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Breast screening is beneficial, panel concludes, but women need to know about harms

Breast cancer screening: new technologies for a new debate.

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The conclusions of the recent independent review on the harms and benefits of breast cancer screening programmes have reopened a decades-long debate, with concerns focusing on the considerable percentage of over-diagnosis occurring in screened women. (1)

However, this renewal of conflicting reactions may obfuscate one of the most significant remarks of Marmot and colleagues' report: we need improvements "to better distinguish between breast cancers that will or will not cause harm during a woman's lifetime." (2)

Therefore, I call the medical and policy-making community to focus discussions on furthering emerging innovative technologies to detect this neoplastic process, instead of just resuming debate about past screening programme results. Aspiring to direct the debate forward, I provide examples of two incipient technologies, microwaves and coded-aperture X-ray phase contrast imaging.

The majority of breast cancers are detected through imaging tools, with mammography, ultrasound and magnetic resonance imaging (MRI) the most common. Nonetheless, these studies are not definitive, present several limitations and deficits in the specificity, often leading to unnecessary invasive probing. (3) Moreover, in the early stages of the disease, subtle visual clues or overlapping patterns in the diagnostic images make it challenging for radiologists to definitively distinguish benign from malignant masses, affecting clinical management. (4)

Amid these concerns, research to improve accuracy and diminish limitations associated with current imaging techniques demonstrates great promise in the basic science arena. In this regard, in early 2012, I visited Queen Mary University and UCL's technological incubators, whose scientists are actively engaged in researching innovative breast cancer imaging applications, by using microwave and X-ray phase contract imaging, respectively.

Microwaves, non-ionizing and with relatively long wavelength, are able to deeply penetrate into optically opaque bodies including living tissue. Microwaves may have unique diagnostic properties; by recording the reflected waves scattered from cancers inside a body, an accurate 3D image of these regions can be reconstructed. (5) Microwave-frequency dielectric contrast between malignant and normal tissue may serve to detect abnormal masses and differentiate between benign and malignant breast tissue. (6) However, the breast tissue's electrical properties, layers of fat, and high water content, acting as the body's shields against microwave radiations, have traditionally constituted the main barriers to development of this technology. (7)

MediWiSe, an organization affiliated with Queen Mary University BioEnterprises, is intensively investigating obstacles and clinical application of this technology. According to Dr. George Palikaras, MediWiSe's CEO, "the short microwave's penetration depth, the possibility to compress the soft tissue—hence to reduce the wave's propagation path—, the use of non-harmful radiation, and the ability to detect an optimal 3-mm lump size are promising features for a new, preliminary, inexpensive, diagnostic option for breast cancer mass-screening."

While this technology targets screening of a young, low-risk population, another innovation, coded-aperture X-ray phase contrast imaging (XPCi), may offer reliable diagnostic support for those women at high risk of breast cancer. Dr. Alessandro Olivo, the inventor of the XPCi method at UCL, describes this innovative approach as "a fascinating method, which can potentially transform all applications of X-ray imaging. It utilizes refraction and interference—instead of conventional attenuation—to generate image contrast." This technique allows enhanced visibility of small details in living tissues (8) and enables detection of breast tissue pathological features hardly visible with conventional devices. As Olivo says, "Due to the demanding requirements XPCi imposes on the radiation source, the main barrier was that this imaging modality was delimited to just synchrotron facilities, where it has been proven to successfully detect breast neoplastic formations."

Olivo's method works with a conventional X-ray source like those used in hospitals; it thus overcomes this "environmental" limitation and could make clinical implementation of XPCi achievable for the first time. (9) If successful in emulating encouraging clinical trial results achieved with synchrotron light sources (10), this technology may provide an incredible opportunity to advance diagnostics for breast cancer. XPCi could therefore change the way in which breast cancer is typically diagnosed, rendering conventional mammography obsolete, yet possibly without incurring the high false positive numbers of MRI.

Breast cancer is one of the most common cancers among women worldwide, with approximately 1.3 million new cases diagnosed and 450,000 deaths annually. (11) Imaging studies, already important in detection, diagnosis, and clinical management of breast cancer, will become increasingly relevant as new therapies are developed to treat both localised and widely metastatic disease.

We must then accurately convey and debate the harms and benefits of current imaging screening programmes. We must also promote further future approaches. While health care policy must be based on facts, it must also be supported with innovative technologies. If not, policy setting and implementation is in jeopardy of becoming a process subject only to critical evaluation and evidence gathering, giving insufficient consideration to technological advancements.

The significant limitations of breast cancer traditional imaging methods underscore the importance of pursuing discussion on the utility of promising breakthrough technologies, including microwave and XPCi, from their early developmental stages. Such innovations may create room to rethink the best age for and frequency of screening, establish new screening programs, reduce over-diagnosis, over-treatment (and costs) of breast cancer, and ultimately have a profound effect on both social understanding and medical practice.

It will take significant time, scientific and economic investments to determine the ultimate role for new technologies in the screening and detection of suspicious breast masses. Most importantly, it will require the full support of clinical practitioners, policy-makers and the greater community. Embracing development of novel breast cancer imaging tools going forward must become the core of a new debate: only collaborative progressive research, innovative thinking, and policy implementation well serve to roll back the mortality from this devastating illness.

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