Section A: Medicine targeting age-related degenerative disease

Medical students face a challenge with the rising tide of increasingly elderly patients. By the year 2020, people age 65 and older will outnumber children under age 5 around the globe\(^1\). Additionally, by the year 2030, there will be a globally increased burden in caring for chronic noncommunicable diseases as they become the major cause for loss of health and life\(^2\). As the baby boomer population begins to reach 65, elderly care will become inescapable as it will extend beyond geriatrics, pervading every medical discipline and specialty.
Doctors and students alike find treating age-related degeneration to be a losing battle as existing methods cannot effectively defer the constant barrage from causative agents, a failure which ultimately results in recurrence and advancement of original and secondary afflictions. The causes of such morbidity are multi-factorial and a consequence of healthy metabolism that result in an age-related degeneration. This renders the conditions impervious to the traditional prevention and curative approaches. A regenerative medicine approach to age-related degenerative disease is uniquely positioned to meet this situation as it is based around repair of damage, rather than direct intervention in highly complex metabolic processes. Here, the authors promote regenerative medicine as a prospective approach to age-related degenerative disease that is outside the limits of preventive and curative therapies which currently dominate the medical curriculum. Regenerative medicine therapies present the potential to provide care without increasing frailty, thus serving the medical ideal of restoring health rather than protracting decline. Such an approach has yet to be sufficiently impressed upon the ranks of the current medical student cohort that is largely unaware of the demographic realities facing their careers. It is important that medical school administrators and students recognize the vast potential in regenerative medicine and actively facilitate the development and distribution of such knowledge among the medical education community.

**Section B: Prevention approach too late for age-related degenerative disease**

Acknowledging the need for therapies focused on aging demographics is not new. Despite decades of research in the basic science of medicine, the curative model of disease has shown itself ineffective at restoring population health. While single-factor diseases were cured with
antibiotics or vaccines, such approaches have not had success when applied to multi-factorial conditions such as age-related degenerative diseases. In lieu of cures, the management of degenerative disease has successfully reduced symptoms and suffering. However, disease management fails to address the underlying conditions and ultimately promotes extended morbidity, suffering, and costs. The alternative approach has been prevention. While prevention does slow the onset of frailty by laudably attending to the underlying causes of degeneration, it does not prevent nor reverse the pathology. For senior patients presenting with such disease, many of whom having eschewed prevention in favor of the curative approaches, prevention is simply too late. Medical students must continue to promote prevention while simultaneously focusing on ways to target the damage of age-related degeneration, rather than simply continuing to manage the frail state.

Section C: Curative approach fails with multi-factorial nature of age-related degeneration

Emerging biotechnology does indeed give us reason to be optimistic about cures. Paradoxically, the staggering nature of our advances in understanding may represent a complexity trap. It is tempting to predict reductions in morbidity and mortality based on the genomics revolution to be commensurate with the development of antibiotics and vaccines. However, those tools were used against diseases caused by single factors. Age-related degenerative diseases are multi-factorial conditions caused by a host of different genes and environmental factors that are deeply rooted within healthy metabolism. Ironically, as our technology peers ever deeper among the root causes, we may be discovering our own impotence in the face of an intractably complicated metabolism. Rather than being confident with such novel discoveries as RNA interference and
the role of epigenetics, their detection should caution that we are still only scratching the surface of metabolic realities. Since cures depend on the extent to which we understand metabolism, optimism towards such curative efforts may be misplaced. The question for medical students centers on how we can target age-related degeneration in a way that improves health-span. Such an approach would intervene after the appearance of signs and symptoms, but before sufficient damage has accumulated to tip the patient into overwhelming system decline; regenerative medicine is such an approach.

**Section D: Regenerative medicine approach**

Regenerative medicine can be applied when prevention is too late, and it sidesteps the metabolic complexity that may waylay the curative approach. Regenerative medicine therapies focus on repairing injured, lost, or aging cells in the human body aiming to restore the structure and function of tissues and organs. Disease treatment and function restoration approaches focus on either prompting the organism to autonomously regenerate damaged tissues, using implants to prompt regeneration, or directly transplanting healthy tissues into damaged environments. Besides regeneration and transplantation options, additional therapies focus on removing damage created by the aging process as it progresses to degenerative diseases. It is important to emphasize that regenerative medicine must exist in a complementary fashion with preventive and curative approaches. Yet, it is the only method that succinctly addresses the accumulation of damage that is unpreventable and incurable by traditional means. A significant increase of publications in the field demonstrates that popularization and commercial use of regenerative methods and technologies is taking place. Advances in medicine are constant and should impact
how medicine is taught and defined. It is imperative that regenerative medicine therapies are supported by informed and inspired students.

Section E: Medical student call to action

The frustration that practicing physicians face in treating age-related degenerative conditions is that while multiple problems are being addressed, the organism continues deteriorating globally. Developing an interest and perspective for regenerative medicine that mitigates this frustration is crucial for invigorating future physicians about the prospects of unavoidable elderly care. The prospect of controlling hypertension, regulating insulin, or managing arthritis should be viewed in light of the alternative: having the opportunity to remove the accumulated damage that leads to these conditions. Advocating the regenerative medicine approach to disease is not a rejection of preventive or curative approaches. It is an addition to the efforts necessary to sustain physical independence and health-span. Fostering and developing an interest in regenerative medicine at the medical school level is essential to the evolution of healthcare as it adapts and adjusts to delivery requirements of the future. It is necessary to understand that such advances represent a growing part of modern medicine and is becoming vital to a successful career within any specialty. Current medical students interested in developing such a career can seek out residency or fellowship training at institutes and centers of regenerative medicine available at various academic institutions. Future physicians will have a variety of potential careers to choose from as regenerative medicine continues to develop and progress. Regenerative medicine is still looking for pioneers, trail-blazers, and most importantly, implementers.
References:


