apparently conflicting issues. It is likely to be of great utility in the development of a moral lens for population health.

Bioethics is adept at bringing into focus the moral salience of very small-scale relationships. It has elucidated with astounding clarity the nature of the relationships between doctor and patient or subject and researcher, for example. It has struggled to bring the same moral vision to the macro-scale. It has yet to provide a satisfactory account of how to think about the ethics of health on a population level. Greater engagement with the issues of public health, which might require adopting the methods of nonideal theory, would help bioethics realize this ambition.

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The scenario is all too common: the elderly woman with end-stage dementia readmitted to the hospital for the fourth time in three months for anorexia, now with a feeding tube, or the late middle-aged man with metastatic cancer progressing despite all proven chemotherapy now pursuing a toxic experimental treatment, or the patient with a rampant infection leading to multiple organ failure who requires machines, medications, and devices to filter the blood, pump the heart, exchange oxygen, facilitate clotting, and provide nutrition. Modern medical science is adept at sustaining life.

The field of bioethics has, since its earliest days, debated end-of-life issues; yet American society more broadly remains ill equipped for the experience of dying. This can be attributed in large part to four factors. First, dramatic technological advance has obscured the distinction between death and life and has confounded the layperson’s ability to know whether death is imminent. Even when medical professionals agree that a patient is dying (as above), the patient and family often remain unaware. Second, our unwavering faith in technology’s abilities has prevented us from wrestling with the reality of death. Third, the secularization of Western culture has marginalized the role of religion in preparing individuals for death. Fourth, physicians—as the new intermediaries between life and death—are notoriously inadequate at discussing end-of-life issues with their patients. When death arrives, seemingly unannounced, patients and family members are shocked and confused, and they struggle to cope.

Given these factors, one of the pressing bioethical concerns for the coming generation is the formulation and dissemination of a framework for dying well. We need a modern version of the Ars moriendi, or Art of Dying, which expressed the societal and ecclesiastical response in the Middle Ages to the widespread death caused by the plague.

It is no secret that the population of the United States is graying. The Administration on Aging, the federal agency responsible for serving the needs of older Americans, reports that in 2009 (the last year for which statistics are available), 39.6 million Americans—12.9 percent of the population—were over sixty-five years of age. Average life expectancy for those who reach sixty-five is an additional 18.6 years. The Administration projects that by 2030, 19 percent of the population will be over sixty-five. So within twenty years, twenty percent of Americans will be elderly, and for this population, death is imminent.

These statistics can be reassessed in the light of history. The midfourteenth century bubonic plague, or “Black Death,” is considered to have been among the deadliest pandemics of human history. It has traditionally been attributed to infection by Yersinia pestis, a bacterium spread by fleas and rats. Historians generally agree that between one-third and two-thirds of Europe’s population succumbed to the plague. Death came rapidly; typically less than a week separated the first sign of illness from the grave.

According to historical accounts, the number of dead increased so swiftly that those spared could scarcely keep up with proper burials. The fourteenth-century Italian humanist Giovanni Boccaccio described the chaos of the period:

Few also there were whose bodies were attended to the church by more than ten or twelve of their neighbours, and those not the honourable and respected citizens; but a sort
Priests, of course, were themselves not immune from the plague. As the death toll mounted and traditional social structures disintegrated, the Catholic Church responded with advice to laypeople on procedures, protocols, and prayers for the dying. This advice came in the form of two texts known as the *Ars moriendi*: a long version published in 1415, and a shorter, illustrated version that began circulating by the mid-fifteenth century. Although the authors of both texts are unknown, they were likely members of the Catholic clergy who were well acquainted with Christian rituals of dying. The texts were quickly translated and widely circulated throughout Europe. The illustrated version made it possible even for the illiterate to ponder the human and existential struggles of the moments before death.

In lieu of a priest at the bedside, the content of the *Ars moriendi* serves to walk the layperson through the process of dying. It emphasizes (the long version in particular) that the Christian can prepare for a good death by leading a repentant, righteous life. Since God is in control even of the moment of death, death should not be feared. The text cautions that the dying are often tempted to unbelief, despair, impatience, pride, and avarice, but insists that they need not succumb to such temptations. A series of questions aids the dying in reaffirming their beliefs and receiving consolation. Finally, the text prescribes specific activities and prayers for the attendants to perform on behalf of the dying; in doing so, the attendants also anticipate and prepare for their own deaths.

Having witnessed the sudden death of half of the population, it is easy to understand both why the Catholic Church would issue instructions on the protocols of dying and why the public would so widely accept them. The popularity of the *Ars moriendi* also spread to non-Catholic Christian traditions, where its protocols for dying remained influential for generations. As recently as the late nineteenth century, German American Lutherans were using a *Daily Hand-Book for Days of Rejoicing and of Sorrow*, a text that “quickened and comforted many thousands of souls, and made of their dying hour, an hour of joy,” and that drew on the spirit and principles of the *Ars moriendi*.

But over the last century and a half, the deathbed ritual lost its appeal. Churches began to deemphasize the concept of dying well and to promote instead the notion of living well. Within a more secularized society, medical science offered new hope and salvation, and death became the enemy. It is here that we find the dying patient today: in the intensive care unit with an array of tubes, devices, catheters, and monitors blurring the boundary between life and death—a boundary that patient and family alike are unprepared to face.

This is the challenge for bioethicists in the decades ahead: to create a framework for teaching an aging population to prepare for death and to support one another through the dying process. Critics might argue that this remains the role of the clergy; but in a secular society, clergy no longer have that authority or influence. The *Ars moriendi* of the late Middle Ages was successful precisely because it addressed a universal need in a manner that fit a particular culture and was easy to understand and to apply. Such a tool today would need to accommodate a vast array of belief systems while remaining easy to use. The deathbed must again become a place of community, a place for the dying to forgive and to receive forgiveness, to bless and to receive blessing, and a place for the attendants to anticipate and prepare for their own deaths.

Perhaps our society will never again face devastation on the scale of the bubonic plague. Modern medical science has proven adept at delaying the moment of death. But as the population ages, death will once again become a more present reality, and we will need to be prepared.

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Interventions to replace undeveloped, destroyed, or degenerated tissues are not new. However, regenerating tissue was thought to be impossible. “Regenerative medicine” aims to actually regenerate tissue. Therefore, it presents a significant shift in the goal of medicine. Regenerative medicine employs three strategies: (1) inducing the body’s inherent regenerative capacities in vivo through the application of growth factors and/or stem cells; (2) “tissue engineering,” or creating complex structures in vitro containing cells and custom-made scaffolds to implant in the patient; and (3) recolonizing donated, decellularized structures with patient-derived cells and implanting them in the patient.

Regenerative medicine has been enthusiastically received as it promises to make further interventions redundant. Also, it may provide solutions for as-yet-un treatable conditions, and it may benefit anyone from neonates (possibly even fetuses) to the elderly. All medical fields have embraced it, from dentistry and orthopedics to neurosurgery and cardiology. Its growth is based on our increased knowledge of cell—and especially stem cell—biology and biomaterials, and on the increasing prevalence of degenerative diseases. In the future, regenerative medicine may therefore touch most of our lives.

While there has been a steady increase in the volume of medical research, the field has been largely ignored in bioethics. A PubMed search on “regenerative medicine” resulted in 1,385 papers in 2008, 1,595 in 2009, and 1,282 in the first seven months of 2010, of which respectively 38, 33, and 17 included “bioethics.” In the same years—2008, 2009, and 2010—the phrase “tissue engineering” resulted in 4,508, 5,024, and 3,387 papers, of which only 25, 17, and 12 included “bioethics.” A literature review of 2008 brought up 203 papers when the search was guided by this string: “regenerative medicine AND/OR tissue engineering AND ethic*.” All but thirteen of these articles appeared in biomedical journals, and, out of the thirteen exceptions, very few were in bioethics journals. The ethical issue most commonly addressed in all of the articles was the use of human embryonic stem cells.

These data might suggest that there are no new ethical issues involved in regenerative medicine. In fact, a number of ethical challenges may arise.

While the principles of regenerative medicine are easy to explain and the possible benefits even easier to appraise, relatively few products have made it into clinical trials, and even fewer into therapy. So far, we know some of the “vocabulary” of tissue formation—the genes, cells, growth factors, and extracellular environment involved—but we know very little of the “syntax” of healthy and affected tissues: how these elements interact during the tissue formation process, how the native tissue (healthy and affected) interacts with the new, and whether these interactions are unique for each individual or common for all persons. For now, regenerative medicine is more akin to tissue handicraft than tissue engineering: products are developed on a case-by-case basis, and most research energy is spent on identifying and combining the pieces of the puzzle, then translating these findings into a therapeutically active product.

Another challenge the development of regenerative medicine presents is that it is not being pursued by the usual actors—the big pharmaceutical companies that have the money, infrastructure, and clinical trial experience to bring a therapy to market. Rather, the driving forces behind regenerative medicine are cell biologists and biomaterials experts, many of whom are not acquainted with bioethical issues. Ethics committees, on the other hand, are often unfamiliar with regenerative medicine. This disconnect may make it difficult to design ethically acceptable clinical trials on regenerative medicine. There is also the considerable time it takes to go from bench to bedside—if the bedside is ever reached. This lag, and the huge investment necessary for small and medium-sized enterprises to develop these products, requires the participation of private investors. This investment is happening in an international context, where Western ethical sensitivities are not always the prime concern. Which products make it after their initial development may thus depend not only on their therapeutic merits, but also on the expected return-on-investment and on the playing field that is created by international regulations—for instance, the European Union’s regulation on advanced therapy medicinal products, and...