

## Chapter 2. Aging: natural or disease? A view from medical textbooks

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### Abstract

According to medical tradition, aging coincides with illnesses such as cancer, Alzheimer's disease and cardiovascular disease, yet is itself a 'normal', 'natural' and non-pathological process. From this perspective, anti-aging drugs are more akin to cosmetics and mind-altering drugs than to treatments in the medical sense. Yet, arguably, this traditional view of aging is incorrect. Senescence manifests as a broad spectrum of deteriorative changes, leading to debilitating and ultimately fatal pathologies. It makes little sense to speak of healthy or normal senescence: the entire process is characterized by pathology. Anti-aging drugs as a preventative approach to delay senescence fall very much within the medical remit. In this chapter we ask: Do doctors really think that aging is not a disease? And if so, why do they think this? To address the latter, we ask: What are medical students taught about the relationship between aging and disease? To this end, we analyze the contents of 14 widely used, standard textbooks of general medicine. The results suggest a general neglect of the question of what aging is, unease about the somewhat arbitrary classification of different manifestations of senescence as normal or pathological, and the absence of any rationalization of the concept of normal aging. Our findings suggest that medicine remains in the dark about aging.

### 1. Introduction

Whether a given condition is labelled as a disease or not can depend on a number of factors - including linguistics. For example, in one survey people were asked of 60 different conditions whether they considered them to be a disease or not.<sup>1</sup> The study found that alcoholism was seen as a disease, but smoking not. In some ways this is an odd finding since both - broadly speaking - elicit dependence symptoms, involve substance abuse and are detrimental to health in the long-term. Plausibly, this quirk reflects the choice of words employed in the

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survey. Perhaps if the terms used had instead been *drinking* and *nicotine addiction*, the classification would have come out the other way around?

Difficulties of classification also affect *aging*. For example, if one went to the doctor and asked for a prescription for anti-aging drugs, their response would likely be surprise, amusement or perhaps mild irritation. This is because aging, in the medical field, is not regarded as a disease.

The question of what exactly is meant by “anti-aging drugs” is complicated by several factors. First, linguistics, and the problem that the word “aging” has more than one meaning. Second, the question of whether aging is a disease. Thirdly, problems relating to what counts as an anti-aging intervention. These issues will be reviewed here briefly, and a serving definition of the meaning of *anti-aging* suggested. This builds on previous work which attempts to define anti-aging interventions.<sup>2–10</sup> We will then present an attempt at a broad and general description of the biological basis of aging, to offer the beginnings of an etiological basis for the understanding of senescence as a disease syndrome. Then, in the main part of this chapter, we examine how the aging vs disease question is presented in general medical textbooks.

## 1.1. What does “aging” mean?

The word *aging* acts as a stumbling block in discussion because it has multiple meanings that are sometimes conflated. The main, distinct meanings are:

- The passage of time (*calendar aging*).
- Time-dependent alterations, usually in adult living organisms, but also inert objects (*age changes*).
- Cumulative deteriorative changes in adult organisms leading to pathology and death (*senescence*).<sup>11–13</sup> Senescence is one type of age change.

An unfortunate, additional source of confusion is that the word senescence also has a second meaning, as introduced by Leonard Hayflick, that of *cellular senescence*. This refers to a specific type of cellular change where proliferative capacity of cells is lost, and a pathogenic hypertrophic phenotype appears. Confusion between these two meanings can, in some contexts, be avoided by use of the term *organismal senescence* to contrast with cellular senescence. However, it seems likely that the two meanings of senescence will continue to generate confusion. Replacement of *cellular senescence* with another term would solve this problem.

Thus, the English language is a hindrance in that the multiple meanings of aging impede understanding. Not all languages have this problem; for example the Russian *stareniye* (старение) means, essentially, senescence. For people, age changes include maturational changes, such as the attainment of wisdom, and character development. In this sense, an anti-aging drug would be highly undesirable; clearly, the interest is in anti-senescence (or geroprotectant) drugs, where senescence is meant in its original sense, not the sense of cellular senescence.

## 1.2. Is aging a disease?

Human senescence manifests as a wide range of deteriorative changes, including some that are debilitating and sometimes fatal (e.g. cardiovascular disease, cancer and dementia) and some that are not (e.g. greying of hair and wrinkling of skin). In medicine, a conceptual division is made between the former, as diseases for which aging is a risk factor, and the latter which are not pathological but rather manifestations of *normal* aging.<sup>14–16</sup> Here, aging itself is viewed as a natural and non-pathological process. However, this division and the notion of normal aging is problematic in a number of respects. For example, the designation of particular senescent changes as normal or pathological has been controversial, as illustrated by the transfer of late-onset Alzheimer’s disease and osteoporosis from the former to the latter category.<sup>5</sup> Moreover, from a biological perspective, senescence, a biological process whose defining characteristic is deterioration, is a fundamentally pathological process, identifiable as damage accumulation, degeneration, loss of function, and emergence of numerous

disease states that can cause suffering and death. At present there exists some division between perspectives on aging in the medical and scientific domain. In the former the concept of normal aging is more prevalent, whereas in the latter there are more doubts about the existence (or meaning) of “non-pathological senescence”.

As a contribution to this debate, we present here an attempt at a disease definition of aging. Ideally, a disease definition will include a full description of the disease etiology. In this case of aging, this is not possible, since the biological mechanisms that cause senescence are only partly understood. This definition does not pretend to encompass the views of all biogerontologists, and it surely will not do so. We hope that its faults will incite others to develop better definitions.

### 1.2.1. An attempt at a broad account of the etiology of senescence

Organismal senescence manifests as diverse pathologies, including neurodegenerative diseases, cardiovascular disease and cancer as well as minor pathologies such as skin wrinkling, and encompasses the etiologies of these conditions. There is no single etiology of organismal senescence, but rather multiple causes that generate a number of syndromes and unitary diseases. Thus, aging is a disease super-syndrome. These etiologies are predominantly the result of inherited predisposition, but environmental factors that promote damage and injury also play an important role, often through effects on the expression of predispositions (e.g. mechanical injury to joints can contribute to osteoarthritis).

Insofar as it is genetically determined, organismal senescence is a form of genetic disease, but of a special kind, as follows. According to contemporary medical understanding, a genetic disease is the result of a mutation in a gene that disrupts its evolved function, changing the gene from wild type to mutant, thereby disrupting biological function and causing pathology. By contrast, the inherited predisposition to organismal senescence is largely specified by wild-type genes. This seemingly paradoxical claim makes sense in the light of the evolution of aging.

Until the middle of the last century, aging was viewed as an adaptation that benefited the species by removing worn out, old individuals. This view is still quite common among the general public, but it is incorrect. According to modern evolution theory, natural selection moulds gene action to optimize reproductive success, not longevity. Natural selection can favour genes which increase reproductive success in early adulthood even though they might promote pathology in later ages – so called antagonistic pleiotropy (AP).<sup>13</sup> This means that although organismal senescence is not an adaptation, it is genetically programmed: late-life action of genes that bring us into existence eventually cause our death.<sup>17</sup>

The evolutionary theory predicts that senescent pathologies arise from late-life action of many genes. Animal model research has shown that some genes specifying central regulators of growth and development (i.e. common to most cell types) are AP determinants of multiple age-related pathologies, including some that contribute to late-life mortality. Inhibiting late-life effects of these genes can lead to amelioration of a wide spectrum of late-life pathologies – typically delaying their onset (decelerated aging). Thus, within the broader AP genetic predisposition one can define discrete genetic etiologies leading to syndromes of age-related pathology. For example, late-life accumulation of senescent cells (*sensu* Hayflick) and, particularly, mTor-activated gene expression in these cells appears to contribute to development of multiple age-related pathologies; research in mice suggests that these pathologies include atherosclerosis, the three major classes of cancer (carcinomas, sarcomas, lymphomas), glomerulosclerosis, cardiomyocyte hypertrophy, cardiac dysfunction, lipodystrophy and cataractogenesis.<sup>18,19</sup>

In conclusion, organismal senescence is a disease multi-syndrome, a set of syndromes and unitary diseases. The main underlying cause is wild-type genetic pre-disposition, in which respect it is etiologically distinct from most other diseases. However, standard etiologies (e.g. microbial pathogens, injury, gene mutations) do play a major role in organismal senescence, particularly when programmed aspects of aging increase predisposition to their pathogenic effects.

### 1.3. What is an anti-aging intervention?

If one rejects the traditional dichotomy between normal aging and aging-associated diseases, then the meaning of *anti-aging* becomes problematic. If the aging disease super-syndrome is understood as the sum of senescent pathologies and their causes, this suggests that any treatment of any senescent pathology could be understood to be an anti-aging treatment. This is problematic because treatments for existing senescent pathologies (e.g. chemotherapy for late-life cancer, or hip replacement operations) do not conform with the objective of improving late-life health by intervening in aging itself. This critical, central aim of biogerontology seems diluted or lost within such a redefinition of anti-aging.

In response to this, a new definition of anti-aging has been proposed,<sup>9</sup> to retain the utility of the term. Here, anti-aging refers specifically to the preventative approach to improving late-life health. By this view, anti-aging treatments are interventions which counteract any etiology of organismal senescence. Based on the above account, two basic types of anti-aging treatment can be distinguished: those which act upon late-life AP etiologies (e.g. rapamycin); and those that prevent causes of pathology for which AP-generated senescence is a prerequisite (e.g. sunscreen, to prevent pre-cancerous lesion formation).

A further difference in this proposed new understanding of anti-aging is that it is based on the understanding that there is no one etiology of senescence. This means that no treatments inhibit the totality of aging, only parts of it. Consistent with this, anti-aging treatments with efficacy in animal models can improve late-life health and extend lifespan but not prevent aging altogether. This type of outcome is sometimes described as *decelerated aging*, but this is likely to be an imprecise description; more exactly, interventions of this sort impact the etiology of a cluster of senescent pathologies that limit lifespan - not the aging process overall.

According to the new definition of anti-aging, any preventative approach to senescent pathologies is an anti-aging treatment, whether the etiologies involved generate a broad or a narrow range of pathologies (defining broad vs narrow geroprotectants). This means that not only are (potential) broad-sense interventions such as dietary restriction and mTor inhibition anti-aging interventions, but so are also narrow-sense interventions such as the use of sunscreen to prevent sun damage to skin and the use of toothbrushes to prevent dental decay. By this view, dentists and, particularly, dental hygienists are narrow-sense anti-aging practitioners.

### 1.4. Aims of this study: How is the aging vs disease division represented in medical textbooks?

Do healthcare professionals regard aging as a disease, as a normal process, or as something entirely different? How much emphasis does medical education put on the process of aging? To explore these issues, we have taken two approaches. Firstly, we examine several previous studies that examine attitudes of health care professionals towards aging. Secondly, we explore what medical students are taught about aging. One may suppose that the rejection of the aging vs disease dichotomy by many biogerontologists is informed by their study of the biology of aging, including reading the views of other biogerontologists. Similarly, the belief in the aging vs disease dichotomy common among doctors is presumably attributable, at least in part, to what they learn in medical school. Important determinants of the frameworks of ideas within scientific and professional fields are the reference textbooks that are used for undergraduate teaching.<sup>20</sup> We have conducted a preliminary investigation of what medical students are taught about the relationship between aging and disease, analyzing 14 widely used textbooks of general medicine. We wished to discover to what extent textbooks argue that aging is distinct from disease and, if so, to examine the arguments and evidence presented for such a claim. For reference and comparison, Table 1 presents a selection of quotes arguing against the aging vs disease dichotomy, many from biogerontologists.

**Table 1. Selected quotations arguing against the aging vs. disease dichotomy.**

Charcot, 1881, p. 20 <sup>43</sup>	“The textural changes which old age induce in the organism sometimes attain such a point that the physiological and pathological states seem to mingle by an imperceptible transition and to be no longer sharply distinguishable.”
Kleemeier, 1965, p. 55 <sup>44</sup>	“Can the effects of aging <i>per se</i> be distinguished from those of pathology? (...) To attribute to aging all time associated changes to which no specific cause can be found is at best a temporary holding tactic which will suffice only as long as we are ignorant of the mechanism involved. Time alone causes nothing.”
Hall, 1984, p. 78f <sup>45</sup>	“Attempts have been made by numerous workers to separate physiological from pathological aging. The two are, however, so interrelated as to make attempts relatively abortive. It would be far more relevant to accept the existence of a continuum of ageing phenomena.”
Rattan, 1991, p. 526 <sup>46</sup>	“Although it is well known that most diseases show marked increases with age, the connection between the ageing process and the incidence of age-related diseases is highly underestimated. Recent developments in gerontology are unearthing the molecular link between ageing and disease.”
Holliday, 1995, p. 138 <sup>47</sup>	“... the distinction between so-called natural ageing and the pathologies that are common in old people is artificial. What we see is an increasing likelihood of many diseases in individuals as they age, which does not, of course, mean that all individuals develop all the pathologies.”
Callahan and Topinkova, 1998, p. 94 <sup>2</sup>	“In short, not only does aging lend itself to be characterised as a disease, but the advantage of doing so is that, by rejecting the seeming fatalism of the label ‘natural’, it better legitimises medical efforts to either eliminate it or to get rid of those undesirable conditions associated with it.”
Guarente and Kenyon, 2000, p. 261 <sup>3</sup>	“When single genes are changed, animals that should be old stay young. In humans, these mutants would be analogous to a ninety-year-old who looks and feels forty-five. On this basis we begin to think of ageing as a disease that can be cured, or at least postponed.”
Caplan, 2005, p. S75 <sup>6</sup>	“(...) the common belief that ageing is a natural process is also mistaken. And if that is true, and if it is actually the case that what occurs during the ageing process parallels the changes that occur during paradigmatic examples of disease (...), then it would be reasonable to consider ageing as a disease.”
Gems, 2009, p. 3 <sup>48</sup>	“The evolutionary theory adds insult to injury by telling us that it is a process without any kind of benign function in the cycle of life; moreover, it is, essentially, a form of genetic disease, that everybody has and that is invariably fatal. We, all of us, have inherited a horrible and invariably fatal genetic disease.”
Bulterijs <i>et al.</i> , 2015 p. 3 <sup>49</sup>	“As aging appropriately fits the definition of disease, there is a shifting consensus that aging should be seen as a disease process in itself, and not a benign progression of age that increases the risk of disease.”

## 2. How is aging viewed in the medical field?

### 2.1. Two surveys of the medical perception of aging

How is the relationship between aging and disease perceived in the medical establishment? We were unable to identify any studies addressing this issue specifically. However, two studies analyse the concept of disease more broadly and include the question of the status of aging, and therefore give some indication of the medical perception of aging.<sup>1,21</sup> It is worth noting that neither study deals with the linguistics, i.e. no study distinguishes the different meanings of aging (e.g. maturation vs senescence).

#### 2.1.1. BMJ vote on the top ‘non-diseases’

In 2002, the British Medical Journal (BMJ) ran a poll to identify the most widely recognized *non-diseases*. Non-disease was defined as “a human process or problem that some have defined as a medical condition but where people may have better outcomes if the problem or process was not defined in that way”.<sup>21</sup>

The BMJ is ranked fifth amongst general medical journals. It targets doctors, researchers and other health professionals,<sup>22</sup> thereby addressing the core medical field. For the survey, the editorial board and journal readers brainstormed nearly 200 conditions potentially qualifying as non-diseases. Then, 570 people voted on whether a



particular condition was as a non-disease. Among these, aging ranked first, constituting the top non-disease (Table 2). This is striking considering the presence of other, clearly non-pathological conditions like work (2<sup>rd</sup> place) or boredom (3<sup>rd</sup> place).

One may argue that the survey format is likely to miss differing opinions on the classification of aging for several reasons. Firstly, of the 570 participants only 271 (44%) believed aging was a non-disease. Perhaps the remaining 56% disagree with aging as the top non-disease. However, whilst keeping this possibility in mind, the fact that aging is the most frequently identified non-disease is a strong indication of the prevailing notions in the medical field. Secondly, and most importantly, the BMJ definition of non-disease is not saying “this state is not a disease”. Instead, the poll asked for conditions that are *best* not labelled as diseases. This definition of non-disease does not prohibit the opinion that aging is a disease. However, it appears irrational to think of something as a disease whilst also thinking that it was best not labelled as one. Thus, despite these two limitations, the BMJ study can be used to demonstrate that aging is not classified alongside other recognized diseases in the medical field.

**Table 2. Top 20 non-diseases in descending order of non-diseaseness<sup>21</sup>.**

1 Aging	11 Childbirth
2 Work	12 Allergy to the 21st century
3 Boredom	13 Jet lag
4 Bags under eyes	14 Unhappiness
5 Ignorance	15 Cellulite
6 Baldness	16 Hangover
7 Freckles	17 Anxiety about penis size/ penis envy
8 Big ears	18 Pregnancy
9 Grey or white hair	19 Road rage
10 Ugliness	20 Loneliness

### 2.1.2. Surveying the public, health professionals and legislators on disease

A study from Finland by Tikkinen et al. provides a clearer picture of the medical perception of aging.<sup>1</sup> Again an opinion poll was taken, about 60 different states of being, with participants evaluating two claims: “(this state of being) is a disease” and “(this state of being) should be treated with public tax revenue”. The study consulted four groups: 1,517 members of the general public, 56 members of parliament, 741 doctors and 966 nurses. Given our interest in aging and disease, we have focused on the results of the first claim; however, it is notable that a correlation exists between responses to the two claims.

Tikkinen and colleagues show that of the 60 conditions, there is considerable variation in opinion whether 43 of them constitute diseases. The classification of the remaining 17 cases is clearer, as more than 80% of respondents agree with each other. Here, twelve states are clearly seen as diseases, and five states are clearly not. Interestingly, aging is among the conditions that are clearly not seen as diseases, along with grief, homosexuality, wrinkles and smoking (Figure 1).

A strength of this study is the large sample size. Its results suggest that laypeople are slightly more likely than health professionals to see aging as pathological. This is despite the fact that health professionals are, if anything, more inclined than laypeople to classify states as diseases.<sup>1,23</sup> But if clinicians do not view aging as a disease, what do they see it as instead? This question is particularly interesting, as some states associated with aging (e.g.

breast cancer, prostate cancer, deafness, adult onset diabetes) are viewed as diseases while others (e.g. insomnia, night-time urination, menopause, wrinkles) are not. Do healthcare professionals distinguish between pathological and non-pathological aging? To try to address this, we turned our attention to medical textbooks.

## 2.2. Medical textbook analysis

The BMJ survey and the Finnish study suggest that aging is best not labelled as a disease in medicine. However, as pointed out previously, the terminology is vague and there are connotations between chronological aging, age changes and senescence, as well as what constitutes normal and pathological in each of these areas. We suspect that the results of these surveys may partially reflect linguistic confusion. In particular, we argue that whilst chronological aging and many age changes are not pathological, senescence is a disease (or a disease syndrome). By means of a textbook analysis, we aim to trace the roots of this linguistic confusion as they grow in the soil of undergraduate medical education.

We have examined how aging is described in medical textbooks. Textbooks accompany the medical curriculum, represent the roots of medical education and build a foundation for the values and attitudes in medicine. How frameworks of ideas are maintained within different fields can be discovered by textbook analysis.<sup>20</sup> How textbooks present aging is likely to be a major determinant of the medical view of the aging vs disease dichotomy. The textbook analysis also served several additional purposes.

- To supplement the findings of the Tikkinen et al.<sup>1</sup> study; in particular to probe whether they are representative of attitudes beyond Finland.
- To add a qualitative dimension to the Finnish study; if aging is not viewed as a disease, then how is it viewed?
- To test the claim<sup>6</sup> that medical textbooks do not sufficiently deal with aging. As far as we can ascertain, a formal medical textbook analysis to this end has not been conducted before.
- To create a foundation for future, more detailed investigations of this issue.

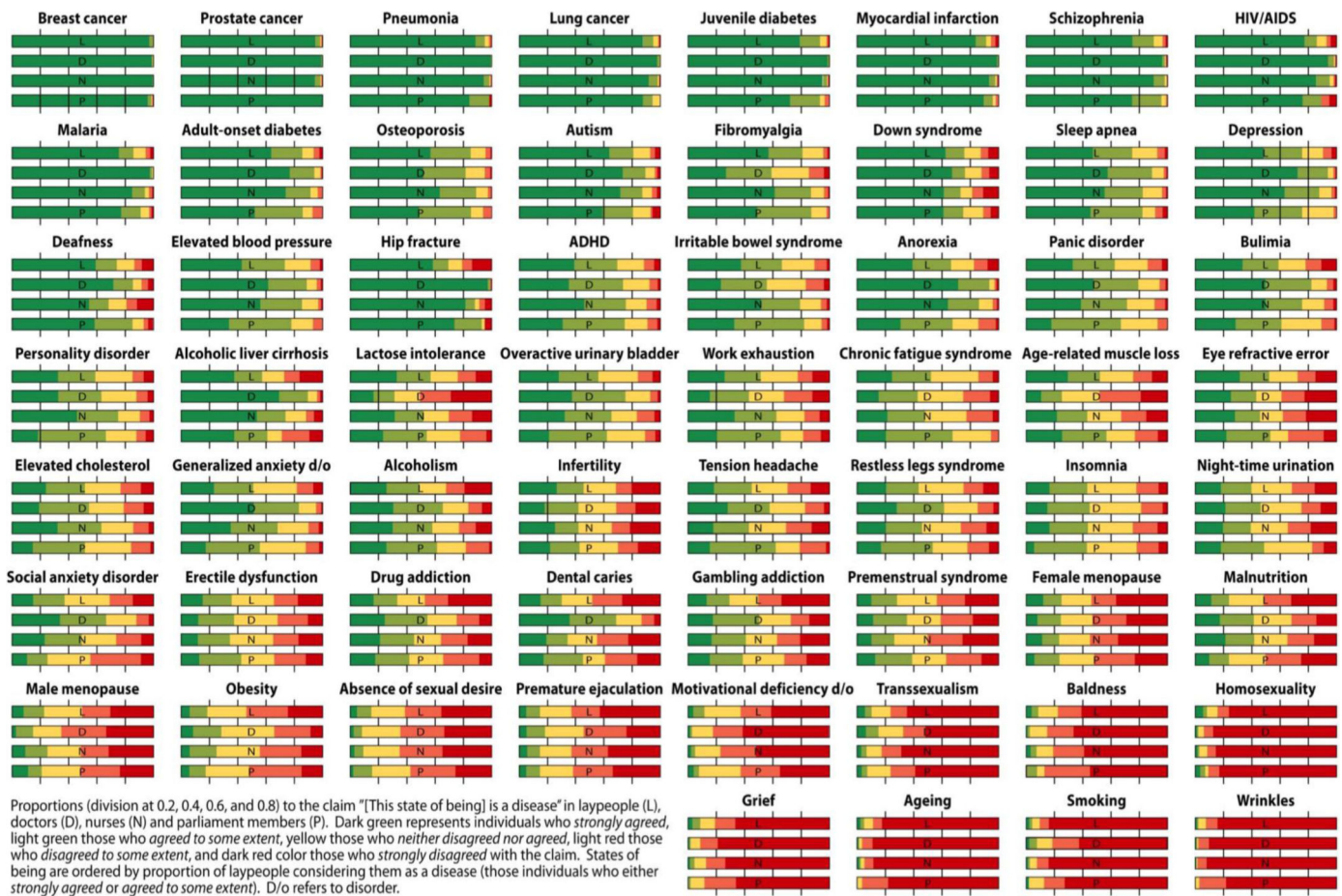
Textbook analyses have been used in research before, for example to look at multiple editions of the same textbook to understand how the presentation of obesity has changed,<sup>24</sup> and how the idea of giving medical prognoses has faded over the years.<sup>25</sup> Other studies have looked at a range of textbooks to assess whether they provide adequate factual information on specific topics<sup>26–28</sup> or adequate patient-orientated communication skills.<sup>29</sup>

Our main aim here is to discover how medical textbooks present the relationship between aging and disease. In particular, do they specifically argue the existence of a separate, non-pathological process of aging? If so, what is the justification for this separation? And what are the criteria for deciding which deteriorative age-changes are part of normal aging, and which are pathological changes?

### 2.2.1. Methodology

#### 2.2.1.1. Textbook selection

The study was conducted in University College London (UCL) libraries. For the final analysis, 14 textbooks were selected. Due to the great number and variety of medical textbooks, the selection process was not straightforward. Medicine is divided into more than 40 disciplines with separate textbooks.<sup>30</sup> An interesting question is how aging is understood in different medical disciplines, but this lies beyond the scope of this study. Instead, we focus on textbooks of general clinical medicine, also known as reference books. These textbooks include factual knowledge to practise medicine, explain basic science, research evidence and the context of underlying principles. Moreover, they outline how to apply this knowledge to manage patients. However, even within this niche, a plethora of textbooks exists. For instance, some may constitute multi-volume reference guides for professionals, whilst others are intended as pocket books for junior doctors and others as revision aids



**Figure 1.** Laypeople (L), doctors (D), nurses (N) and members of parliament (P) evaluate the claim “[This state of being] is a disease”. Although there is much variation in the perception of disease, aging is one of the five states that is clearly not seen as a disease. This view is stronger amongst doctors and nurses than laypeople<sup>1</sup>.

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for a specific student exam. Which ones are most widely consulted amongst university students? It appears that a universal list identifying key textbooks for each medical discipline, compiled by asking medical schools for their recommendations, was last created in 1971.<sup>30</sup> Other studies employ one or a few subjective methods to create a selection of textbooks for analysis.<sup>28,29</sup> Therefore, we used a combination of approaches to assess the popularity of medical textbooks. Overlap in the following subjective sources indicates the frequent use of particular textbooks:

- A review of articles and blog posts recommending a list of medical textbooks (e.g. The Student Room Community, 2015).<sup>31</sup>
- A review of the number of holdings in the library shelf WB100 *Practice of Medicine*.
- A review of the short loans collection, shelving the most frequently borrowed library books.
- A review of textbooks used in previous medical textbook analyses.
- A review of the medical core collection for libraries with the tag *general medicine*, as specified by the Chartered Institute of Library and Information Professionals (CILIP).
- A review of readings lists for the Bachelor of Medicine and Surgery (MBBS) programme.

Table 3 shows our final selection of medical textbooks. The table includes the number of worldwide library holdings as an indicator of the relative popularity of the selected textbooks. This information was extracted from



WorldCat, a global platform assembling library holdings and thereby creating a *collective collection* of worldwide libraries.<sup>32</sup>

**Table 3. Medical textbooks selected for analysis. Listed by title in alphabetical order.**

Name of Textbook	Mention 'aging' in index (Yes/No)	Chapter on 'aging' (Yes/No)	Library holdings worldwide**
Blueprints Medicine <sup>50</sup>	N	N	232
Color Atlas and Text of Clinical Medicine <sup>51</sup>	N	N	409
Davidson's Principles and Practise of Medicine <sup>37</sup>	Y*	Y	848
Goldman's Cecil Medicine <sup>52</sup>	Y*	Y	572
Harrison's Principles of Internal Medicine <sup>36</sup>	Y*	Y	2089
Kumar and Clark's Clinical Medicine <sup>34</sup>	Y*	N	485
Lecture Notes: Clinical Medicine <sup>53</sup>	N*	N	293
Medical Sciences <sup>54</sup>	N*	N	268
Medicine <sup>33</sup>	Y*	N	185
Medicine and Surgery – an Integrated Textbook <sup>55</sup>	N	N	240
Medicine at a Glance <sup>56</sup>	Y*	N	347
Oxford Handbook of Clinical Medicine <sup>35</sup>	Y*	N	488
Oxford Textbook of Medicine <sup>57</sup>	Y*	N*	14
Textbook of Medicine <sup>38</sup>	Y*	Y	348

\* These textbooks mention a related term such as “elderly”, “geriatrics” or “older adult”.

### 2.2.1.2. The research process

To established how the selected textbooks deal with aging, we first reviewed the index for the term *aging/ageing* (U.S./U.K. spelling). For books where the index did not contain the term, no further analysis was conducted. If the index did contain the term, we checked whether a) the textbook dedicates an entire chapter or more on aging; and b) the textbook deals with the aging vs. disease dichotomy. For the latter, the book had to show some acknowledgement of the complexity of the aging process and to put it into a medical context. This might include addressing some of the following questions. What is the relationship between aging and age-related diseases? Is the first normal and the second pathological? What is the current state of research into the biology of aging? What are the mechanisms and evolutionary origins of aging? What is the future of geriatric medicine? Can one intervene in the aging process? Textbooks do not deal with the aging vs. disease dichotomy if they only offer descriptive accounts, such as outlining changes or diseases with the highest prevalence amongst elderly, or discussing how to manage and treat older adults. For the purpose of this study, we are interested in textbook passages that discuss the aging-disease dichotomy.

To check whether accounts of the aging vs. disease dichotomy are tied to other terms, we reviewed the textbooks for the terms *elderly*, *geriatrics* and *older adults*. Additionally, in the final qualitative analysis, we selected the textbooks which touch on the aging vs. disease dichotomy, and used quotations and illustrations to analyse specifically whether aging is seen as a disease.

### 2.2.1.3. Strengths and limitations of the textbook analysis

In terms of the textbook selection, this study is limited to textbooks of general clinical medicine. Moreover, it does not consider the specific audience each textbook is aimed at. For example, some books are clearly geared

towards undergraduate students, while others may be written as handbooks for junior doctors or reference guides for professionals. Thus, it is not clear whether similar results would be obtained by analysing textbooks across different medical fields or textbooks targeting specific audiences.

Additionally, it is unlikely that undergraduate medical students will limit their readings to student textbooks, but access professional sources for better and more detailed understanding of particular areas. However, the sample of textbooks analyzed here does represent popular general clinical textbooks used by undergraduate students; a several methods were used to define the most widely consulted general clinical textbooks, to try to reduce selection bias. Nonetheless, the selection was drawn from a study of University College London (UCL) libraries, and other universities may hold different types on clinical textbooks.

This limitation was somewhat balanced by including WorldCat ratings in the analysis. These offer a global basis of comparison between the popularity of the final textbook selection. It should be noted, however, that the WorldCat numbers refer to all editions of a particular textbook. Thus, it is likely that older textbooks will have more holdings than more recent textbooks, regardless of the popularity. Moreover, WorldCat search results do not necessarily correspond to all available items, because some libraries may not have subscribed to their service. Additionally, it appears that WorldCat is biased for example by excluding non-academic libraries, such as hospital libraries, from their search results. Nevertheless, WorldCat numbers are valuable in offering an objective measure to textbook usage.

## 2.2.2. Results

Of the 14 books reviewed, five (35.7%) do not mention aging and ten (71.4%) do not dedicate an entire chapter on the topic (Table 3). Searches for additional terms elderly, geriatrics or older adults were also performed but did not lead to discussions of the nature of aging. For example, the *Oxford Textbook of Medicine*, a comprehensive three volume reference guide dedicates an entire chapter to Gerontology, but does not discuss the nature of aging itself. Instead, the chapter focuses on the concept of frailty and the major problems which bring older people into hospital other than specific diseases (e.g. falls, pressure sores, incontinence). The chapter also includes a comprehensive guide to geriatric assessment and care.

Similarly, in other less detailed textbooks, index entries for elderly, geriatrics or older adults typically refer to changes occurring in particular age groups. A typical example is the following passage from *Medicine*: “Many of the patients now on renal replacement therapy are elderly. In the elderly, most renal diseases are seen with greater frequency because of increased incidence of hypertension, diabetes mellitus, vascular disease and prostatic disease. Tumours are also more common in the elderly. Of the glomerular diseases, membranous nephropathy is more common in the elderly” (p. 503).<sup>33</sup>

### 2.2.2.1. Books mentioning aging but without dedicated chapters

Nine textbooks (64.3%) mention aging in the index, of which four dedicate at least one chapter on the topic and are discussed later. In the remaining five, there are few index entries on the topic, and what they refer to varies considerable. For example, they examine aging under the topic headings cancer, drug side effects, haematological changes, hypogonadism and skin changes. Thus, aging is presented as a modulator and risk factor for disease. The nature of aging itself is not discussed.

Among these five, two – *Kumar and Clark's* and the *Oxford Handbook of Medicine* – stand out in how they depict aging and portray the elderly, acknowledging the different ways that aging is conceptualised in medicine.<sup>34,35</sup> In *Kumar and Clark's* aging is described in the chapter *Nutrition*. Here, there is a synthesis between theories of aging, and nutrition as a key moderator of the aging process. There is no discussion of aging in relation to disease, though the elderly are occasionally portrayed in a somewhat depressing way. For example, there is a discussion of malnutrition due to “lack of cooking skills (particularly in widowers), depression and lack of motivation” (p. 215). Moreover, it is noted that elderly people “in institutions” commonly have multiple

nutritional deficiencies and vitamin D supplements may be required because “often elderly people do not go into the sunlight” (p. 215).

By contrast, the *Oxford Handbook of Clinical Medicine* appears more at pains to counter negative stereotyping of the elderly. Here aging is mentioned in the chapter ‘Thinking about Medicine’ and presented as a disease-like state: “Any deterioration in an elderly patient is from treatable disease until proven otherwise. Find the cause; don’t think: this is simply aging. Old age is associated with disease but doesn’t cause it per se. Do not restrict treatment because of age – age alone is a poor predictor of outcome.” (p. 12). Interestingly, despite this clear statement about aging, there is no separate chapter to deal with this issue. In summary, the index entries and contrasting depictions demonstrate the varied representation of aging in medical textbooks.

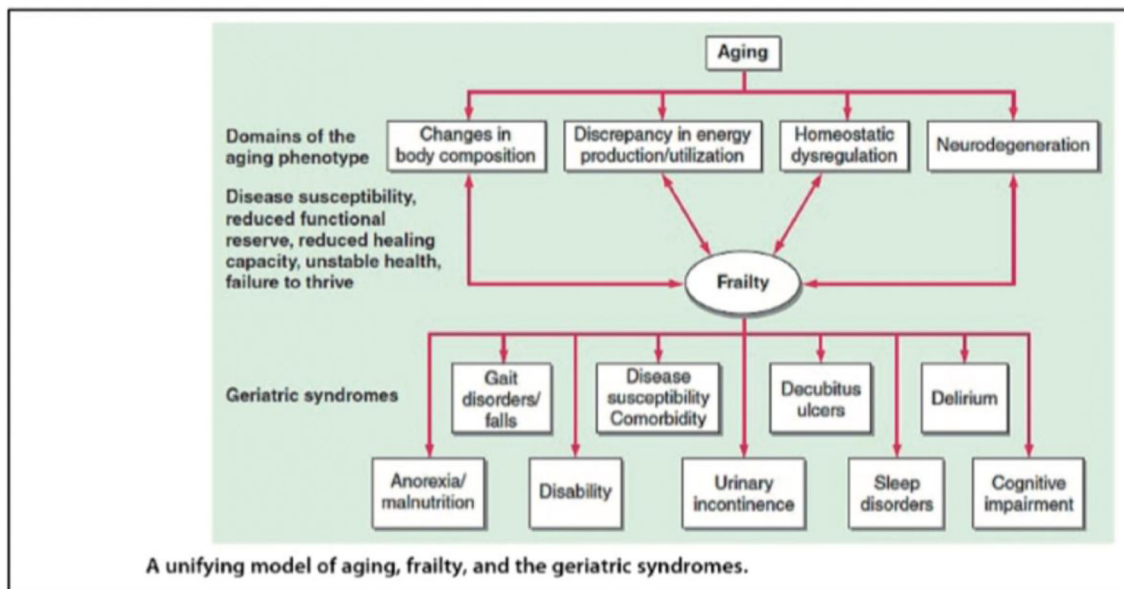
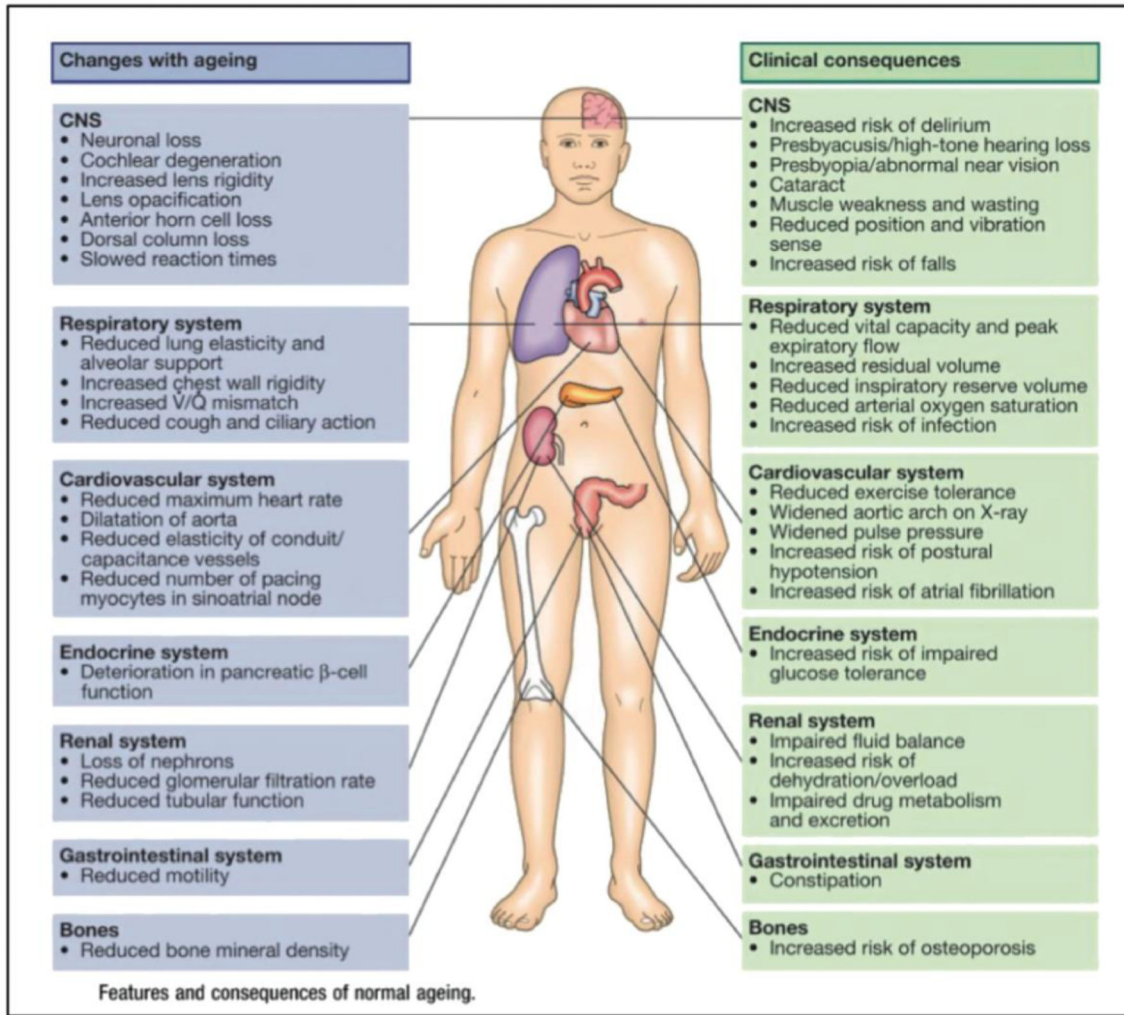
#### 2.2.2.2. Books with dedicated chapters on aging

Of the 14 textbooks, four (28.6%) have a specific chapter on aging. Looking at the number of editions and WorldCat library holdings, these textbooks are among the most established and popular of those examined here. They make the most reference to questions of what aging is and its relationship to disease. *Harrison’s Principles of Internal Medicine* includes two chapters on aging,<sup>36</sup> and *Davidson’s Principles and Practise of Medicine* has information boxes throughout the book relating each condition to old age.<sup>37</sup> So is aging depicted as distinct from, similar to or the same as disease?

The general trend across these four textbooks is similar: aging is neither regarded as a disease, nor as something entirely normal, but has components of both. A recurrent term is *geriatric condition*, referring to deteriorative changes with age that are not regarded as diseases. For example, “a sudden onset of headaches or a recent change in bowel habit is never normal in old age, whereas gradually failing hearing and vision may be” (*Textbook of Medicine*, p. 191).<sup>38</sup> Table 4 lists more quotations that touch upon the distinction between disease and aging. Additionally, Figure 2 and Table 5 and 6 show how various senescent changes are categorized into pathologies and non-pathologies.

How is it decided whether a given senescent change is to be viewed as pathological or normal? Overall, there seems to be a consensus agreement with respect to this division. For example, visual impairment, hearing impairment, falls and bone loss are attributed to normal aging. Diabetes and Alzheimer’s disease, on the other hand, are referred to as diseases. However, for some conditions, such as sleep disturbances, classifications vary (Figure 2).

While no clear criteria are presented to distinguish normal senescent changes from pathological ones, there is some recognition that this binary distinction can be problematic. For example, according to *Davidson’s*, “the physiological features of normal aging have been identified by examining disease-free populations of older people, to separate the effects of pathology from those due to time alone. However, the fraction of older people who age without disease ultimately decline to very low levels so that use of the term ‘normal’ becomes debatable” (p. 167). *Harrison’s* notes that the separation occurs “somewhat artificially” (p. 94 e-1). This problem is further outlined in the *Textbook of Medicine*: “There has been a long-running debate on what constitutes normal gait in old age and the cause of senile gait disorder” (p. 180f.). Generally, the textbook recognises that “the distinction between this and normal physiological aging is often difficult to make, and there is increasing recognition that so-called normal aging is the result of occult pathology” (p. 174).



**Figure 2. Illustrations of the distinction between normal and pathological aging from two textbooks of clinical medicine. Top, Davidson's Principles and Practise of Medicine, ref.<sup>37</sup> Bottom, Harrison's Principles of Internal Medicine, ref.<sup>36</sup>.**

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**Figure 3. Representation of the conventional view that “aging is normal”;** from *Basic Pathology*, Lakhani et al., (© 2009), Taylor & Francis, ref.<sup>58</sup>. This excellent textbook on the biological basis of disease presents this nice cartoon without further explanation.

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**Table 4. Quotations from four medical textbooks highlighting the distinction between normal and pathological aging.**

Davidson's Principles and Practise of Medicine <sup>37</sup>	<p>“The physiological features of normal ageing have been identified by examining disease-free populations of older people, to separate the effects of pathology from those due to time alone. However, the fraction of older people who age without disease ultimately decline to very low levels so that use of the term ‘normal’ becomes debatable.” p. 167</p> <p>“The effects of ageing are usually not enough to interfere with organ function under normal conditions, but reserve capacity is significantly reduced.” p. 167</p> <p>Information Box on Atherosclerosis and Ageing: “prevalence: related almost exponentially to age in developed countries, although atherosclerosis is not considered part of the normal ageing process” p. 602b</p>
Textbook of Medicine <sup>38</sup>	<p>“The resulting disability is not fixed or inevitable. For example, high-tone deafness and high blood pressure are common in elderly Britons, but are absent among elderly persons in the Eastern Islands. Osteoporosis is common in western Europe and the USA but rare in China. Thus descriptions of physical decline are too variable to be useful for defining ageing.” p. 172</p> <p>“Degenerative changes occur throughout the body with increasing age, but these may become sufficiently marked to constitute a pathological process. The distinction between this and normal physiological ageing is often difficult to make, and there is increasing recognition that so-called normal ageing is the result of occult pathology.” p. 174</p> <p>“A sudden onset of headaches or a recent change in bowel habit is never normal in old age, whereas gradually failing hearing and vision may be.” p. 191</p> <p>“occasional ectopic beats occur in about one-sixth of elderly persons, but any other arrhythmia should be regarded as abnormal and investigated by electrocardiography” p. 192</p>
Goldman's Cecil Medicine <sup>52</sup>	<p>“Health status in aging is a result of many factors, including the chronic diseases of aging and many other prevalent “geriatric” conditions that cannot be defined as classic “diseases” because they do not result from a single pathological cause.” (p. 98)</p> <p>“physiologic aging modulates the way in which illnesses cause signs and symptoms” p. 105</p> <p>“geriatric syndromes emerge from these age-related changes” p. 105</p>

Table 4 continued from previous page.

	<p>“Some physiological changes imitate illness when they may be a normal part of aging. Diabetes mellitus may ‘appear’ and ‘disappear’ in the elderly.” p. 105</p> <p>“The major clinical impact of normal physiologic ageing in the lungs is an earlier appearance of shortness of breath as warning signal of underlying disease.” p. 106</p> <p>“normal ageing produces an obvious decrease in the size of the thymus gland” p. 106</p> <p>“Severe neuropsychiatric conditions are due to diseases that increase with age but are not part of the normal aging process.” p. 114</p> <p>“The process of aging produces important physiologic changes in the central nervous system (...). These processes result in age-related symptoms and manifestations for many older persons (...) the decline may be modified by factors such as diet, exercise, environment, lifestyle, genetic predisposition, disability, disease and side effects of drugs. These changes can result in the common age-related symptoms of benign senescence, slowed reaction time, postural hypotension, vertigo (...). In the absence of disease, these physiologic changes usually result in relatively modest symptoms and little restriction in activities of daily living. The changes decrease physiologic reserve, however, and increase the susceptibility to challenges posed by disease-related, pharmacologic and environmental stressors.” p. 114</p>
Harrison's Principles of Internal Medicine <sup>36</sup>	<p>“The phenotype that results from the aging process is characterized by increased susceptibility to diseases, high risk of multiple coexisting diseases, impaired response to stress (including limited ability to heal or recover after an acute disease), emergence of “geriatric syndromes” (characterized by stereotyped clinical manifestations but multifactorial causes), altered response to treatment, high risk of disability, and loss of personal autonomy with all its psychological and social consequences. In addition, these key aging processes may interfere with the typical pathophysiology of specific diseases, thereby altering expected clinical manifestations and confounding diagnosis.” p. 76</p> <p>“The term geriatric syndrome encompasses clinical conditions that are frequently encountered in older persons; have a deleterious effect on function and quality of life; have a multifactorial pathophysiology, often involving systems unrelated to the apparent chief symptom; and are manifested by stereotypical clinical presentations. The list of geriatric syndromes includes incontinence, delirium, falls, pressure ulcers, sleep disorders, problems with eating or feeding, pain, and depressed mood. In addition, dementia and physical disability are sometimes considered to be geriatric syndromes.” p. 79</p> <p>“Normal aging is associated with a decline in food intake that is more marked in men than in women.” p. 81</p> <p>“Modest changes in balance function have been described in fit older individuals as a result of normal aging.” p. 164</p> <p>“The aging process is the major risk factor underlying disease and disability in developed nations, and older people respond differently to therapies developed for younger adults (usually with less effectiveness and more adverse reactions).” p. 94e-1</p> <p>“The phenotypic components of aging include structural and functional changes that are separated, somewhat artificially, into either primary aging changes (e.g. sarcopenia, grey hair, oxidative stress, increased peripheral vascular resistance) or age-related disease (e.g. dementia, osteoporosis, arthritis, insulin resistance, hypertension).” p. 94 e-1</p> <p>“Clinicians need to understand aging biology in order to better manage people who are elderly now. Moreover there is an urgent need to develop strategies based on aging biology that delay aging, reduce or postpone the onset of age-related disorders, and increase functional life and healthspan for future generations. Interventions related to nutritional interventions and drugs that act on nutrient-sensing pathways are being developed and, in some cases, are already being studied in humans. Whether these interventions are universally effective or species/individual specific needs to be determined.” p. 94 e-7</p>

**Table 5. Textbook distinction between normal vs pathological decrements in physiological performance in old age. Retabulated from ref.<sup>38</sup>, p. 177.**

Normal age-related functional decline	Pathological process
Impaired sight (presbyopia)	Cataracts, macular degeneration
Impaired hearing (presbycusis)	Effects of ototoxic drugs, diuretics or vascular disorders
Bone loss	'accelerated' osteoporosis
Decline in intellectual function	White matter lesions due to hypertension; Alzheimer's disease
Impaired glucose tolerance	Diabetes
Minor gait slowing and balance impairment (increased sway)	Parkinson's, Alzheimer's or cerebrovascular disease; dementia; vestibular lesions; cervical spondylosis, visual problems
Altered sleep pattern	Insomnia due to nocturia (due to detrusor instability); pain, depression, etc.

**Table 6. Textbook distinction between clinical diseases and geriatric syndromes. Retabulated from ref.<sup>52</sup>, p. 99.**

Clinical diseases	Geriatric syndromes
Hypertension	Disability
Arthritis	Hearing impairment
Heart disease	Urinary incontinence
Malignant neoplasm	Falls
Influenza	Visual impairment
Diabetes	Frailty
Alzheimer's disease	
Sinusitis	
Ulcers	
Stroke	
Asthma	
Emphysema	
Kidney disease	
Liver disease	

### 2.2.2.3. Summary of findings

There is considerable variability in the way that aging is represented in textbooks of general clinical medicine. Broadly, three categories exist:

- 1). Textbooks that do not mention aging in the index. This is the case in a large proportion of textbooks. They do not address the question of what aging is, the division between aging and disease, etc. Related terms in the index, such as elderly, geriatrics, or older people refer to descriptive passages, where changes in the elderly are outlined or examination procedures recommended.
- 2). Textbooks that mention aging in the index, but do not have a specific chapter dedicated to the topic. Here, aging is referred to in multiple sections of the book. Aging is not the focus of these sections, but

rather a risk factor for other diseases or modifier for drug dosages. In most cases, the textbooks do not include discussions of aging itself.

- 3). Textbooks that have at least one chapter on aging. This is the case in four clinical textbooks, which appear to be the more popular ones. They deal with aging in most detail, but do not label it as a disease. Instead, all four textbooks present aging as partly normal and partly pathological. Problems arising from this distinction are recognized by all textbooks. However, none provide a rationale for viewing aging as a natural and non-pathological part of senescence, or define criteria for distinguishing pathological and non-pathological elements of senescence.

### 3. Discussion

The aim of this study is to examine the extent to which medicine still relies on the traditional distinction between normal aging and disease. Based on its etiology, we argue that senescence is a pathological process and phenomenon. By contrast, non-pathological senescence is a relic concept rooted in traditional ideas about aging, whose origins seem to lie as far back as the writings of the Roman physician Galen in the second century A.D.<sup>39</sup> Interestingly, our analysis reveals considerable variety in the way that aging is presented in medical textbooks. It is at times presented as an underlying risk factor for disease, or a modulator for drug dosages, or looked at in biogerontological terms, or barely mentioned at all. Only four out of fourteen textbooks examined consider the nature of aging itself, and the relation between aging and disease. Here aging is seen not as a disease, but as something between a pathological and normal process. This diverse pattern of representation of aging across medical textbooks appears to reflect linguistic confusion caused by the multiple and easily conflated meanings of the English word aging. This confusion impacts on medical understanding and medical care.

What are the implications of this pattern of representation of aging? Given that some textbooks barely refer to aging, and those that do rarely discuss the nature of aging or its relationship to pathology, this suggests that many medical students are left in the dark about these critical issues. Moreover, regardless of which textbook medical students use, they will not be taught that aging is a disease. Not even the more popular textbooks that discuss aging support this notion. Instead, they explain that aging lies somewhere between normal and pathological processes. This distinction is artificial, confusing and problematic, especially when classifications vary, as seen with sleep disturbances. Therefore, one clinician may refrain from treatment, dismissing sleep disturbances as normal, whilst another clinician may seek treatment. More broadly, failing to understand senescence as pathology is not only inadequate in scientific terms, but also a barrier to delivering quality treatment to the elderly. Underlining this point, the surgeon Gawande (2014) acknowledges that “(...) scientific advances have turned the processes of aging and dying into medical experiences, matters to be managed by health care professionals. And we in the medical world have proved alarmingly unprepared for it” (p. 6).<sup>40</sup>

Our small scale textbook analysis raises several further questions and directions for future research. First, it leaves unanswered whether the content of the textbooks examined represent general medical views, which are also influenced by lectures, work placements, and personal experiences. Looking at the previous studies on medical conceptualisations of aging, there appears to be a correspondence between textbook content and the later attitude of medical professionals. For instance, like the textbooks, the study by Tikkinen *et al.* (2012) indicates that healthcare professionals do not see aging as a disease.<sup>1</sup> However, the study gives no indication of whether doctors see aging as part pathological and part normal – the view represented in more popular textbooks – or whether they have encountered arguments against the aging-disease false dichotomy at all. In-depth interviews or focus groups could yield more information about how medical professionals learn about concepts of aging, and how these influence their treatment of the elderly.

Second, the question arises why the view of aging not being a disease, but rather a normal occurrence, is so persistent in medicine. Gawande (2014) claims that “people naturally prefer to avoid the subject of their decrepitude” (p. 35) and doctors are turned off by geriatrics, because they do not have the faculties to cope with



it.<sup>40</sup> This idea is discussed by Caplan (2005), who suggests that doctors employ the ideas of the *naturalness* of aging as a type of defense mechanism, against despair when repeatedly dealing with chronically and incurably ill elderly patients.<sup>6</sup> There are other possible explanations for doctors' reluctance to view aging as a disease which could be investigated. For example, is it that they wish to avoid association with quack peddlers of anti-aging medication? Do they view interventions in the aging process as artificial enhancement technologies? Do they anticipate adverse economic consequences of an increasingly older population? Do they believe that the goals of treating aging are intangible? Or do they believe that experiencing the aging process has its benefits? These questions could be answered by structured interviews or focus groups with medical professionals.

It would also be interesting to explore whether the medical representation of aging has changed across the years, similar to that of obesity.<sup>24</sup> For example, osteoporosis was not regarded as a disease by the WHO until 1994.<sup>41</sup> Perhaps this is indicative of a broader reconceptualisation of aging (i.e. senescence), informed by biogerontological investigation. Considering the textbook analysis, the more popular and more established textbooks distinguish themselves by noting the artificial distinction between normal and pathological aging. Perhaps this acknowledgment is the first step into fully recognizing aging as a disease? A textbook analysis, looking at how aging is portrayed in previous editions of these volumes, could test for the existence of this transformation process.

Lastly, it must be noted that although moving towards a disease classification is reasonable and beneficial in several ways, it increases the risk of biomedicalizing aging. That is, there is a danger that a new medical model takes over and defines other non-biological processes of aging, including social and psychological ones.<sup>42</sup> Therefore, more research is needed to find out how to recognise aging as a disease without devoting resources away from understanding these other important phenomena of aging.

To conclude, our analysis of medical textbook content suggests a general neglect of the question of what aging is, unease about the somewhat arbitrary classification of different manifestations of senescence as normal or pathological, and the absence of any rationalization of the concept of normal aging. Some of these problems reflect linguistic confusion created by the word aging. These observations suggest that medicine remains in the dark about aging.

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