, 2014.
5. Li Z, Austin RM, Guo M, Zhao C. Screening test results associated with cancer diagnoses in 287 women with cervical squamous cell carcinoma. *Arch Pathol Lab Med.* 2012;136(12):1533–1540.
6. Bettigole C. The thousand-dollar Pap smear. *N Engl J Med.* 2013;369:1486–1487.
7. Brotherton JM, Murray SL, Hall MA, et al. Human papillomavirus vaccine coverage among female Australian adolescents: success of the school-based approach. *Med J Aust.* 2013;199(9):614–617.
8. Clinical Laboratory Improvement Amendments of 1988; Final Rule. *Federal Register*. Feb. 28, 1992;57:493.1257.
9. Bentz JS, Hughes JH, Fatheree LA, et al. Summary of the 2006 College of American Pathologists Gynecologic Cytology Proficiency Testing Program. *Arch Pathol Lab Med:* 2008;132(5):788–794.
10. College of American Pathologists' Interlaboratory Comparison Program in Nongynecologic Cytopathology. 2011 Year End Summary Report. www.cap.org/apps/docs/committees/cytopathology/2011_ngc_program_year_end_summary.pdf. Accessed Dec. 10, 2013.
11. Olson MT, Tatsas AD, Ali SZ. Cytotechnologist-attended on-site adequacy evaluation of thyroid fine needle aspiration. *Am J Clin Pathol.* 2012;138(1):90–95.
12. American Society of Cytopathology Multidisciplinary Steering Committee on the Future of Cytopathology White Paper. Facing the future of cytopathology. Discerning the future needs of our profession. May 14, 2010. www.cytopathology.org.
13. Garcia E, Ali A, Choudhry S. The American Society for Clinical Pathology 2012 vacancy survey of clinical laboratories in the United States. *Lab Medicine.* 2013; 44(1):3–7.
14. Moriarty AT. Heads in the sand—or not? *CAP TODAY.* August

2008, 62–63.
15. Austin RM. Dismantling of the U.S. cytotechnology educational infrastructure is premature and carries significant risk. *Arch Pathol Lab Med.* 2008; 132(2):154–158.
16. Goulart RA. Cytotechnologists today: much more than "Pap-ologists" with schools in need of our support. *Am J Clin Pathol.* 2008;129(4):523–524.

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