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A Role for Science in Public Policy? The Obstacles, Illustrated by the Case of Breast Cancer Screening Policy

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Abstract

A coherent and helpful public policy based on science is difficult to achieve for at least three reasons. First, there are purely practical problems—for example, that scientific experts often disagree on policy-relevant questions and their debates often continue well beyond policy appropriate timelines. Second, there are epistemic problems—for example, that science is hardly the neutral supplier of factual information (free of contested social values) that traditionally has been supposed. And third, there are social problems: given the commercialization of today's science and its enduring limitations (sexism, racism, homophobia, ableism, etc.), much of scientific research today fails to meet the moral and political standards one would expect it to meet in order to inform public policy. In this paper, we examine such

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problems in the context of breast cancer screening policy and suggest the role philosophy of science should play in dealing with the situation.

Keywords
science for policy, breast cancer policy, mammography screening, science and values, democratization of science

Science-based Policy: The Obstacles

October is Breast Cancer Awareness Month all over the world, yet the confusions surrounding breast cancer are as pervasive as ever. Should women of all ages do monthly breast self-examinations? Should they have annual clinical breast examinations as well? Should they also have mammograms every year? Every other year? Every third year? And, if so, at what age should these begin, and at what age cease? Finally, how should the ever-smaller lesions these mammograms uncover be treated? The health policies dealing with these questions vary from country to country and even from medical organization to medical organization within the same country.[1] So why wouldn't women be confused? Science, of course, was to settle such questions in a uniform way, worldwide—in as uniform a way, worldwide, as the international Breast Cancer Awareness Month itself. So, why hasn't it done so?

There are many reasons a coherent and helpful science-based health-care policy, or in fact any other science-based policy, might be difficult to achieve.[2] One reason relates to purely practical issues. Scientific experts often disagree on questions of vital importance to policy, and their debates can continue well beyond policy appropriate timelines.[3] And even when experts do not disagree, the results of their inquiries may fall far short of the level of certainty demanded by policy makers or their results may take a back seat to other kinds of considerations. (The way governmental policy in some countries has essentially ignored or dismissed the consensus of climate scientists and instead privileged economic goals offers a painful example of both possibilities). What's more, in many cases conflicting lay expertise has seemed as relevant, or even more relevant, as scientific expertise to the formation of sound policy and, sometimes, in fact, *is* more relevant (probably the most famous example of lay expertise correcting the faulty assumptions of scientific experts is Brian Wynne's 1990s studies of Cumbrian sheep farmers—see, e.g., Wynne 1996—but recent examples

abound; see, e.g., Suryanarayanan and Kleinman 2012, 2016). Science can even make policy deliberations more rather than less intractable. Some have suggested, for example, that policy deliberations must often be "descientized" in order to become manageable, given that policy deliberations often involve different scientific specialties, and these specialties can bring with them different, even incompatible, interests, methods, and standards of proof as well as different, even incompatible, bodies of knowledge (Sarewitz 2004; cf. Collingridge and Reeve 1986; Sarewitz 2006). So, practical problems can definitely thwart science-based policy in a variety of ways.

A second reason a coherent and helpful science-based policy might be difficult to achieve relates to more straightforwardly epistemic concerns. Expecting science to play a definitive role in the formation of policy has traditionally presupposed that science can be a neutral arbiter of policy questions, a neutral supplier of factual information. But science is simply not like that. As already stated, different scientific specialties often bring with them different, even incompatible, interests, methods, and standards of proof as well as different, even incompatible, bodies of knowledge. Even the same specialty can exhibit such differences: think, for example, of the different methods (translational medicine, evidence-based medicine, consensus conferences, narrative medicine) sometimes used in medical research to answer the same questions (see, e.g., Solomon 2015). And such differences can yield conflicting policy recommendations with no defensible way to resolve the conflicts. What's more, philosophers, historians, and sociologists of science have shown, over the last several decades as well as times long past, that science is shot through with social (e.g., moral, political, and cultural) values that shape everything from research questions, concepts, and hypotheses to the communication and application of research results (Neurath 1913; Rudner 1953; Hempel 1960; Longino 1990, 1995; Kitcher 2001; Dupré 2007; Douglas 2009; Kourany 2010). Even the dichotomy between facts and values has been challenged (see, e.g., Putnam 2004; Dupré 2007, but also Dewey 1938; Anderson 2004). And all this has undercut the authoritativeness of the information science might offer and hence the significance of a science-based policy.

A third reason a coherent and helpful science-based policy might be difficult to achieve relates to this value-laden aspect of science—more specifically, to the particular values that inform much of science today. To put it bluntly, much of science today simply fails to meet the moral and political standards one would expect it to meet in order to inform public policy. This is the unmistakable message of recent science studies

scholarship regarding the commercialization of science—regarding, for example, the effects of the new intellectual property laws and the privatization of science, the pervasive conflicts of interest of researchers and the difficulty of finding independent researchers with no industrial ties, the creation of new research structures and publication strategies such as contract research organizations and ghost authorships, the outsourcing of research to low-wage countries with weaker regulatory environments, and so on (see, e.g., Angell 1997; Krimsky 2003; Slaughter and Rhodes 2004; Mirowski and Van Horn 2005; Greenberg 2007; Elliott 2008; Michaels 2008; Bok 2009; Sismondo 2009; Kukla 2012; Proctor 2012; Stephan 2012; Biddle 2014). In short, recent science studies scholarship reveals a science increasingly skewed toward private commercial gain and away from the public good.

In addition, feminist science studies scholarship reveals the sometime sexist or racist or classist or homophobic or ablest values of scientists themselves and the research practices and systems of knowledge they have inherited from an even more biased past. Relevant here are studies of the exclusionary structures even highly privileged women scientists of the past had to deal with as well as the obstacles their contemporary sisters (and many of their brothers) still face, and the methodological and conceptual shortcomings of science these exclusionary structures have produced. Relevant, as well, are studies of the hierarchies—gender, racial, class, and cultural—that have been constructed by society, then naturalized by fields such as anthropology, psychology, and biology, and then used to justify those exclusions (see, e.g., Keller 1985; Harding 1986; Schiebinger 1989; Fausto-Sterling 1992; Kourany 2002; Jordan-Young 2010; Roberts 2011).

All this science studies scholarship exposes a gap between the ideal role that science was expected to play in informing public policy—a role closely related to the search for the public good and the common welfare—and the actual character of the science now available for policy-making. And it is far from obvious that this actual character now enables science to play a helpful role in the formation of policy, especially in liberal democracies.

Breast Cancer Screening Policy as Illustration

So, there are at least three reasons a coherent and helpful science-based policy might be difficult to achieve, and these reasons relate to three sorts of problems—practical, epistemic, and social. What's more, all of these problems seem to beset the case of breast cancer. Take, for example, the issue of screening mammography policy for women at average risk[4]—an issue that

continues to be at the center of controversy.[5] Fueling this controversy are eight randomized screening mammography trials, the total that have been conducted in the world to date. Four were conducted in Sweden: the Two-County trial (Tabár et al. 1985), the Malmö trial (Andersson et al. 1988), the Stockholm trial (Frisell et al. 1991), and the Gothenburg trial (Bjurstam et al. 1997). Two, referred to as the Canadian trials, were conducted in Canada as part of a nationwide initiative (Miller et al. 1992). And one was conducted in New York (Chu, Smart, and Tarone 1988) and one in Edinburgh (Alexander et al. 1999). Conclusions regarding these trials range from the view that screening mammography fails to save the lives of any women at average risk of breast cancer and should therefore be discontinued all the way to the view that screening mammography is the most important tool we have for catching breast cancer at highly curable stages and should therefore be used on a regular basis for all women starting at the age of forty and for high-risk women starting much sooner.

Prominent on the one side, for example, is the Cochrane Collaboration, an international not-for-profit network of scientists from over 120 countries, which prepares systematic reviews of primary research in human health care and health policy. In 2000, Danish Collaboration researchers Peter Gøtzsche and Ole Olsen published a meta-analysis in the *Lancet* of the eight randomized controlled trials of screening mammography, and in 2009 and 2011 Gøtzsche and Margrethe Nielsen and in 2013 Gøtzsche and Karsten Jørgensen published updates of that study (see Gøtzsche and Olsen 2000; Gøtzsche and Nielsen 2009, 2011; Gøtzsche and Jørgensen 2013). In each case, the conclusion reached was that the benefit from screening mammography "is small at best." Indeed, "if based on the randomised trials [the benefit is] ten times smaller than the risk that [the patient] may experience serious harm in terms of overdiagnosis" (Gøtzsche and Jørgensen 2013, 17). The authors go on: "screening for breast cancer with mammography causes more deaths than it saves" (Gøtzsche and Olsen 2000, 133). Worse still, if one acknowledges the biases in most of the trials that show a benefit from screening mammography, one has to "accept that there is no reliable evidence that screening decreases breast cancer mortality." In short, "screening for breast cancer with mammography is unjustified" (Gøtzsche and Olsen 2000, 133). And this conclusion has been further supported by recent improvements in cancer treatment (which may make early detection and hence screening mammography irrelevant to survival). An Australian study from 2011 (Burton et al. 2011), for example, suggests that most of the reduction in breast cancer mortality can be attributed to parallel hormonal therapy and chemotherapy and not to screening; and another 2011 study

(Jørgensen, Keen, and Gøtzsche 2011) suggests that the decline in breast cancer mortality actually started before screening practices were implemented in many countries and more likely coincides with the introduction of tamoxifen, the leading anti-estrogenic drug. Further, recent research into the genetic makeup of individual breast cancers suggests that cancer survival may have more to do with the biology of tumors than with early detection through mammography screening.

But all this represents only one side of the controversy. Prominent on the other side are Swedish researchers such as Lennart Nyström of Umeå University and American researchers such as Linda Humphrey of the US Preventive Services Task Force. In 1993 and 2002, Nyström and colleagues published meta-analyses in the *Lancet* of the four Swedish trials, and in 2002, Humphrey and colleagues published a meta-analysis in the *Annals of Internal Medicine* of all eight screening mammography trials (see Nyström et al. 1993; Nyström et al. 2002; Humphrey et al. 2002). In each case, the conclusion reached was the exact opposite of the Cochrane researchers: that the trials demonstrated that screening mammography has been an important lifesaver for breast cancer victims and should therefore be continued. And this conclusion has been endorsed by other researchers around the world as well (see, e.g., Puliti et al. 2012), as well as by such august bodies as the American Cancer Society, which now backs screening mammography for all women starting at the age of forty-five.[6] The pro-mammography conclusion has also been endorsed by many gynecological oncologists who emphasize their experiences with "real live patients" rather than meta-analyses and statistics—the real live patients they have been able to cure with the help of screening mammography. And this should not be the least bit surprising. As philosopher of science, Miriam Solomon (2015) points out, "Narratives of salient cases, in which screening mammography detected a cancer that was subsequently treated, play an important role for clinicians, most of whom were trained at a time when the 'early detection saves lives' mantra was governing and can easily recall a successfully treated and grateful patient" (p. 216). Meanwhile, the debate continues, of course well past policy-appropriate timelines.

Practical problems, then, have seemed to make a coherent and helpful science-based breast cancer screening policy difficult to achieve. But epistemic problems may be operating as well. Both sides of the debate have been accused of being swayed in their analyses by their value commitments or worse—have been accused of deliberately manipulating elements of their analyses to serve their value commitments. How can this be? Many cancers grow very slowly or not at all and hence are perfectly harmless. The

problem is that pathologists cannot distinguish between these harmless cancers and those that are potentially life-threatening, and so the standard is to treat them all. Since screening mammography leads to the detection of both kinds of cancers, it therefore leads to the treatment of both kinds of cancers, whether by surgery, radiation, chemotherapy, drug treatment, or some combination of these. Thanks to recent advances in mammography, this includes the detection and treatment of smaller and smaller cancers (harmless as well as harmful) that would not have been detected without mammography. It also includes the detection and treatment of lesions that are not clearly cancers at all, lesions that pathologists are hard pressed to correctly identify. In most cases, for instance, ductal carcinoma in situ—a localized lesion in the milk ducts that is considered "stage zero cancer" or "precancer"—is diagnosed as early stage cancer and treated accordingly.

Now Gøtzsche and his colleagues are most concerned about the overdiagnosis, misdiagnosis, and overtreatment of breast cancer brought about by screening mammography—that is, the "breast cancer" diagnosis and treatment of perfectly harmless cancers and noncancerous lesions that would never have occurred without mammography along with the unnecessary anxiety, breast removals, and even loss of lives that sometimes accompany the treatments. And this may be the reason they apply especially stringent standards when evaluating the five randomized screening trials that show benefits of mammography (i.e., the Two-County trial, the Stockholm trial, the Gothenburg trial, the Edinburgh trial, and the New York trial), while they apply less stringent standards when evaluating the three randomized screening trials that show no benefits of mammography (i.e., the Canadian trials and the Malmö Trial). For example, Gøtzsche and Olsen (2000) critique the randomization methods in the five trials favoring mammography screening for not guaranteeing a truly chance procedure, which according to them introduces unacceptable biases into the process and thereby renders the trials invalid. They claim, for example, that the randomization process in the Edinburgh trial did not produce a study group and a control group that were sufficiently similar, for the trial had a disproportionate number of women in the highest socioeconomic stratum in the study group (53 percent) when compared to the control group (26 percent). At the same time, they express no concern about the possible differences between the study group and the control group in the Mälmo trial (which found no benefits of mammography), even after they note that such information is not available for scrutiny (Gøtzsche and Olsen 2000, 130). Others have pointed out further ways in which Gøtzsche and Olsen are inconsistent in their analyses of the trials, failing to see comparable problems in the trials

showing benefits of mammography and the trials showing no benefits of mammography (e.g., Duffy, Tabár, and Smith 2001; Senn 2001).

Nyström, Humphrey, and their colleagues, on the other hand, are most concerned about the *lack* of diagnosis and treatment of life-threatening cancers that *would* occur *without* routine screening mammography and the loss of lives that would ensue. And this may be the reason they consider less worrisome the limitations of the five trials favoring mammography. Nyström and his colleagues (2002), for example, acknowledge some of the randomization problems that Gøtzsche and Olsen (2000) highlight, but they claim that the problems have been appropriately addressed with minimal statistical adjustments following the randomization process, adjustments that Gøtzsche explicitly rejects (Gøtzsche 2012, 121). Humphrey and her colleagues (2002) find similar randomization problems in *all* the trials, including those that are critical of screening. Their conclusion, however, is that "... when judged as population-based trials of cancer screening, most mammography trials are of fair quality," and that, as a result, there is "inadequate evidence ... to cause us to reject the inference that screening mammography reduces breast cancer mortality rates" (p. 335). In short, Humphrey and her colleagues acknowledge that all of the trials have randomization problems, but they do not consider this sufficient for invalidating them or for overturning the conclusion of the majority of the trials that mammography saves lives.[7]

The upshot is that the two sides' meta-analyses yield completely opposite results, but interestingly enough, just the results we would expect given their values.[8] So, a sharp divide between the values motivating each side's methodological decisions may be causing the rift between the two sides. Each side subscribes to laudable values—on the one side, that what should be minimized is the overdiagnosis, misdiagnosis, and overtreatment of breast cancers and, on the other side, that what should be minimized is the loss of lives from breast cancers that could have been successfully treated at their earliest stages—but these values support opposite conclusions. As a result, a particularly thorny sort of epistemic problem may be making a coherent and helpful science-based breast cancer screening policy difficult to achieve.

And social problems may be doing so as well. To begin with, conflicts of interest have been pointed out for some of the main players. For example, László Tabár, the principal investigator of one of the first randomized controlled trials of screening mammography, the Two-County trial (Tabár et al. 2003), and an important mammography advocate, pursued commercial activities involving mammography years before his trial supporting

screening mammography was published, though he never declared a conflict of interest in that publication (in fact, he denied it). Tabár, it turns out, also owns an American company, Mammography Education, Inc., in Arizona (Gøtzsche 2012, 105). Daniel Kopans, another leading supporter of screening mammography who advocates such mammography for women in their forties, owns several patents on mammography-related methods and breast biopsy techniques, though he also has not declared this conflict of interest in publications (Gøtzsche 2012, 242). The American Cancer Society, another outspoken advocate of screening mammography for women in their forties that spends millions promoting mammography—a $3 to $4 billion a year industry—receives huge donations from that industry as well as various chemical industries, and its board of trustees includes corporate executives from the pharmaceutical industry as well (Epstein 1999, 565). And the list goes on.

Of course, not every scientist whose research has supported screening mammography has a conflict of interest. Still, the direction of a great deal of breast cancer research is to ever more sensitive modes of cancer detection and hence ever more cancer treatment as well as ever more effective modes of treatment. And all this serves obvious economic interests and, in fact, has been shaped by those same interests, given that the research is largely funded by those interests (the mammography industry, the pharmaceutical industry, manufacturers of radiation technology, etc.). In this sense, if in no other, breast cancer research—the same research that supports screening mammography—has been skewed toward private commercial gain.

Well, so what? Skewing research toward ever more effective cancer detection and ever more treatment that is more effective is also, obviously, helpful for women. What could be a more appropriate kind of research? For one thing, a research program focused at least equally on prevention. Such a program would better contribute to women's flourishing. Who would deny that not having the disease in the first place would be much better than having a cure available? Yet the causes of breast cancer continue to be mostly unknown—only 5 percent to 10 percent of breast cancer incidence can be attributed to genetic factors, and only 30 percent of women diagnosed with breast cancer have any known risk factors (such as delayed childbirth or the late onset of menopause; Ehrenreich 2001; Rebbeck 2002; Green 2013). Despite this, research on the causation and prevention of breast cancer has been marginalized and underfunded. In the United States, for example, the three major funders of breast cancer research are the National Institutes of Health, the Department of Defense, and Susan G. Komen. But in recent years none of them has allocated more than 15 percent

of their research budget for investigating the causes of breast cancer or more than 9 percent for investigating modes of prevention, and much of the time their funding for these is a good deal less.[9]

More significant still, the same corporations that steer research to detection and treatment at the same time invest heavily in activities that are suspected of causing the cancer in the first place. In fact, many of these corporations seem to be profiting on both ends: on the one end, they manufacture products that contain carcinogenic chemicals and, on the other, they profit from developing the mammography screening technologies and drugs that treat the cancers that result. The more women (and also, in fact, men) with breast cancer, the more patients who pay for detection and treatment.

The pharmaceutical company AstraZeneca is a good example. On the one hand, AstraZeneca has received millions of dollars a year from breast cancer treatment as the original developer and for years the only manufacturer of tamoxifen, the world's top selling antiestrogenic drug (Epstein 1999, 573). On the other hand, the pharmaceutical giant also owns Syngenta, a pesticide company that produces Atrazine, which is commonly used in corn crops and which is also suspected of causing cancer (Atrazine, in fact, is the second most used herbicide in the United States after Monsanto's Round-up).[10] AstraZeneca's response to the increasing prevalence of breast cancer is thus not surprising. As the creator and main sponsor of Breast Cancer Awareness Month, AstraZeneca galvanizes more and more popular attention to breast cancer. But the focus of its campaign is on screening mammography as the most effective weapon in the fight against breast cancer, and the funds raised in the campaign are channeled to still more research on detection as well as treatment ("the cure") rather than causation and prevention.

And AstraZeneca is no exception. Cosmetic companies such as Estée-Lauder and Avon (which use carcinogenic chemicals in their products) and dairy companies such as Yoplait (which has used recombinant bovine growth hormone to stimulate their cattle) also use similar business strategies.[11] The problem even affects nonprofit organizations such as the American Cancer Society and breast cancer advocacy groups such as Susan G. Komen, which have close ties to screening mammography manufacturers and pharmaceutical companies as well as other areas of the chemical industry that manufacture carcinogenic products. These heavily support research for the detection and treatment but not the prevention of breast cancer. So there are major economic reasons why research on cancer prevention has

remained at the margins. Of course, there are other reasons as well. As historian of science, Robert Proctor (1995) points out:

> The sad truth is that cancer prevention is low prestige. Prevention is impoverished in an age of heroic medicine, where the reward structure is heavily biased in favor of last-ditch, quick-burst, high-tech interventions and high-profile, Nobel-Prize-potential basic science. In the field of research, this means exorbitant funding for therapies and molecular genetics and a more penurious approach to epidemiology, nutrition, health education, occupational health and safety, and behavioral and social science research—none of which will ever generate a Nobel Prize. In clinical practice, it means that surgeons and radiologists earn hundreds of thousands of dollars while preventive medicine languishes, grossly underfunded. (p. 267-68)

In short, "heroic" (masculine?) values as well as commercial interests have shaped the research agenda of breast cancer science, the research agenda that privileges the development of ever more sophisticated screening mammography technology. And this research agenda fails to meet the long-term needs and interests of women. This is the third reason—the social reason—a breast cancer screening policy that is at once science-based and helpful to women has not been achieved.

What Can Be Done to Help?

There are, then, at least three reasons we still lack a coherent and helpful science-based breast cancer screening policy worldwide: a practical reason (that prominent experts continue to disagree regarding the policies the available evidence supports), an epistemic reason (that competing, though equally laudable, values seem to be grounding these conflicting policies), and a social reason (that other, far less laudable, values seem to be not only privileging one of these policies but also blocking other, more socially defensible, alternatives). A conflict over values, then, seems to lie at the heart of the screening policy stalemate. What can be done to deal with this situation?

Many have thought that democratizing science, enabling stakeholders to be actively involved in the scientific research process, would produce policy-appropriate science. Accordingly, in recent years we have witnessed the proposal of various kinds of citizens' juries (Stewart, Kendall, and Coote 1994) and consensus conferences (Hörning 1999) and participatory research projects involving scientists and community members (see, e.g.,

Epstein 2000; Kleinman 2000; Wylie 2005; Martin 2006), all aimed at making scientific research more suitable for public policy. And when we consider breast cancer research in particular and the conflict over values complicating breast cancer screening policy, this turn to democratization seems especially appropriate. After all, who better to decide the values that should guide research and policy than those most directly affected—women![12]

Unfortunately, however, the prospects of democratization in this case seem far from promising. For breast cancer screening policy and the research agenda supporting it *have* been democratized; that is, the views and concerns of women *have* been taken into account rather than ignored. Indeed, organizations that advocate for women's health and well-being have exerted serious pressure on the research establishment. Yet, that hasn't helped to produce a coherent screening policy.

For one thing, while women's advocacy organizations such as Susan G. Komen and the Feminist Majority Foundation have pressed for ever more mammography screening and the research that underlies it, women's advocacy organizations such as the National Women's Health Network and Breast Cancer Action have pressed for just the opposite. In short, democratization has maintained the conflict over values complicating breast cancer screening policy rather than resolve it.[13]

For another thing, the democratization has occurred within a context shaped not only by commercial interests and masculine values but also by sexist values. To get a handle on the situation, compare the case of mammography screening with that of prostate cancer screening—more particularly, "prostate-specific antigen" (PSA) screening, a test that measures the level of PSA produced in the prostate, where elevated levels of the PSA enzyme have been associated with occult prostate cancer. The scenario in the two cases is interestingly similar, at least at first glance. As in the case of mammography screening, the randomized controlled trials thus far conducted regarding the efficacy of prostate cancer screening have yielded very different outcomes: whereas an American study found that PSA screening did not decrease mortality rates, a European study found that it did (Harvard Men's Health Watch 2009). In the case of PSA screening, then, just as in the case of mammography screening, experts have proposed different policies. While one group—supported by the American Cancer Society (2016)—recommends annual PSA testing for men aged fifty and older who have a life expectancy of at least ten years, another group—supported by the US Preventive Services Task Force (2012)—recommends against such screening, arguing that the potential benefits do not outweigh the harms that

frequently occur as a result of either the further diagnostic procedures that follow a positive PSA outcome or the actual treatment if further tests are also positive.

However, there is an important difference between the two cancer screening cases. Whereas the breast cancer case is marked by thoroughgoing policy disagreement, at least one point of agreement characterizes the prostate cancer case: both parties to the debate have expressed serious concerns about the substantial costs of overdiagnosis and overtreatment associated with PSA screening, and these have shaped their policy guidelines. For example, the American Cancer Society (2016)—the most prominent body that supports regular PSA screening—emphasizes that doctors should always discuss with their patients "the uncertainties, risks, and potential benefits of prostate cancer screening"; that they should revisit this discussion whenever the patients' health, values, or preferences change; and that patients should be encouraged to make their own decisions regarding their own diagnostic procedures and treatments. This contrasts sharply with the ways the American Cancer Society suggests that women should be treated regarding mammography screening. Here, as was pointed out previously, it urges every woman of at least forty-five years of age to have annual mammogram screening, with no discussion of possible harms that might occur as a result and no emphasis on the importance of women's individual decision-making in the face of such harms. As author and breast cancer survivor Peggy Orenstein (2013) points out, "all the well-meaning awareness [produced by the breast cancer awareness movement] has ultimately made women *less* conscious of the facts: obscuring the limits of screening, conflating risk with disease, compromising our decisions about health care, celebrating 'cancer survivors' who may have never required treating." Democratization can hardly produce a viable breast cancer screening policy under conditions like these.

But democratization *can* produce a viable policy if women are given the information they need—information about the medical scene and the risks and benefits of both routine screening and the treatments that can follow, information about the corporate scene and the various interests at stake regarding routine screening, and information about the research scene and the sorts of investigations pursued and not pursued, rewarded and ignored. If women are given this kind of information, women—at least a goodly number—will be better able to assess their needs and press for a far more appropriate kind of science than what is currently available (see, e.g., the activities of the Think Before You Pink Campaign at http://thinkbeforeyoupink.org, as well as studies such as that of Hersch et al. [2015] and

suggestions such as those of Johansson and Brodersen [2015]). And out of this can come something as powerful and global as other achievements of the women's movement.

In the meantime, however, what is needed is a method that can produce closure to the current controversy using the information, both normative and empirical, currently available, conflicted though it is. And such a method may lie ready at hand.

Consider, for example, the way the International Diabetes Federation, an organization of over 230 national diabetes associations in 170 countries and territories, developed its latest type 2 diabetes policy, the 2017 "Clinical Practice Recommendations for Managing Type 2 Diabetes in Primary Care." For this policy, the federation convened a working group of diabetes experts from around the world, and it gathered the most recent policies for the management of type 2 diabetes in effect in the various regions of the world. The search yielded twenty-three different policies published by 2015. The "AGREE II" scoring system—"Appraisal of Guidelines for Research and Evaluation II"(Brouwers et al. 2010)—was then used to assess the quality of these various policies. This scoring system takes into account (i.e., produces separate quantitative scores for) six dimensions of quality: (1) scope and purpose (the overall aim of a policy, the specific health questions it covers, and its target population), (2) stakeholder involvement (the extent to which a policy was developed by the appropriate stakeholders and represents the views of its intended users), (3) rigor of development (how the evidence for a policy was gathered and synthesized, how the recommendations were formulated, and how they were updated over time), (4) clarity of presentation (the language, structure, and format of a policy), (5) applicability (the likely barriers and facilitators to implementation, strategies to improve uptake, and resource implications of applying a policy), and (6) editorial independence (whether the formulation of recommendations was unduly biased with competing interests).

Using the AGREE II scoring system, twelve policies were selected from the twenty-three based on their general score (of 70 percent or higher, averaged from the six separate quantitative scores) and/or their widespread acceptance and use (in the case of those from the International Diabetes Federation, the American Diabetes Association/European Association for the Study of Diabetes, and the American Association of Clinical Endocrinologists). Finally, these twelve policies were further evaluated in terms of their answers to forty-one questions (covering nine topics such as the way the policies treat screening and diagnosis, lifestyle changes, initial treatment, add-on treatment, and cardiovascular risk factors). The forty-one

questions were selected by the working group as most relevant for the management of people with type 2 diabetes at the primary care level, and the final evaluation of the twelve policies using these questions occurred in a consensus meeting held in Brussels in March 2015. During this meeting, the working group developed its final policy recommendations, intended as an evidence-based global guideline for the care of people with type 2 diabetes all over the world. The recommendations cover three levels of care (standard, comprehensive, and minimal) that can be applied in settings with different resources.

The procedure used by the International Diabetes Federation to generate its 2017 type 2 diabetes policy constitutes a widely respected method to generate global health-care policies that are at once science based and socially defensible. So it may provide a template for breast cancer policy—a way, in particular, to generate a breast cancer screening policy that fulfills the practical, epistemic, and social requirements for which we have argued.

A Role for Philosophy of Science?

But what does any of this have to do with philosophy of science? We have argued that, in the long run, women must be enabled to be actively involved in an informed way in breast cancer research (both its agenda and process) if the most coherent and helpful breast cancer policy is to result. Even the short-run method for generating breast cancer policy offered above recognizes the importance of such democratization ("stakeholder involvement") in its evaluation procedures. So, what, if anything, can philosophers do to help? Clearly, journalists and clinicians and their various organizations and outlets can make crucial contributions to aid such democratization. And so can the other practitioners of science studies, particularly sociologists, economists, and historians of science. But can philosophers of science help as well? The aim of philosophy of science, after all—its aim right from the start—has been to capture and even improve upon science done well, indeed the best that science has to offer. So, if it is more appropriate breast cancer science that is needed here, philosophers of science should be able to oblige.

Of course, traditionally this aim of philosophy of science has concerned only the epistemic features of science, but our sights have broadened in recent years to include also the social dimensions of science. So, we now also investigate the ways social values operate in science and the ways such values are to be coordinated with science's epistemic values so as to preserve the objectivity, and hence excellence, of science (see, e.g., Longino

1990; Harding 1995; Kitcher 2001, 2011; Solomon 2001; Anderson 2004; Dupré 2007; Forge 2008; Douglas 2009; Kourany 2010). And since we philosophers of science have now also directed attention to the inappropriate ways, the pharmaceutical industry and sometimes also governments have intervened in the health sciences—how greed and a conservative political agenda have all too frequently led to compromises in these sciences' epistemic values (see, e.g., Krimsky 2003; Biddle 2007; Brown 2008; Elliot 2008, 2011; Kitcher 2001, 2011; Shrader-Frechette 2007, 2011, 2014)—we can help women be more critical of the various claims and bits of advice they have received about breast cancer, and we can empower women to demand better. Some of us have even investigated the adequacy of the health sciences' epistemic values themselves, questioning, for example, the status of randomized controlled trials as the gold standard for policy-relevant science (see, e.g., Cartwright 2007). So, if it is more appropriate breast cancer research that is needed, we philosophers of science should be able to oblige.

Except for two problems. First, philosophy of science, as currently constituted, is not an especially good resource for ensuring the *social* appropriateness of the science on which breast cancer policy will be based. At best, philosophy of science can only help ensure the *epistemic* appropriateness of that science. For regarding our foray into the social dimensions of science, thus far we philosophers of science have largely limited our inquiries to uncovering the *epistemically unacceptable* intrusion of social values into science and, especially, the epistemically unacceptable intrusion of *unacceptable* social values into science, but we have not ventured very far toward revealing what the *acceptable* social values might be that would constitute *acceptable*, even *required*, social value intrusions into science. Some of us have even acted as though this question of acceptable social values for science is not properly part of philosophy of science at all but only part of ethics and political philosophy or only related to the preferences of ordinary citizens in a liberal democracy, even though, as we have seen, the social and the epistemic in science cannot be easily separated. And, at any rate, political theorists and ethicists frequently fail to have the scientific literacy to venture on such scientifically specific questions and in fact tend not to do so (two significant exceptions are Brown [2009] and Anderson [2013]), and ordinary citizens in a liberal democracy might welcome the insights of philosophers of science as they do the insights of ethicists and political philosophers. Certainly, we are envisioning that women would welcome the social as well as epistemic insights of philosophers of science regarding breast cancer research. Interestingly, feminist philosophers of

science have tended to pursue the question of acceptable social values for science far more than other philosophers of science. This may be because feminist science studies (and feminist studies in general) are highly interdisciplinary areas of investigation; they recognize no sharp divide between epistemology and philosophy of science on the one hand and ethics and political philosophy and also political science on the other. There is no reason philosophy of science proper should not do the same.

The second problem: philosophy of science, as currently constituted, is not an especially good resource for ensuring the *practical* appropriateness of the science on which breast cancer policy will be based. At least, few suggestions now come from philosophers of science regarding the kind of scientific enterprise that would be up to the job of providing information that is at once epistemically and socially appropriate and also timely and helpful to society. Perhaps it is thought that this is a proper area of investigation only for the sociology of science (or only for social science or science studies more generally) or perhaps it is thought that the very idea of such an investigation improperly treads on the freedom of scientific research or improperly banks on the predictability (even teachability) of scientific creativity and innovation. At any rate, given the current love affair with scientific pluralism among philosophers of science, there is little hope that we will be up to the job any time soon.

We philosophers of science thus have quite a bit of work still to do to fulfill what is now a central goal for many of us: to help develop a science and philosophy of science conducive to a truly informed and progressive public policy. It is hoped that the various obstacles and lacuna pointed up in the foregoing, far from undermining this goal, will constitute a renewed call to action on its behalf.

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Notes

1. See, for example, the most recent debate in the United States regarding the age at which mammography should begin. While the American Cancer Society now recommends that mammography screening for women at average risk should begin at the age of forty-five, other groups such as the National Comprehensive Cancer Network and the cancer survivor group Breastcancer.org advocate for the American Cancer Society's former starting age of forty (American Cancer Society 2015; Grady 2015; Breastcancer.org 2015; Cohen 2015). Meanwhile, the debates in other countries tell a different story.
2. As we shall see, there are important interconnections among these reasons even though clarity demands their separation.
3. Of course, as Naomi Oreskes makes clear, such disagreements can be resolved in a variety of ways, not only (or perhaps ever) by the achievement of any kind of definitive proof. Even so, Oreskes never challenges that large-scale consensus is necessary for science-based policy (see Oreskes 2004).
4. This is to be distinguished from diagnostic mammography policy. While screening mammography is routinely used to detect breast cancer in women who have no apparent symptoms, diagnostic mammography is used after the appearance of such symptoms (e.g., a lump or change in the size or shape of the breast).
5. See, for example, Begley (2014), Gorski (2014), Kolata (2014), and Simon (2014) for the recent flare-up of the controversy following the publication of a new Canadian study—Miller et al. (2014). And see Breastcancer.org (2015), Cohen (2015), Grady (2015), and Oeffinger et al. (2015) for the latest debate regarding the American Cancer Society's change of its mammography screening guidelines.
6. As already stated, this is a revision of their previous position that all women should begin a yearly mammography screening program starting at the age of forty. Interestingly, other groups, such as Breastcancer.org and Susan G.

Komen, have criticized this revision, urging a reinstatement of the old guidelines.

7. The problem of experimenters' regress (Collins 1992), that is, a vicious circularity that appears when the quality of the experiment is defined in terms of the output of the same experiment, might also be lurking here.
8. On the role of values in meta-analyses, see Stegenga (2011). For an interesting discussion on the role of values in setting diagnostic criteria and how this might lead to overdiagnosis, see Biddle (2016).
9. See Interagency Breast Cancer and Environmental Research Coordinating Committee (2013), National Cancer Institute (2013), and Komen (2014) for specific budget allocations for breast cancer research.
10. Syngenta has recently orchestrated a defamation campaign against University of California, Berkeley, biologist Tyrone Hayes and his research findings regarding Atrazine's effects on sexual development (he found signs of hermaphroditism in frogs exposed to Atrazine; see Aviv 2014).
11. Recombinant bovine growth hormone (rBGH) has been found to increase insulin-like growth factor-I (IGF-I) levels in milk (Juskevich and Guyer 1990). Recent meta-analyses have found a significant association between IGF-I and breast cancer in premenopausal women (Renehan et al. 2004) and also in postmenopausal women (Endogenous Hormones and Breast Cancer Collaborative Group 2010). Like AstraZeneca, the pharmaceutical company Eli Lilly, which bought the rights to produce rBGH from Monsanto in 2008, also produces drugs for cancer treatment, such as Gemzar. Lilly is also a contributor to the American Cancer Society. See, for example, http://thinkbeforeyoupink.org/? page_id=2.
12. Of course, men get breast cancer too, but they represent only a tiny proportion of breast cancer cases—less than 1 percent. And only one in a thousand men will ever be diagnosed with breast cancer. See "Male Breast Cancer" at http://www.nationalbreastcancer.org/male-breast-cancer.
13. For a general analysis of the limits of democratizing strategies in commercially driven medical research, see Fernández Pinto (forthcoming).

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