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SCIENTIFIC CONTRIBUTION

Medicalization and overdiagnosis: different but alike

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Abstract Medicalization is frequently defined as a process by which some non-medical aspects of human life become to be considered as medical problems. Overdiagnosis, on the other hand, is most often defined as diagnosing a biomedical condition that in the absence of testing would not cause symptoms or death in the person's lifetime. Medicalization and overdiagnosis are related concepts as both expand the extension of the concept of disease. They are both often used normatively to critique unwarranted or contested expansion of medicine and to address health services that are considered to be unnecessary, futile, or even harmful. However, there are important differences between the concepts, as not all cases of overdiagnosis are medicalizations and not all cases of medicalizations are overdiagnosis. The objective of this article is to clarify the differences between medicalization and overdiagnosis. It will demonstrate how the subject matter of medicalization traditionally has been non-medical (social or cultural everyday life) phenomena, while the subject matter of overdiagnosis has been biological or biomolecular conditions or processes acknowledged being potentially harmful. They also refer to different types of uncertainty: medicalization is concerned with indeterminacy, while overdiagnosis is concerned with lack of prognostic knowledge. Medicalization is dealing with *sickness* (sick role) while overdiagnosis with *disease*. Despite these differences, medicalization and overdiagnosis are becoming more alike. Medicalization is expanding, encompassing the more "technical" aspects of overdiagnosis, while overdiagnosis is becoming more ideologized. Moreover, with new trends in modern medicine, such as P4 (preventive, predictive, personal, and participatory) medicine, medicalization will become all-encompassing, while overdiagnosis more or less may dissolve. In the end they may converge in some total "iatrogenization." In doing so, the concepts may lose their precision and critical sting.

Keywords Overdiagnosis · Medicalization · Ideology · Science · Futile · Unnecessary

Introduction

Overdiagnosis and medicalization are often mentioned in the same vein and even in the same sentence (Frosch et al. 2010; Bandini 2015). The terms are core in a wide range of critiques of modern medicine. Both concepts indicate concern with the fact that the number of persons who are considered to be or treated as were they diseased is increasing. Both urge reflection on the limits of the concept of disease. Some also consider overdiagnosis to be a form of medicalization (Rogers 2015). However, overdiagnosis and medicalization have different historical and ideological backgrounds (Clark 2014). The term "overdiagnosis" stems from health professionals' reflection on the limits and utility of diagnostics, while "medicalization" has its roots in critiques of modern medicine from without, especially from philosophy and the social sciences (Maturo 2012).

Thus, it is pertinent to ask whether overdiagnosis and medicalization are similar, comparable, or compatible. And if not, what is the difference? These are the key questions

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in this article and will be addressed by giving examples, definitions, characteristics, as well as by identifying drivers of medicalization and overdiagnosis respectively. A comparison and an analysis of the dynamics of the concepts amounts to a conclusion that, although medicalization and overdiagnosis have very different points of departures, the concepts are getting closer with recent developments in the life sciences, especially in what has been coined "P4 medicine." Nevertheless, it still is fruitful to differentiate between them.

Medicalization

The term is frequently traced back to the critique of modern medicine in the 1960s and 1970s by scholars such as Ivan Illich, I.K. Zola, Michel Foucault, R. D. Laing, Thomas Szasz, and others (Nye 2003; Zola 1972; Ballard and Elston 2005).

Examples, definitions, and characteristics

There are many examples of medicalization in the literature. Some examples of phenomena that have been medicalized are: shyness (Scott 2006), sorrow (Wakefield 2012; Bandini 2015), sadness (Horwitz and Wakefield 2007), love (Earp et al. 2015), addiction (Clark 2014), death (Goh 2012), poverty (Sadler et al. 2009), aging (Illich 1976), pregnancy, menopause, childbirth (Ballard and Elston 2005), infant feeding, sexual function (Moynihan 2003; Moynihan et al. 2002), mood, (child) behavior (Sadler et al. 2009), race (Duster 2007), criminality (Verweij 1999), beauty, and baldness (Moynihan et al. 2002).

Medicalization has frequently been defined in terms of dominance, its basic phenomena (problems), specific background rationalities or ideologies, or combinations of these. Table 1 gives some examples of such definitions.

Healthism is a related term, and "disease mongering" has been used to denote a certain form of medicalization in order to highlight the urge of the pharmaceutical industry to sell sickness (Moynihan et al. 2002). Moral concerns have been identified, e.g., that medicalization would weaken people's feeling of security and confidence in health and promote unwarranted personal moral obligations (to guard their health) (Verweij 1999), but also that it privileges a biomedical perspective, i.e., that it is a kind of epistemic injustice (Wardrope 2015). More recently, it has also been argued that medicalization has evolved from being a one-dimensional concept of professional dominance to become a multidimensional concept influenced by a wide range of actors, including patients and industry (Conrad 2007). In a societal perspective medicalization has become "the product as well the cause of societal faith in medical knowledge and practice."(Ballard and Elston 2005)

Medicalization has also been classified according to its occurrence. E.g., *conceptual medicalizations* is when medicalization is a result of using medical taxonomy on new areas ("mammary ptosis"), *institutional medicalization* is when medical doctors become managers without any leadership training, and *interactional medicalization*, is when medical doctors define social phenomena as disease (homosexuality) (Conrad 2007). Medicalization has also been conceived of as a *process* versus as an *outcome*, as something *positive* or something *negative*, as something *partial* or *complete*, or in terms of a wide variety of *actors* (health care professionals, patients, industry, health policy makers) (Conrad 2005; Clark 2014).

Hence, there are several ways to classify medicalization. The core appears to be how *phenomena, authority, or rationality related to medicine becomes pervasive to areas previously not considered to belong to the realm of medicine*.

Drivers of medicalization

A wide range of drivers of medicalization have been identified (Conrad 2005), such as the pharmaceuticalization (Maturo 2012; Bell and Figert 2012; Abraham 2010), biomedicalization (Cipolla 2010; Clarke et al. 2003), and genetization (Maturo 2012; Lippman 1998) of society, as well as the drive for human enhancement (Cipolla 2010; Rose 2007). Not only medical doctors or the pharmaceutical industry are core actors in the medicalization, but patients or patient interest groups (Ballard and Elston 2005) and society at large.

It may also be argued that medicalization is enhanced by the conflation of the three perspectives on human malady, i.e., *disease*, *illness*, and *sickness*. The professional perspective, *disease*, is redefined and expanded into the realm of personal experience, *illness*, and into the social role of *sickness*. As expressed by Maturo: "it seems that today these three dimensions – body, psyche and society – are fully involved in the medicalization process. Moreover, health should be considered more as a "process", than a state. A process in which "physical, mental and social wellbeing" is constructed, maintained and rebuilt." (Maturo 2012) While it may be important to differentiate between medicalization and other social processes (Garry 2001) the expansion of the concept (see below) makes this more challenging.

Moreover, medicalization may also be propelled by values. Sadler and colleagues argue that medicalization is driven by values such as (a) the interest of managing illness in the most efficient, economical, or profitable manner. Moreover, it is propelled by (b) professional interests in

Table 1 Examples of definitions of medicalization

Type of definition (referring to as the basic aspect)	Example of definition
Dominance, authority (medical imperialism)	Medicalization is:
	"the expansion of medical authority into the domains of everyday existence"(Metzl and Herzig 2007)
	"extension of medical authority beyond a legitimate boundary"(Rose 2007)
	Extended social control: "On a practical level 'medicalization' refers to the phenomenon that (healthy) persons tend to adjust their life and life-style according to medical information, advice and procedures." (Verweij 1999). See also Davis (2010)
Basic phenomena (problems)	''Medicalization' describes a process by which nonmedical problems become defined and treated as medical problems, usually in terms of illness and disorders''(Conrad 2007)
	"Medicalization describes a process by which human problems come to be defined and treated as medical problems."(Sadler et al. 2009)
	"Medicalization occurs when human problems or experiences become defined as medical problems, usually in terms of illnesses, diseases, or syndromes." (Conrad and Barker 2010)
	Using medical terms for "normal life:" "terms such as 'health', '(un)healthy', and 'illness' are used for 'new' areas: behaviour, properties, events and problems which used to be part of normal life." (Verweij 1999; Zola 1972)
Background rationalities or ideologies (combined with phenomena)	"Medicalization is a process by which human problems come to be defined and treated as medical problems. It involves the application of a biomedical model that sees health as freedom from disease and is characterised by reductionism, individualism, and a bias toward the technological." (Clark 2014)

terms of a desire for power or wealth, (c) eudaimonia in improving human welfare, (d) the tension between individualism and communalism, where the individual responsibility for health plays an important role. Medicalization is also used to (e) minimize or shift political problems, e.g., to depoliticize politically difficult social problems. Additionally, (f) technological values such as ''push-button solution,'' ''quick fix,'' and ''magic bullet'' beliefs are at play. Related to this there appears to be a drive (g) to transcend human-existential limitations in terms of ''trans-'' or ''post-humanism'' (Sadler et al. 2009).

Hence, a wide range of drivers for medicalization are identified, all contributing to its expansion and diversity.

Trends and directions

The concept of medicalization was initially introduced as a critique of the excessive authority of doctors and its detrimental consequences. Ivan Illich argued that by overdoing its scientific and cultural authority the medical establishment became a "threat to health" (Illich 1976). His remedy was "laicisation of the Temple of Aesculapius."

However, as already alluded to, the traditional critique of doctors, expanding their empire implied in the medicalization label, has been checked by a myriad of actors and institutions: "Nowadays, the power of doctors is constrained by the shadow of the law, the apparatus of bioethics, evidence-based medicine, and patients' demands for autonomy to be respected, their rights to health satisfied, their injuries compensated." (Rose 2007)

Accordingly, the "doctor blaming" of the early medicalization debate has been replaced by "patient blaming" in the 2000s (Tomes 2007). "Ignorant, irrational patient-consumers provide an easy explanation for the persistence of problems: they refuse to believe in the truths revealed by science or economics, they resist paying what services are worth; they seek the wrong services (Botox, breast implants) and ignore the prudent action (smoking cessation, healthy diet)." (Tomes 2007) However, the debate has moved on to acknowledge that medicalization is not only an outcome, but a complex process with a wide range of actors. It has also come to acknowledge positive (Sadler et al. 2009) and pervasive aspects of medicalization, and that some appreciated benefits do not come without medicalization, e.g., benefits of drugs like Viagra do not come without medicalizing human sexuality (Garry 2001). That is, while the core moral mover of the medicalization debate in the 1960s and 1970s was to bar dominance and power, this has become more nuanced; where inevitable and positive aspects of medicalization have been highlighted and debated (Ballard and Elston 2005; Sadler et al. 2009).

In a broadening perspective Nicholas Rose argues that medicalization "has made us the kind of people we are" in

three dimensions. First, by medically stimulated *infrastructure* and ways of *organizing human life*. Water supplies, sewage systems, vaccination etcetera, has made us live "medical forms of life." Second, a wide range of social phenomena are explained and given meaning in *medical terms*. Third, medical expertize has been extended to a wide ranges of life, such as death, grief, and reproduction (Rose 2007). Moreover, it is argued that medicalization has individualized social problems (Conrad 1992).

As Rose points out, medicalization has become a part of "making up" the person: "It was in part through medicine that the human being became a possible object for positive knowledge—a living individual whose body and mind could be understood by scientific reason." (Rose 2007) Hence, the original function of the medicalization debate, i.e., using "medicalization" as a useful slogan for disputing the legitimacy of medical concerns or identifying the "extension of medical authority beyond a legitimate boundary" (Rose 2007) has lost its relevance. As Rose points out, medicalization is not useful as a description, as an explanation, or as a critique any longer. Medicalization has become too diverse and complex; it is driven by a multitude of motives and interests, and it is far from obvious why it is worse to analyze a phenomenon in medical terms than in other terms (Rose 2007). Hence, it may be argued that medicalization has lost its power as a critical concept in the analysis of medicine in society, and thereby also its relevance.

Accordingly, it can be maintained that (the function of) medicalization has gone from "making something medical" to "making something real." In the 1960s and 1970s the medicalization was to gain control and power over something by making it subject to medical professional attention. Today, it can be argued, medicalization is as much giving something acceptance and status by making it medical (Svenaeus 2015). By becoming a biological or medical phenomenon something gains relevance, i.e., there is a biomedicalization (Clark 2014). The power of medicine has changed from being something external and univocally obtrusive to become something pervasive and ambivalent.

Hence, it can be argued that medicalization has slipped from the hands of outsiders, such as philosophers and social scientists, and into the hands of biologists—it has transformed from a concept for criticizing power relationship in medicine to become the transformative power of modern medicine.

In sum, the concept of medicalization has been transformed. The number of types and categories of medicalization has increased and its moral underpinning has been nuanced. Moreover, medicalization is not restricted to making non-medical phenomena medical problems, but now includes the process of making medically identifiable phenomena real. With this the concept has departed from its origin and become all-encompassing. It includes making tumors to cancer and making Börjeson–Forssman–Lehmann syndrome a genetic disease. Broadening medicalization to making of any condition a medical issue (and not only non-medical phenomena) the concept loses its precision and critical potential. Hence, it needs differentiation and specification (as described above), and medicalization in the very broad sense may even include overdiagnosis.

Overdiagnosis

Let us now turn to overdiagnosis and analyze this concept in the same manner. The term stems from the same period as the term medicalization. It was previously named pseudodisease, and related (and sometimes confused) terms are overdetection, misdiagnosis, futile diagnostics, overtesting (Carter et al. 2015b).

Examples, definitions, and characteristics

Examples of overdiagnosis have been documented for diagnostic tests for a wide range of diseases: prostate cancer, breast cancer, pulmonary embolism, asthma, hypertension, ADHD, chronic kidney disease, gestational diabetes, lung cancer, osteoporosis, thyroid cancer (Welch and Black 2010; Welch et al. 2011; Moynihan et al. 2012) are but a few examples.

As in medicalization, overdiagnosis in a way consists of an expansion of the concept of disease, but the expansion is somewhat different. Traditionally, in medicalization previously non-medical phenomena, such as sexuality, pregnancy, childbirth, menopause, eating habits, criminality, ageing, and others, become subject to biomedical descriptions and are given medical significance. In overdiagnosis it is phenomena that are already characterized in biomedical terms, such as non-invasive lesions in the epithelium (in the breast), that are given pathological significance, such as *ductal carcinoma* in situ (DCIS). Overdiagnosis is frequently defined as a diagnosis of a condition in a(n asymptomatic) person where the diagnosis does not produce a net benefit for that person. In other words, overdiagnosis is «[t]he detection of abnormalities that are not destined to ever bother us» or "that will never cause symptoms or death" (Welch et al. 2011).

Moreover, the term overdiagnosis has been used in a narrow sense, e.g., in operational definitions in order to be able to estimate overdiagnosis in health care practice. The term has also been used in a wide sense, as an umbrella term for many kinds of flawed diagnostics (overdetection, overutilization, misdiagnosis, including overdiagnosis in the narrow sense). It may be fruitful to differentiate

between situations where overdiagnosis is a result of poor test performance (maldetection overdiagnosis) and where it stems from altered definition of disease (misclassification overdiagnosis) (Rogers 2015).

It is also worth noticing that the overdiagnosis is a challenging term, as its definitions presuppose prophetic abilities (e.g., by terms such as "not destined," "will never cause") (Hofmann 2014). Hence, it is not directly observable (with exception in what is called "pathological reserve," see below) and has to be estimated with methods difficult to validate. Therefore, estimating overdiagnosis is controversial (de Gelder et al. 2011; Hofmann 2014) and has spurred heated debates, especially with regard to mammography screening (Welch and Passow 2014). As such overdiagnosis shares the "spookiness" of medicalization.

As such, an overdiagnosis is not a false positive test result, as it is not false. The diagnosis is correct according to given diagnostic standards. However, the diagnosis will not benefit the person. A specific correctly diagnosed condition according to a medical standard metodology, say DCIS, may not come to result in symptoms, disease, or death if left untreated. Nonetheless, the same condition may turn out to become fatal breast cancer if not detected or treated. Hence, it is not making DCIS something of pathological significance that is the core of overdiagnosis. DCIS is already pathologically significant according to medical standards. In medicine DCIS is believed to cause breast cancer and death if not detected and treated. Only those cases that do not benefit from detection and treatment are overdiagnosed. Hence, overdiagnosis is a result of uncertainty, and has an epistemic basis. In medicalization, non-medical phenomena, say sorrow or sexuality, are given pathological significance.

Of course, one can argue that since we do not know whether diagnosis or treatment is beneficial, the condition should not be looked for in the first place. This issue is at the core of the overdiagnosis debate. However, that is a normative question following from overdiagnosis being an inevitable result from uncertain diagnostics (early diagnosis of heterogenous diseases with undifferentiating methods). Those who would have died if not diagnosed are not overdiagnosed. They are correctly diagnosed according to established and accepted medical standards. They are lucky. Those who would not have experienced disease or died if not diagnosed, are overdiagnosed, and are unnecessarily diagnosed and treated. They are unlucky (but they may not know).

Accordingly, one can apply the different types of uncertainty suggested by Wynne (1992) and argue that overdiagnosis is a matter of uncertainty (in terms of known outcomes with unknown probability distributions) while medicalization is a matter of indeterminacy. In the first case we know what can happen, e.g., a person can develop breast cancer, while in the latter the uncertainty is primarily a question of social commitment: do we help the person with sorrow better if we make it a disease? In the first case it is an epistemic question of uncertain diagnostic utility. In the latter it is a matter of classificatory (and social) utility.

Hence, although both medicalization and overdiagnosis may be considered to be social constructions of disease, following Hacking (1999), the "social construction" in overdiagnosis is different than in traditional forms of medicalization. Claiming that DCIS is a social construction includes a claim that a certain biological phenomenon is a social construction by the medical profession while claiming that sorrow is a social construction includes a claim that a certain ordinary life phenomenon experienced by most people is a social construction by health-stakeholders (patients, health professionals in general, society, Pharma). Hence, there is a difference with respect to the phenomenon that is socially constructed and the actors.

Correspondingly, following ordinary conceptions of disease, where diseases are defined in terms of modifiable risks (Schwartz 2008; Temple et al. 2001), some of the most prevalently treated conditions in modern medicine such as hypertension and hyperglycemia clearly are defined and handled as disease. However, phenomena such as menopause, criminality, baldness, and ageing are not as easy conceived of as a "modifiable risk," and hence not as easily handled as disease.

It may very well be that risk is not considered to be disease according to the biostatistical theory of disease (Boorse 1975, 2014; Schwartz 2008) or other theories of disease (and I agree that it is not) (Hofmann 2016). Nonetheless, this is irrelevant as long as the conditions detected by screening and early diagnostics are looked for and treated as medical matters (or diseases).

Accordingly, an overdiagnosis, is detection of a medically identified condition that can cause disease and death. This is not controversial, as the detected diagnosis is considered to be correct. The problem is that detecting the same medically defined condition may benefit some (if treated), and harm others (if the case would not develop to symptoms or disease). Hence, we do not know. Overdiagnosis is an inevitable result of early detection of conditions that can result in disease (according to medical conceptions). This triggers quite heated debates on whether we should look for such conditions, but not on whether such medical conditions can result in symptoms, disease, and death.

Therefore, overdiagnosis makes specific *cases* of medical conditions medical matters that are unnecessarily diagnosed (and treated). Other and similar *cases*, however, are correctly considered to be medical matters. With

medicalization, (human non-medical) *conditions*, and not *cases*, are made medical matters. Hence, overdiagnosis definitely looks like a form of medicalization, but it is different in several ways.

Let us take a specific case, say Mrs.Hanson, who is diagnosed with DCIS resulting from mammography screening and with grief after experiencing the loss of her beloved husband. Mrs. Hanson would (counterfactually) not have experienced breast cancer if not screened, and she would not have been diagnosed with grief (e.g., in terms of "major depressive disorder") before the emergence of DSM-V. Is Mrs. Hanson overdiagnosed and medicalized? Certainly, mrs. Hanson is overdiagnosed, as her situation falls under the definition of overdiagnosis. However, is she medicalized? We would say that the condition is medicalized, but hardly that she is medicalized herself. Other related differences between overdiagnosis and medicalization are illustrated in Table 2.

Drivers of overdiagnosis

A wide range of drivers of overdiagnosis have been identified in the literature (Hofmann 2014, 2015). The industry is a driving force, wanting to develop and implement ever better diagnostic technology, either in alliance with professionals or patients (Payer 2006). Moreover, professionals have interests in improving their services by using ever more sensitive diagnostic technology, but also in promoting professional interests and prestige. Professionals are also afraid of missing "silent killers" as well as treatment opportunities (Wiener et al. 2013; Lin et al. 2008). They fear decision regret (Tymstra 1989), as well as litigation (Lin et al. 2008). A reduced professional self-confidence, may also increase the extension of testing and subsequently overdiagnosis.

The expansion of disease definitions is another driver of overdiagnosis ("disease inflation," "disease creep") (Moynihan et al. 2014). Including (unpredictable) early stages of a condition in the definition of disease or including new pre-sick conditions, such as "pre-diabetes," will increase overdiagnosis. The same may the branding of disease entities of obscure origins.

Technology is an important driver of overdiagnosis. Increased diagnostic accuracy will capture more (and milder) cases that will not develop into symptoms or disease if not detected. The apparent success of new diagnostic technology may also direct our focus to surrogate outcomes resulting in overdiagnosis. Moreover, detecting more (and milder) cases may increase the attention at the disease and further its testing. Broad access to advanced diagnostic technology may result in more frequent testing (of milder cases and healthier people). Detecting ever milder cases will lead to more overdiagnosis, and thereby more overtreatment (both directly and indirectly by lowering the treatment threshold as a result of detecting more cases).

Patients, on the other hand, are more informed, and request more tests. Correspondingly, the increasing number of «worried well» will augment overdiagnosis. Media is also a driver of overdiagnosis, as there is a bias in their writings on health care. Lack of health services is covered more frequently than excess, underdiagnosis more often than overdiagnosis. Phrases like "had they discovered the cancer earlier, my husband would not have died" are much more frequent than "had they not found the pre-cancer, I would have been ignorant and would have avoided unnecessary treatment." People are glad they are "saved."

Table 2 The difference between overdiagnosis and medicalization illustrated by an example where a person (Mrs. Hanson) is diagnosed with DCIS resulting from mammography screening and with grief after experiencing the loss of her beloved husband

	Overdiagnosis	Medicalization
Correct diagnosis according to prevailing professional ideals?	NO (as Mrs. H is overdiagnosed)	YES
Correct implications (treatment) according to prevailing professional ideals?	NO (as Mrs. H is overdiagnosed)	YES
Medical controversy with respect to whether the condition can result in symptoms, disease, or death?	NO (as DCIS CAN result in these events)	YES (for grief after bereavement)
Medical controversy with respect to whether the conditions should be looked for and diagnosed?	Depending on accuracy and outcome (some for DCIS)	SOME (YES for expected grief)
Social controversy with respect to whether the condition should be addressed as a medical problem?	LITTLE	Depending on social commitment
Is overdiagnosis and medicalization avoidable (respectively)?	NO, not if one strongly wants to avoid disease and death (from breast cancer)	YES, medicalization may not be necessary to avoid disease and death

Note that also medicalized conditions can be overdiagnosed

This has been labeled "the popularity paradox." (Raffle and Muir Gray 2007)

General beliefs and attitudes also drive overdiagnosis. Beliefs, such as "it is better to know than not to know," "the new is better than the old" (*Argumentum ad novitatem*), "early is better than late" or exuberance for the more advanced, and the belief that "more testing is better" contribute to increased overdiagnosis. The same goes for what can be called the imperative of possibility ("we have to test because we can"). "Risk aversion" and "uncertainty aversion" may also drive overdiagnosis. Legislation can drive overdiagnosis through defensive medicine.

Correspondingly, several ethical issues are identified with overdiagnosis. Overdiagnosis produces harm from unnecessary labelling and treating people, as well as from potential side effects. Unnecessarily diagnosing and treating persons results in waste of resources that could be better spent on necessary treatment for persons more severely affected. Cost inflation undermines trust in health systems based on solidarity. Moreover, intensifying biotechnical activity can marginalize and obscure the wider social and economic causes of disease (Heath 2013).

Trends and developments

Overdiagnosis has been a technical term to denote correct but futile diagnostics. It has an epistemological basis, i.e., uncertainty about the outcome of diagnostics. As such, it represents an internal critique within medicine and the medical sciences (such as diagnostics and epidemiology). The aim was not to bar domination and power, but primarily to avoid harm. One of the problems with the narrow technical conception of overdiagnosis is that it presupposes counterfactual information or prophecies (see above). At present it is not possible to predict whether a detected DCIS will develop into breast cancer. Studies of indolent diseases in persons who die (i.e., studies of the pathological reserve) are less and less feasible, as more and more people have been tested (or screened and treated). There is no way to know whether a person would not have become diseased when diagnosed.

However, the overdiagnosis debate has escaped the closed rooms of professionals and scientists. It has, together with other terms, been used to criticize excessive (harmful) medicine. BMJ's campaign "Too much medicine" and the ChoosingWiselyCampaign (www.choosingwisely.com) may be examples of how the debates on overdiagnosis has been integrated into a broader (and more ideological) context. If this analysis is correct, overdiagnosis has moved from a narrow technical and internal critique of harmful testing to become a broader ideologically founded critique of excessive medicine. As such the concept of overdiagnosis has been broadened towards more ideological issues while it may be argued that medicalization has lost some of its ideological critique and moved from addressing non-medical to medical phenomena.

Overdiagnosis and medicalization

Table 3 gives an overview of the characteristics of medicalization and overdiagnosis respectively. There are many similarities. Both medicalization and overdiagnosis make more people diseased, i.e., make more classified as diseased and make more people feel ill. Both play a crucial role in the critique of modern medicine, and in particular in criticizing the unwarranted expansion of medicine. Medicalization and overdiagnosis pose similar kinds of moral reaction as they are both considered to be unnecessary, futile, or even harmful. As such, both imply a reasoning from *ought* to *is*: Because something, i.e., a non-medical phenomenon in the case of medicalization, and a medical condition in the case of overdiagnosis, will not benefit a person (or a group of individuals), the phenomenon or condition should not be made disease.

Moreover, both concepts are somewhat obscure in that it is not quite clear what they refer to. In medicalization it is not obvious how medical phenomena are differentiated from non-medical phenomena (Fabrega Jr. 1980). Overdiagnosis, on the other hand, is obscure in that it requires prophetic or counterfactual abilities in order to know whether a given diagnosis is overdiagnosis or not, as you do not know whether the person will develop symptoms and disease when making the diagnosis (Hofmann 2014). Neither medicalization nor overdiagnosis are easy to operationalize.

Some also argue that overdiagnosis is a form of medicalization (Rogers 2015). However, as can be seen from the definitions and descriptions above and Table 3, it is not enough to make more people diseased for a medical expansion to be medicalization. "Nonmedical problems" or "human problems or experiences" have to become medical according to traditional conceptions of medicalization. Ductal carcinoma in situ is a medically defined phenomenon and not a human or experienced phenomenon. Making sorrow and hypertension cases of disease clearly both involve defining a phenomenon as pathological and differentiating it from what is considered to be "normal." Nevertheless, the first is not yet measured and monitored by medical means, while the latter is already subject to medical attention (as a result of advances in medical technology) (Hofmann 2001). Hence, overdiagnosis is different from medicalization in that its subject matter is not non-medical, but medical, phenomena.

It may of course be argued that definitions of medicalization that include biomedical phenomena would include

Table 3 Overview of differences and similarities between medicalization and overdiagnosis

	Medicalization	Overdiagnosis
Professional background	Social sciences (external)	Health professions (internal)
Etymology	Iatrogenesis	Pseudodisease
Related terms, Synonyms	Disease mongering, healthism	Overdetection, Lanthanic disease, Misdiagnosis, Futile diagnostics, Overtesting
Moral concern	Power balance (avoid medical imperialism and inflated role of health care)	Avoid futility (appropriateness)
	Avoid specific forms of rationality	*Premium non nocere*
	Maintain richness and heteronomy of life	Avoid unnecessary intervention
	Weakening feelings of security and confidence in health	Maintain trust in health professionals
	Promoting unwarranted moral obligations (to guard health)	
Examples	Shyness, sorrow, sadness, love, addiction, death, poverty, pregnancy, childbirth, infant feeding, baldness, menopause, sexual function, mood, (child) behavior, beauty, coeliac disease, race, aging, compulsive buying	Prostate cancer, breast cancer, pulmonary embolism, asthma, hypertension, ADHD, chronic kidney disease, gestational diabetes, lung cancer, osteoporosis, thyroid cancer
Definition	A process by which human problems come to be defined and treated as medical problems.	A condition diagnosed that would otherwise not go on to cause symptoms or death.
Disease perspective (Disease, Illness, Sickness)	Sickness	Disease
Conceptual concerns	Expansion of the concept of disease	Unwarranted expansion/moving of the boundaries/cut-offs/limits of disease
Type of uncertainty	Indeterminacy (social commitment)	Uncertainty (epistemic)
Strikes (at which level)	Conditions	Persons
Concerns with utility	Classificatory (social) utility	Diagnostic utility
Types	Conceptual	Extra persons diagnosed
	Institutional	Post-test Diagnosis Reduction
	Interactional	Surplus diagnosis
		Non-reductive extra diagnosis, i.e., extra persons diagnosed without reduction in deaths
		Reduced number of deaths attributable to early testing
		Extra diagnosis per prevented death
		Extra treatment per prevented death
Intension–process–effect	Intended process	Undesired (side) effect
Drivers (engines)	Pharmaceuticalization	Disease (expansion of definition)
	Genetization	Technology (increased accuracy, imperative)
	Biomedicalization	Patients (requesting tests)
	Human enhancement	Professionals (defensive, expansive)
	Altering or gaining the significance of a given (non-medical) phenomenon	Industry
		Media (hype, missed disease)
		General trend (risk aversion, argumentum ad novitatum)
Development	1. Doctor-blaming (Anti-authority/dominance)	1. Technical term to denote correct but futile diagnostics (Internal critique)
	2. Broadening the critique: Patient-blaming	
	3. Nuancing medicalization: Complex issue, positive and negative aspects ("Bionic society")	2. Ideological term to criticize excessive (harmful) medicine
Potential solution if conceived of as a problem	Define phenomenon as a social or cultural (and not a medical) issue	Improve diagnostics to differentiate cases that will develop to symptoms and disease from those who will not

overdiagnosis or that defining medicalizaition in terms of "making biological, mental, social, or social phenomena to medical problems" would embrace both medicalization and overdiagnosis. This is correct, but then we would need to change the prevailing definition of overdiagnosis, which presently presupposes a differentiating between medical and non-medical phenomena. "Hypercholesterolemia" is not a non-medical phenomenon, as we have no experience of it without medical concepts and measurements. Nevertheless, we have to acknowledge that people experience their conditions more in terms of medical concepts, e.g., patients may feel their "large intestines a bit bound" (Nessa and Malterud 1998).

Moreover, medicalization is a qualitative term, which in the ordinary broad sense has not been measurable. Overdiagnosis, on the other hand, is quantifiable and measured all the time (Carter et al. 2015a; de Gelder et al. 2011; Welch and Black 2010). However, it can be argued that overdiagnosis is not measurable either, as it can only be estimated or measured indirectly, and there is no consensus about the measurements (de Gelder et al. 2011). As already pointed out, overdiagnosis is in principle measurable in at least two ways. First, the pathological reserve can be investigated for populations who have not been screened, and second, it is in principle possible to randomize persons with conditions detected by screening onto treatment and non-treatment arms. Hence, it appears to be warranted to say that medicalization tends to be qualitative while overdiagnosis tends to be quantitative.

Another difference between the two concepts is that medicalization makes a (non-medical) phenomenon alter or gain significance. One of the reasons for making sorrow a medical matter was to enhance its significance in order to be able to help. Correspondingly, one of the reasons to make lack of attention and disciplined school behavior a medical matter was to focus on the phenomenon and to control it. A condition is not overdiagnosis in order to alter its significance. Overdiagnosis is a negative side effect of diagnostic uncertainty due to imperfect methods and complex (medically acknowledged) phenomena.

All things considered, medicalization has become more specified in terms of pharmaceuticalization, genetization, and biomedicalization, and hence more "technical." Moreover, medicalization has come to include other than experiential non-medical phenomena, and as such becoming all-encompassing, embracing overdiagnosis and ordinary diagnostics. On the other hand it appears that overdiagnosis has become more ideological. Therefore, it can be argued that the initial distinctions between medicalization and overdiagnosis are getting blurred.

How will this evolve in the future? Any answer to this question will be speculative. Nevertheless, investigating one powerful emerging trend that appears to be transformative of medicine as well as the concepts of medicalization and overdiagnosis, P4 medicine, may be a fruitful exercise.

The future of medicalization and overdiagnosis: P4 medicine

The recent movement called P4 medicine (Preventive, Predictive, Personal, and Participatory Medicine) (Flores et al. 2013; Hood 2013), based on systems medicine and network theory (Hood et al. 2012), represents a self-acclaimed paradigm shift. By continuously monitoring and constantly analyzing a wide range of bodily, mental, and social parameters and biomarkers medicine will paradigmatically improve in preventing and predicting disease, in coaching persons, and treating patients, e.g., through personalized therapies. Not only the genome, but also the "the proteome, for proteins; the transcriptome, for genetic material transcribed into RNA; the metabolome, for molecules, such as hormones, synthesized by our bodies; the glycome, for all our sugars; the lipome, for lipids; the interactome, for how proteins relate to one another; and the exposome, denoting our environment. With the remarkable convergence of the digital medical tools we now have the 'individualome.' We are on the threshold of determining how each person in our universe is indeed distinct." (Topol 2012)

Additionally, it is argued that the participatory collecting, reading, and interpretation of data will empower the individual to be in charge of their life (Hood and Price 2014). Each individual may in the future come to measure and monitor himself (by the "Quantified Self-Tracking") and empower himself in the data production, and by changing and adjusting his life according to the results and "alarms" (Swan 2009). As it is stated by actors in the field: "Finally, remember: unlike regular science, Quantified Self is about personalization (as opposed to generalization): you use your own data in order to learn about yourself." (http://measuredme.com.previewdns.com/about-measured-me/).

The integrative personal omics profile (iPOP), and the particular example coined "the Snyderome" (Chen et al. 2012) has become the very symbol of this new type of "medicalization." The potential of measuring "everything" and "life itself" makes everything a potential indicator of risk or disease. It makes "medicalization" pervasive. Hereby medicalization goes from making ordinary life experiences subject to medical attention to measuring every aspect of life, and thereby making it subject to "experience," attention and control. Even more: it makes persons themselves control their own lives. Every measurable parameter—beyond any everyday experience—

becomes subject to (medical) attention, and thereby given meaning and weight. E.g., how you have slept and your mood is not any longer qualified by your experience, but quantified by apps and extensions to your smartphone, continuously registered and uploaded to your "health cloud"—and eventually defining your experience of sleep and mood.

If actualized, this pervasive development would make medicalization all-encompassing. It would be what has been called a "medicalization of life itself" (Barker 2010; Vogt et al. 2016). Only measured medical matters have meaning. One problem with such a broad conception of medicalization would be that it may make the term meaningless. No distinctions can be made as everything is medicalized. Nonetheless, medicalization may still have a critical function, e.g., by revealing conceptual and interpretative control. Note that generating meaning in P4 medicine as described above, i.e., making information from the data, may be beyond the control and power of the individual. It may be remote to the health professional as well, as it can be in the firm grip of the "big data guys." Hence, the term medicalization may still have a critical function—e.g., to reveal how the conceptual and interpretative control is held by the new "medics" (i.e., "the big Data guys"). However, the difference is that it is not experienced ordinary life phenomena that become subject to medical attention, but phenomena that are defined and mediated by medical technology. Accordingly, medicalization and overdiagnosis become preoccupied with the same (medically defined) phenomena.

Due to increased participation and personal responsibility, future conceptions of medicalization may appear to be in the hand of the individual, and may thereby be open for more "patient blaming." However, the epistemic challenge is how the data are validated and transformed to information relevant for the individual, and the moral issue is where and with what justification the limits between health, health threat, and disease are set. The challenge, compared to previous types of medicalization, is that the expansion of the realm of biomedicine has moved beyond professional power, patient interest, and epistemic-ethical structures (of making phenomena real and relevant). It has included individual's moods and emotions, crept physically into the bed and under the skin of persons, and made the constitution of true and good—of epistemology and ethics (of knowledge and power)—to some remote and invisible place inhabited by technicians.

What will happen with overdiagnosis in P4 medicine? One plausible scenario is that P4 systems medicine will dissolve overdiagnosis (as defined above). The reason for this is that as every parameter relevant for the wellness of a single person will be measured and analyzed. The individual will become his own standard of health and disease, or more precisely, the individual will validate the tests and set the standard for cutoff values. Hence, any possibility of assessing what happens without being diagnosed or treated will adjourn. If everything is measured and given significance nothing can be verified as overdiagnosed. In a way overdiagnosis will become everything and nothing, and the critical potential of the term may deplete.

Nevertheless, even if overdiagnosis will lose its meaning in the technical sense, it may very well make sense as an overarching critique of medicine: measuring everything makes everything diagnostic relevant. That is, overdiagnosis may be dissolved as an internal technical term focusing on avoiding harm and become a term relevant to an ideologically based critique of an expansive all-encompassing medicine.

Accordingly, with extensive and continuous monitoring of physiological, immunological, epigenetic, genomic, metabolic, proteomic, mental, and social parameters as suggested in P4 systems medicine, the distinction between medicalization and overdiagnosis is strongly reduced.

Even more, if P4 systems medicine is able to realize its ambitions and destruct the existing disease-focused medicine (Topol 2012) and to create a paradigmatically new type of wellness medicine (Hood et al. 2015; Flores et al. 2013; Hood and Price 2014) then the traditional (technical) conception of overdiagnosis will be dissolved and the ideologically fueled conception of overdiagnosis may merge and become a form of medicalization.

Conclusion

Medicalization and overdiagnosis are similar. Both result in more people being diseased. Both pose moral concern and serve critical functions. Both medicalization and overdiagnosis imply reasoning from *ought* to *is*, and none of the concepts are easy to operationalize. Nevertheless, they stem from different traditions with different perspectives. The critique of medicalization has traditionally addressed how non-medical phenomena become medical matters, while in overdiagnosis the phenomena raising concern are conditions that are medically identified. In the first case it is controversial whether the phenomena will cause disease and/or death, while this is not so in the latter. They also refer to different types of uncertainty: medicalization results from indeterminacy, while overdiagnosis results from lack of diagnostic knowledge. Medicalization is (for some) an intended process, while overdiagnosis (for all) is an undesired effect. Medicalization is dealing with *sickness* (sick role) while overdiagnosis with *disease*.

Despite these traditional differences, medicalization and overdiagnosis are becoming more alike. Medicalization has

moved from expanding the realm of medicine to new territories to using medicine to expand the realm of what is real and enhance significance. Medicalization is extended beyond non-medical phenomena and new conceptions tend to become comprehensive, also covering overdiagnosis. Overdiagnosis on the other hand has expanded from discussing cases not needed to be diagnosed to discussing the negative effects of expansive diagnostics in general. Overdiagnosis thereby has become more ideologized. While overdiagnosis has been an 'internal' question to medical discourse while medicalization an 'external' one, bringing the medicalized lens to focus on phenomena not previously in its attention, this distinction may become blurred as medicalization and overdiagnosis are broadening concepts that may merge.

In particular, with new trends in modern medicine, such as P4 medicine, medicalization will become all-encompassing, while overdiagnosis more or less may dissolve. They may both converge in some total "iatrogenization." However, in doing so, they may lose their precision and critical power.

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