
Screening: mapping medicine's temporal spaces

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Abstract This paper examines the history of population screening through an analysis of contemporary medical journals. The term was first used in the modern sense in the inter-war years to describe the school health examination which sought to identify the early signs of disease and abnormality, a strategy which was extended to new recruits during the Second World War. After the war, screening began to target those illnesses in the civilian population which had a clear temporal trajectory, especially 'chronic' illnesses. Since the 1980s, enthusiasm for population screening has declined within the medical community: opportunistic screening has seemed more appropriate for diseases with multifactorial aetiology, and those programmes which have survived have been increasingly challenged through an expanding analysis of their potential harms. In identifying the early precursors of clinical disease in apparently normal populations, however, screening heralded the emergence of a new form of clinical practice concerned with the surveillance of 'healthy' patients within the context of new temporal spaces of illness.

Keywords: screening, history, time

A century or so ago 'screening the patient' would probably have referred to the use of curtains around the patient's hospital bed to provide privacy for a medical procedure. In the 1950s, it marked the brave new world of testing the population for the early stages of disease. Nowadays, it is likely to be a site of contestation over whether it confers benefits or harms. This paper attempts to map these changing uses of the term and the debates which have surrounded its deployment, from its first appearance in the inter-war years of the 20th century, through its period of ascendancy in the post-war years, to its more turbulent history in the early 21st century. In doing so the paper identifies underlying changes in the temporal dimension of illness, of which screening is simply one manifestation.

The role of population screening within healthcare has been of interest to doctors, patients, lay groups, lobbyists, and other healthcare professionals, among others, but the analysis in this paper is based primarily on debates within medicine – the relationship with these other discourses is briefly discussed in the final section. Medical engagement with screening was accessed by examining contemporary medical journal articles, editorials and correspondence. Major medical journals are now digitalised and word searchable from their first issues, so they were used to identify when, and in what context, the notion of medical screening was separated from earlier different uses of the term. The subsequent expansion of the use of screening as a routine medical procedure was tracked through a range of medical journals published in both the UK and US supplemented by PubMed searches. Trends were charted in Excel (examples are available in the supplementary files accompanying this paper) and

these were corroborated using Google Ngrams which word searches over five million books (Michel and Shen *et al.* 2011). These trends were then explored in more detail, in particular looking for evidence of changes in the meaning or context of use of screening and related constructs. This process also facilitated the choice of illustrative material used to underpin the paper's narrative.

The screen

Discovery of the diagnostic value of X-rays at the very end of the 19th century was followed by their application in routine clinical practice. The fact that the radiographic image was viewed on a screen meant that the terms 'screen' and 'screening' began to be applied to patients undergoing X-ray examination. In a study of the value of X-rays in the diagnosis of lung cancer, for example, it was observed that 'The movement of the ribs during inspiration may be plainly seen by means of the screen ... [though in this case] the physical signs were so conclusive that screening does not afford the physician any real assistance' (Lawson and Crombie 1903: 212).

One of the main reasons for X-raying a patient was to identify the then relatively common disease of tuberculosis. Tuberculosis usually presented clinically with weight loss and haemoptysis (coughing of blood) only after the disease had been well established; X-ray examination, however, could detect the very early stages of the disease before its presence became overt. The threat of 'latent tuberculosis' was a particular hazard for people living close together, such as school-children, for whom cross-infection was a real risk and 'screening of the chest and the inspection of films' gave useful diagnostic information (Conference Report 1931: 28). During the inter-war years attempts to identify latent tuberculosis, such as the Massachusetts Children's Tuberculosis Program, involved radiological screening of all those children found to have a higher risk of having the disease, as indicated by a positive response to tuberculin challenge (Wakefield 1930), but later studies began to use X-rays as the first diagnostic sieve. A study of the prevalence of tuberculosis in medical students, for example, carried out at the University of Pennsylvania in 1931 (Hetherington *et al.* 1931), involved X-ray screening all students.

The search for latent tuberculosis was characterised by two related features. The first was the idea of early diagnosis. Treatment options for tuberculosis were few, but it was still a communicable disease, and identification of latent disease was of some importance for the further spread of the disease. The consequent challenge was to recognise the disease as early as possible in its natural history and X-ray 'screening' provided an enabling technology. Secondly, the identification of latent cases implied examining otherwise normal populations which exhibited no symptoms of tubercle infection. These two key elements of screening, which informed its growth and spread in the second half of the 20th century, can therefore be discerned in the early attempts to track tuberculosis in the population. It was also only a small step for the word 'screening', initially derived from a characteristic of the X-ray process, to become shorthand for the process of medically examining 'normal' populations for latent disease; but that step was reinforced by parallel developments in the field of public health.

The second derivation of the terms screen/screening which informs modern usage came from public health. In the late 19th century various medical discoveries alerted doctors to the dangers of vector-borne diseases, particularly those carried by flies and mosquitoes. One way of protecting against the mosquito was to use screens or meshes over windows and

doors – hence the frequent exploration of the best way of ‘screening a building’ in the early decades of the 20th century. Public health also borrowed another meaning of screening from manufacturing and extractive industries where it referred to the use of some sort of sieve to separate larger particles from smaller ones. In sanitary work, for example, it was not uncommon to ‘screen’ various forms of effluent: ‘coarse screening’ was one way of protecting rivers from gross pollution (Lancet Editorial 1899), or, as Soper (1914) noted, some of the most objectionable substances in effluent ‘which look offensive in the water’ (1914: 1091) could easily be removed by use of screens.

In the inter-war years the idea of a metaphorical mesh or screen began to be used to describe the process of separating out abnormality from normality amongst school-children. The application of screening to children reflected the same imperative that drove the early detection of tuberculosis: as the child was growing, any unidentified disease or abnormality might cause future harms unless it was detected early and ‘corrected’. In the US in the 1920s, for example, Buck (1925) described the role of a preliminary “screening” inspection (she used the word in quotation marks given the novel application of the term) of children by the teacher prior to the school medical examination. In the same year Champion (1925) also described the preliminary sifting of school-children prior to a detailed medical inspection, and questioned whether it should be designated as a screening or diagnostic process, while at the same time pointing out that the word screening in this context was not in general use.

Routine screening of children for sight and hearing emerged as applications for the new approach to diagnosis, which targeted normal populations rather than patients presenting with symptoms (Oak 1942), but one of the earliest specific diseases to be ‘screened out’ was tuberculosis (Dugan 1932, *AJPH* Editorial 1932). There was a clear parallel with the ‘screening’ undertaken using radiography in the hospital earlier in the century, in that both uses of the term referred to identifying the same disease. When ‘mass radiography’ was later offered to adult populations as a means of screening for tuberculosis (Bentley and Leitner 1940), the X-ray and the sieve derivations of ‘screening’ finally coalesced.

Controlling future threats

The Second World War provided ideal conditions for the spread of screening technology. It had been usual for new recruits to undergo a medical examination to assess overall fitness for active service and during wartime this examination was increasingly supplemented with formal screening programmes. Those diseases for which there were screening tests, such as tuberculosis and syphilis, provided exemplars of how the technology could be deployed: a defined population, preferably captive to the extent that their compliance was assured, and a test which could identify latent disease. Mass radiography had already been evaluated in civilian populations in many countries in the inter-war years (Bentley and Leitner 1940) but in wartime it took on a new urgency. Cooper (1940), for example, described how 22,000 men underwent X-ray examination/screening in the Australian army in early 1940. Later reports claimed that screening had reduced the spread and overall incidence of tuberculosis in the armed forces (Long and Lew 1945).

The other communicable diseases with high salience since the early 20th century were syphilis and gonorrhoea but these achieved an even higher profile in wartime. Lang (1941) observed that the sickness in the US Navy caused by venereal disease was equivalent to the complement of 11 battleships infected at some time during that year. New screening programmes were therefore established to identify ‘latent’ disease (Robinson 1941) and new

tests were analysed which might be used as a 'screening agency' for blood samples in the identification of syphilis (Webb and Sellers 1943).

The third important screening programme introduced in the armed forces was for psychiatric illness. Memories of shell-shock from WWI led to concerns for the mental state of new recruits, given the risks to other soldiers on the battlefield by those unable to cope with warfare. Unlike the programmes for screening tuberculosis and syphilis, there was little pre-war civilian experience in psychiatric screening so new tests had to be devised to detect recruits at risk. As these tests had the purpose of triaging recruits to identify those needing a more formal psychiatric assessment, they needed to be simple and easy to administer. Psychiatric status could not be measured by biological titration, so a new technology, the screening questionnaire, was developed and refined to supplement – and in part replace – the psychiatrist's assessment. Indeed, such was the perceived power of screening mental state that it became an important tool in assessing all military personnel (Perrot 1944, 1945).

Diagnosis in routine clinical practice had identified pathologies which, in the main, were a burden for the individual; yet there were a number of diseases which because of their communicable nature also posed a threat to others. Early diagnosis of these latter diseases, and their treatment if possible, could therefore be of community as well as individual benefit, and it was this insight which underpinned early attempts to promote screening. Wartime conditions heightened awareness of these threats beyond the individual and hastened the deployment of screening programmes in the armed forces. Since the early 20th century, tuberculosis had been characterised as a disease of interpersonal contact (as against poor sanitary conditions in the 19th century) and the major threat was from 'carriers' in the population who unknowingly could infect others; the dangers to soldiers working closely together were clear. Equally, a single case of syphilis could spread rapidly on some far-off posting if its potential danger was not identified and managed by initial screening. Psychiatric disease, though non-communicable, could also pose a potential danger to others on active service when working together was so important.

The screening of new recruits was extended to encompass tests developed for the school medical examination (for vision and hearing, for example). These tests still carried echoes of danger-to-others which characterised the main screening programmes, as it was the child who threatened the future adult; in fact many of the reasons for rejecting recruits as unfit for active service were childhood diseases and 'abnormalities'. In a novel analysis linking the results of childhood and wartime screening, Ciocco (1945) showed that the growth trajectories mapped in the child were predictive of subsequent military fitness identified in the soldier. The temporal relationship between the child and the young man was further illustrated by problems such as poor dental health, rheumatic fever, eye defects and orthopaedic impairments (like flat feet) which caused recruits to be rejected. These findings reinforced the need for better childhood screening so as to enable earlier identification of abnormalities and avoidance of later problems (Robinson 1941, Shepard *et al.* 1944).

By the 1940s the inverted commas which often accompanied the use of the term 'screening' to denote its metaphorical use appeared less frequently. Occasionally authors felt compelled to say what it meant ('In screening the attempt is not merely to sift out and discard ... The word "screening" designates an attempt to obtain an individual picture of each person, whether his place is to be in the Armed Forces or in the industrial army' (Dunbar 1945: 121)), but it was rapidly becoming the accepted descriptor for triaging latent and early manifestations of disease in large numbers of apparently healthy people (Rowntree 1944).

Post-war extension of screening

After the Second World War, mass radiography for tuberculosis was extended to the whole population (Wilson 1946) and surveillance of the growing child was further reinforced (Capon 1950). In addition, the idea that serious disease of later adult life might lie latent in earlier years was extended to the civilian population. Studies of rising death rates from cardiovascular disease revealed widespread lesions in the coronary arteries of young soldiers killed in the Korean War (Enos *et al.* 1953) leading to calls for screening for latent heart disease in young civilian populations (James 1955). And as the temporal dimension of illness expanded across the lifespan, diseases of older adults began to appear suitable targets for screening. Cases of unsuspected diabetes, for example, were reported as extremely common and whole communities – state and local health departments as well as voluntary and private agencies – could be mobilised as part of the screening effort (JAMA Editorial 1950, Wilkerson and Ford 1949, Wilkerson *et al.* 1955). Equally, cancer detection clinics, which had first begun to emerge in the US in the 1930s, received post-war impetus from the American Cancer Society, the US Public Health Service and many local health departments (Jones and Cameron 1947, Deibert 1948). Development of cervical smears (which later evolved into the 'pap test' for cervical cancer) (Papanicolaou and Traut 1943) encouraged exploration of cell smear methods for diagnosing other cancers at an early stage (Papanicolaou 1948).

With these new techniques and new targets the decades following WWII were marked by the enthusiastic promotion of screening. Who could argue with its logic or its aim? 'Screening for a disease has a most attractive goal – to find the patient in the early stages of a chronic process and to interrupt its dismal natural course' (Carroll 1976: 646). This was a revolutionary method for replacing the usual symptomatic patient with the 'supposedly well person' (Freemont-Smith 1953) as the focus of healthcare. Chapman (1949) suggested that a screening examination of 1,000 apparently well persons over the age of 15 for syphilis, diabetes, glaucoma, anaemia, tuberculosis, obesity, visual defects, hearing loss, hypertension and heart disease would result in the finding of 976 instances of these diseases. As 12 years' experience at the Tulane University Cancer Detection Clinic confirmed, the value of screening was clear when out of over 10,000 'apparently healthy subjects' 92% were shown to have either organic or functional disease (malignancy being detected in 77 patients) (Schenthal 1960).

Screening was concerned with detecting disease as early as possible in its natural history, the better to be able to alter its subsequent course. The earliest opportunities for detection lay in screening the asymptomatic patient, before the well person experienced illness and chose to present to the doctor (Sisson 1957, Hubbard 1957). Consequently, screening reached out into the community whether through taking the 'clinic' to the home, the street or the factory or by inviting normal populations to visit healthcare settings. The main constraint on screening was the apparently limited number of diseases which had a sufficiently long timeline to enable early manifestations to be identified. An acute disease, for instance, or one with short prodromal features, offered little opportunity for detection through population screening. The potential remit of screening was therefore considerably extended when chronic illness emerged as a major clinical problem. The pre-war identification of chronic illness and the post-war rapid expansion in its perceived importance mapped on perfectly to the surveillance agenda (see Figure 1). In the post-war years, screening and chronic illness became two sides of the same coin in that diseases which could be characterised as having a temporal trajectory could, in their turn, be captured by the new screening technologies (Halverson *et al.* 1949, JAMA Editorial 1950, Levin 1951, Holmes and Bowden 1951).

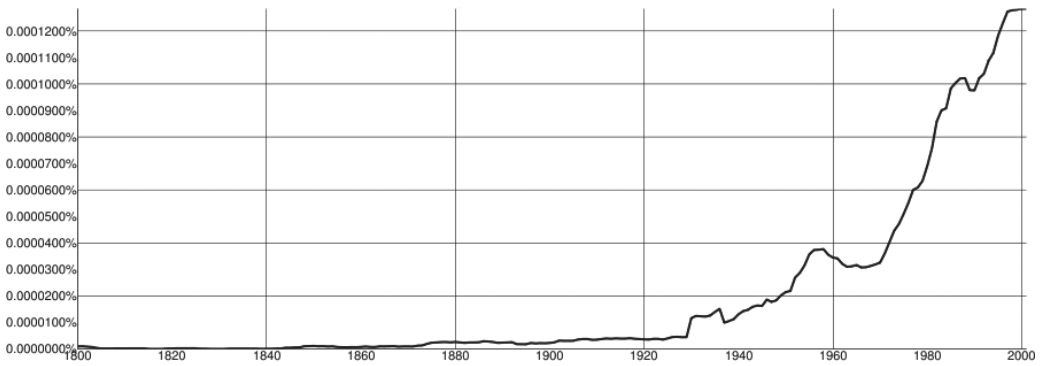


Figure 1 'Chronic illness' in Google Ngrams. The graph shows the frequency of keywords in a given year as a proportion of the total number of words in the database for that year (Michel *et al.* 2011)

The increasing temporalisation of illness in the post-war years, especially through the recognition of the importance of chronic illness, reinforced the significance of prevention: if disease had a developmental timeline then, in principle, it may be possible to delay or halt its progression. The term 'primary prevention' had been used by Dale in 1932 ('Several of the great life-destroying plagues had been banished by a primary prevention' 1932: 1152) but it was only in the 1950s that preventive activity became routinely divided into 'primary prevention' and 'secondary prevention', the latter, which embraced screening, being concerned with stopping early disease progressing further. A decade later, the term 'tertiary prevention' was introduced to describe the rest of clinical activity which could be construed as managing established disease to prevent it getting worse. Post-war medicine therefore mapped out a prevention landscape, a vision of numerous disease timelines which could be targeted at any point so that subsequent illness could be forestalled. Screening was a key component of this wider strategy as it promised to identify and manage disease early in its temporal trajectory; yet this population project was to be undermined by the fragmentation of the temporal space in which illness was located.

Splintered time

Screening relied on identifying the earliest stages of disease: tuberculosis was the archetypal example – a small early lesion was easier to treat than a fulminating case in which the lungs were overwhelmed and the patient seriously ill. Clearly this strategy depended on a linear temporal model in which early small lesions grew larger and/or multiplied through the body. The post-war reconstruction of disease aetiology, however, undercut this step-wise picture of disease development, and redirected screening to new targets.

The celebrated Framingham study, started in 1948 to help identify the earliest precursors of heart disease, reported finding numerous potentially modifiable 'factors of risk' (Kannel *et al.* 1961). Detection of these risk factors re-ordered a medical framework which had assumed that degenerative processes, akin to the natural forces of decay, had underpinned chronic disease. The invention of risk factors – which began to have increasingly widespread use within medicine from the 1970s (see Figure 2) – at once affirmed the temporality of disease but also replaced its former linear spatialisation with a multi-dimensional one. Reliance of the screening project on identifying 'the' early manifestation of a disease was therefore

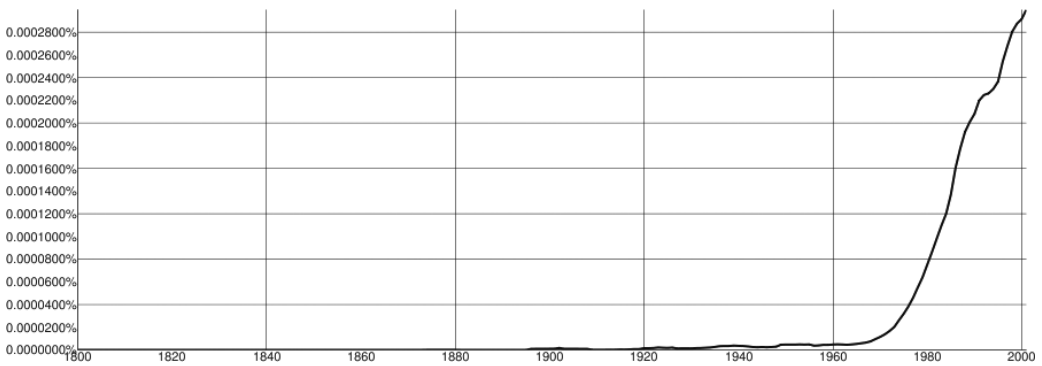


Figure 2 'Risk factor' in Google Ngrams. The graph shows the frequency of keywords in a given year as a proportion of the total number of words in the database for that year (Michel et al. 2011).

unsustainable. As Arnott observed in 1954, the fact that effective prevention depended on knowledge of aetiology meant that 'At once, of course, one is up against the problem of multifactorial causation. There are few disease processes that can be assigned exclusively to a single cause' (1954: 887).

There had been occasional mention of the term 'multifactorial' before the 1950s but only in the context of the genetic determinants of disease. The post-war discovery of multiple risk factors and the rapid spread of 'multifactorial' as the aetiological descriptor for most, especially chronic, diseases undermined the linear developmental timeline on which screening was predicated (see Figure 3). If cardiovascular disease, for example, was 'caused' by high cholesterol, high blood pressure, obesity, smoking, lack of exercise, etc, how could screening

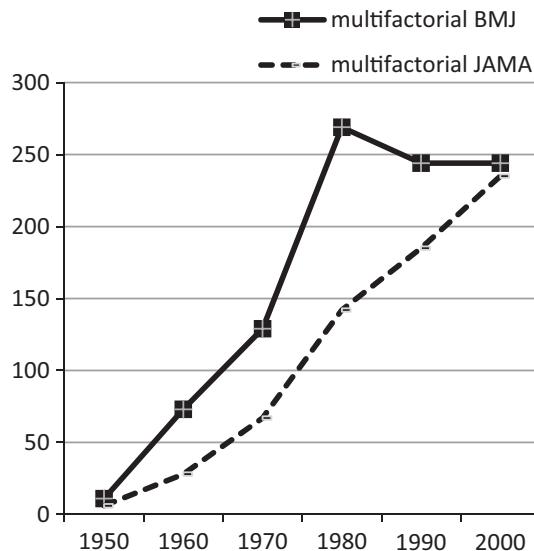


Figure 3 "Multifactorial" Illustrative graph showing number of times indicated concept occurred in specific medical journals over 10 year periods. [BMJ = British Medical Journal; JAMA = Journal of the American Medical Association]

hope to arrest its development? Indeed, even the earliest signs of disease were themselves further risk factors in the multidimensional array.

The initial reaction to the challenge of multifactorial aetiology was to extend screening to capture its proliferating targets. Multiphasic screening, which had earlier been promoted as a means of simultaneously addressing the timelines of multiple diseases, was adapted for the new task.

Multiphasic screening has been undergoing rapid changes in concept. Tests are becoming more sophisticated, quantitative and diagnostic; they are also becoming more risk factor oriented, and aimed at primary prevention. Most current programs include elements of both new concepts, and differ from earlier programs concerned only with presumptive identification of asymptomatic disease in presumably well persons (Thorner 1969: 1037).

In other words, instead of using screening to identify the earliest signs of disease (as in secondary prevention) it could be used to target risk factors and thereby prevent the disease even starting on its temporal trajectory.

Despite this promise, multiphasic screening as an approach to population surveillance proved short lived as it was rapidly overtaken by clinical strategies more compatible with a world of multiplying risk factors. Simultaneous identification of many latent diseases through multiphasic screening became obsolete once so many of these diseases were understood to rely on common risk factor pathways; by the 1980s multiphasic screening had fallen out of favour and by the 21st century had virtually disappeared (see Figure 4).

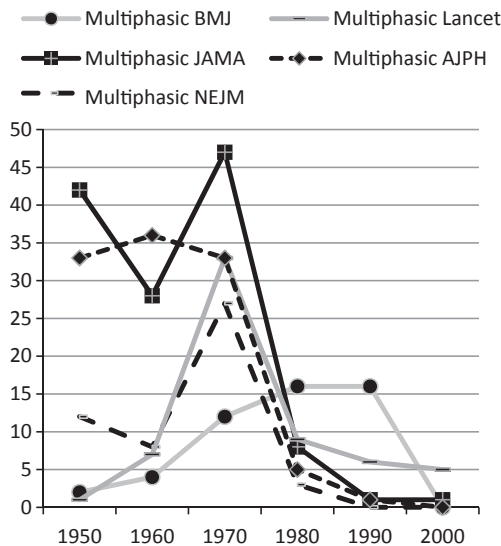


Figure 4 'Multiphasic screening' Illustrative graph showing number of times indicated concept occurred in specific medical journals over 10 year periods. [BMJ = British Medical Journal; JAMA = Journal of the American Medical Association; Lancet; NEJM = New England Journal of Medicine; AJPH = American Journal of Public Health]

The subsequent history of screening was then marked by two divergent patterns. Some population screening survived but only for 'linear diseases' of which there were few, though even this remnant remained under increasing pressure. Otherwise, screening followed the risk factor as it proliferated and moved upstream, with less focus on disease timelines in a population and more on the temporal risk factor spaces of the individual patient. In effect, most of the post-war screening project was absorbed into routine clinical practice which increasingly turned to the identification and management of risk factors in individual patients in an opportunistic way.

The costs of screening

In the final two decades of the 20th century the post-war promise of population screening had been reduced to a handful of programmes suited to those diseases, especially cancers, with a seemingly uni-linear timeline or to maternity and child surveillance where future growth was at stake. But even these screening programmes came under challenge in the face of increasing awareness and attention to their potential costs and harms. At the centre of this critical new analysis of screening stood an emergent figure, that of the subjective and wilful patient.

It was known that some patients had blood pressures which seemed to vary day by day, hour by hour. These were labelled as 'labile hypertensives' (Lockett 1955). But in 1984, in the context of understanding screening for high blood pressure, Kleinart and colleagues (1984) identified a new condition, 'white coat hypertension', which described the brief rise in blood pressure (presumably through patient anxiety) when it was being measured in the clinic. In other words, screening for hypertension could actually be creating the condition – or at least the appearance of the condition – it was designed to identify and manage. At the very least, this implied that many patients carried the label of (and took treatment for) hypertension when in fact their blood pressure was within normal limits. White coat hypertension illustrated two facets of the looming critique of screening. The first was the negative psychological reaction it could elicit in patients; the second were the more general harms which it could produce, particularly of over-treatment.

The idea that patients undergoing screening might have negative psychological reactions to the procedure became an important one during the 1980s. Clayman, for example, criticised the annual health check up in which 'Anxiety is created in the patient, and costly time is spent by the family physician providing reassurance for insignificant findings printed out in computer style and scrupulously sent to both family physician and patient' (Clayman 1980: 2067). In the 1980s increased anxiety was also reported in patients undergoing screening as varied as antenatal (Smithells 1980, Robinson *et al.* 1984), cervical screening (Wilkinson *et al.* 1990) and sickle cell disease (Consensus Conference 1987). This psychological response affected not only those found to be 'positive' but even those with normal results (Benfari *et al.* 1981, Burton *et al.* 1985).

A further facet of the patient's response to screening was the problem of uptake. Screening required the active participation of 'healthy' patients who were persuaded of the virtues of early detection across the disease's timeline. But a growing literature drew attention to the large proportion of eligible patients who failed to respond to the invitation to attend screening (see Figure 5). This 'failure' was yet another manifestation of the patient's psychological reaction to the procedure: as Merrick and colleagues (1985) noted with regard to breast cancer screening 'uptake of screening ... seems likely also to depend on a woman's underlying motivations and attitudes'. Screening uptake rates and

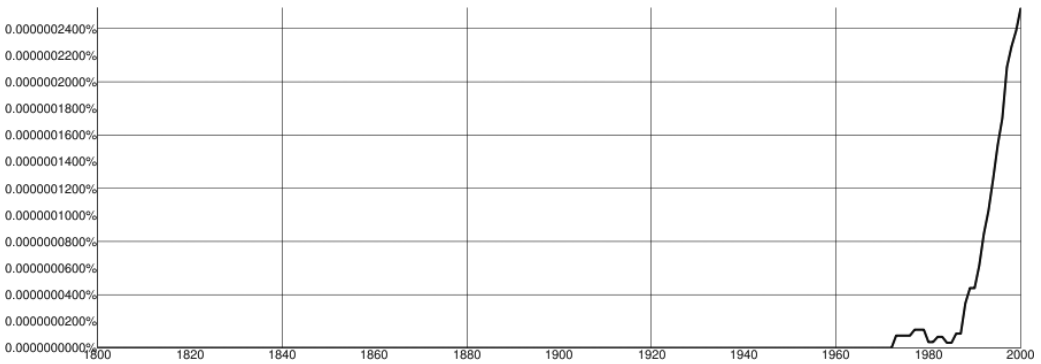


Figure 5 'Uptake of Screening' in Google Ngrams. The graph shows the frequency of keywords in a given year as a proportion of the total number of words in the database for that year (Michel *et al.* 2011)

means of increasing them therefore became a new focus for the screening agenda (Ross 1989, Thornton *et al.* 1995).

Unlike the traditional doctor-patient encounter where patients sought help by reporting their symptoms/illness, screening implied a different sort of contract; indeed, the consent implied by 'uptake' of the service could be absent. HIV antibody screening, for example, which could be conducted on blood taken for other purposes, became embroiled in ethical debates about consent, autonomy and potential harms (Bayer *et al.* 1986). Screening might provide benefit in terms of earlier diagnosis but it was clear that potential psychological and ethical harms were embedded in the very nature of the technology. Marteau (1990) concluded that 'all new screening programmes should include evaluation of the psychological impact of invitation and participation' (1990: 28).

While the psychological and ethical costs of participating in screening programmes received increasing attention, a further addition to the 'negative' side of the equation was emerging. All screening programmes were susceptible to 'misdiagnosis': sometimes patients were judged to be free of disease when in fact they had it (so-called false negatives) and sometimes patients were said to have the disease when in fact they did not (false positives). In the early years of screening the 'yield' of diseased patients was judged as the criterion of success but by the 1980s this figure was seen to consist of both true and false positives: what if most were the latter?

Figures for sensitivity and specificity had been used to characterise some laboratory tests since early in the century but were rarely calculated and reported for screening tests until the 1980s (though they had been recommended in Wilson and Jungner's (1968) 'Principles and practice of screening for disease'). Two further statistics appeared around this time, the test's positive predictive value (what proportion of patients identified as having disease actually did so), and negative predictive value (what proportion of patients identified as not having the disease actually did not). A frequent finding of these two statistics was the large number of patients who were misdiagnosed by screening tests. Irrespective of whether these misdiagnoses were false negatives or false positives they still carried costs for the patient: those with false negatives were falsely reassured while those who were false positive could undergo further investigation and even invasive treatments. Screening therefore became a trade-off between costs and benefits in which concern with uptake (by the non-adherent patient) began to be replaced by a new discourse on informed choice in which the individual patient had to decide whether to attend, once appraised of all the evidence. Meta-analyses of

breast cancer trials, for example, estimated that for every one woman who benefited from screening (in terms of her life being saved) a further ten women underwent the same treatments but unnecessarily (Gøtzsche and Nielsen 2010). Women could therefore be asked to add their personal values to the cost-benefit equation before reaching an individual decision on whether the screening was likely to be advantageous or harmful (McPherson 2010).

In 1974 Ingelfinger critically observed that the screening bandwagon seemed unstoppable as even sceptics had to concede that 'screening programs will be used whether or not any evidence is available that they improve the health of the people' (Ingelfinger 1974: 99–100). Just over a decade later a new more cautious assessment had emerged. In a review of breast cancer screening in 1988, for example, Eddy and his colleagues tried to balance the various costs and benefits of screening according to contemporary evidence. The actual 'disease' was not their central concern nor the characteristics of its earliest manifestations; instead they placed survival benefit in a matrix of anxiety, inconvenience, false sense of security, distress, disfigurement and disability. This calculus was to be frequently reworked in later years and with it came the increasing psychologisation of patients as their reactions, subjectivities and choices were dissected, calibrated and summed. The term 'harms of screening' was totally absent in the medical literature up until the 1990s; since then it can be found with increasing frequency (see Figure 6).

Time and subjectivity

Screening is a 20th century phenomenon. The word itself has its origins in both the X-ray screen and the public health mesh which separated flies from humans and solids from smaller particles. Since then screening has been both dependent on and reinforced by transformations in clinical practice. The first of these is the identification of a timeline for diseases, that they have latent, early and late manifestations, such that intervention towards the beginning of this natural history can change an otherwise predestined outcome. This principle can also be applied to apparently 'normal' populations (which, after application of the screening programme, are invariably no longer normal). These two constructs informed a new form of Surveillance Medicine which began to replace Pathological Medicine during the late 20th century (Armstrong 1995).

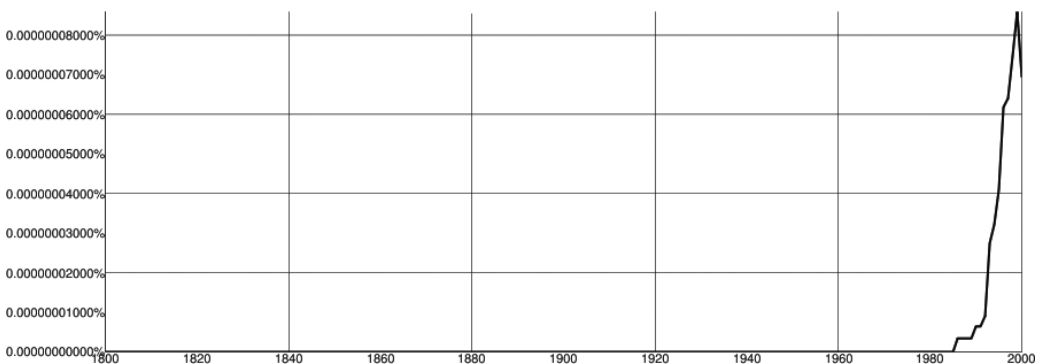


Figure 6 'Harms of screening' in Google Ngrams. The graph shows the frequency of keywords in a given year as a proportion of the total number of words in the database for that year (Michel et al. 2011)

When screening programmes first appeared, they targeted diseases which threatened others. This principle was applied during World War II to embrace all those diseases which might affect a community at war such as tuberculosis, venereal disease and mental disease. Prior to the war, screening had also been applied to the health of school-children on the basis that abnormalities in the child could affect later adulthood. It was this intra-individual threat that underpinned post-war initiatives as screening technologies were applied to the growing numbers of diseases contained within the chronic disease classification which, like the problem of the child in the inter-war years, was a threat to the future of the individual rather than of others. The labelling of cancer, cardiovascular disease, diabetes, rheumatic fever, etc, as chronic diseases opened up new targets for screening programmes.

Screening implied a different type of doctor-patient encounter. Clinical practice at the start of the 20th century involved patients reporting their symptoms to doctors who then, after clinical examination and appropriate investigations, made a diagnosis. The idea of population screening changed that relationship: it was the doctor who sought out the asymptomatic patient who would be unaware of the potential diseases they carried. The focus was not therefore the consulting patient but the non-consulting one, the anonymous person in the population, outside of medical care. Use of the term 'case finding' captured something of this search for unknown disease in the population (though all diagnosis was a sort of case finding). Yet these hidden cases did not have to be identified through 'mass' population screening. The advent of multifactorial aetiology demanded new strategies for early risk factor/disease identification and intervention. The problem, to be sure, was located in the population but rising use of healthcare meant that most of the population could be surveyed when they consulted on other matters. A number of new tactics therefore emerged to replace population screening: periodic examinations, health checks, medical check-ups, risk-profiling, opportunistic screening, etc, together with recruitment of the patient to their own risk factor management. All these approaches involved not only a search for early manifestations of disease in asymptomatic patients but also for even earlier threats. In this way screening, which had originated as a population-wide strategy, moved to the centre of individual clinical practice, more local, less formal, more penetrating, and less resistible.

The absorption of screening techniques into routine risk factor medicine and the contemporary identification of immanent harms of screening programmes meant that the post-war dream of a surveillance society in which mass populations were processed through screening programmes to identify early disease proved transitory. What remains of population screening stands under threat, defended by those such as lay groups and lobbyists who continue to promote the post-war belief in the inherent virtues of the prevention/screening paradigm. When the US Preventive Services Task Force, for example, recommended that women aged 40–49 should make 'individual decisions' about whether to undergo breast cancer screening given that harms might outweigh benefits, it was met by such fierce opposition from various lay and professional interest groups that the debate was characterised as 'the mammographic wars' (Quanstrum and Hayward 2010). The core preventive idea that inspired the screening movement in the 20th century, that disease was better detected early, clearly retains much of its potency for the many lay groups and, indeed, for the many clinical constituencies which are actively involved in delivering screening programmes. Yet the construction of a countervailing thesis (by epidemiologists, psychologists, ethicists and other clinicians) of harms and costs has now established a significant barrier to the introduction of future population screening, as well as forged a critique which is likely to continue to challenge existing programmes. The case for screening was often promoted through the iconic voice of the individual patient whose life had been

'saved'; nowadays identifying that fortunate patient in the midst of all the false positive cases has become an all but impossible task.

One of the many challenges that population screening faced in the closing decades of the 20th century was its engagement with the ethical and psychological patient. This figure was new. In part it was a shape illuminated by the sharp light of screening technologies; but it was also the analysis of the harms of screening over the last three decades which served to construct and affirm the identity of the subjective autonomous patient, not least from sociological writings critical of the objectifying nature of screening procedures (McKie 1995). Screening, as Howson (1999) argued, 'was embedded in a moral framework of self responsibility and social obligation' (1999: 401). In effect, patients' negative psychological reactions to screening both constrained the uncritical expansion of screening but also provided a point of articulation for the increasingly voluble research literature which showed again and again that patients were more than the passive recipients of medical procedures (Marteau *et al.* 1993, Sutton *et al.* 1995, Neher 1999, Considine *et al.* 2004, Brunton *et al.* 2005). Debates at the interface between screening and patient autonomy and integrity have therefore provided an important medium through which that identity could be rehearsed and stabilised.

The new figure of the patient which materialised from the screening project was invested with time. Screening itself was a temporal project as were the illnesses it targeted. In the early years of screening disease timelines criss-crossed populations but in the immediate post-war years the timelines shifted from populations to individuals. The degenerative processes of chronic illness mapped out the temporal space of individuality – a configuration which informed what is now referred to as a 'life-course' perspective. The temporal space of the individual then began to fragment. Multi-factorial risk factor aetiology located illness in a multidimensional space (itself a construct of the second half of the 20th century) undermining the solitary disease trajectory which had justified the earlier population screening regime. The idea of causation itself contained a temporal ordering whereby an earlier event determined a later one. The emergence of multifactorial aetiology further emphasised this temporality of illness (and also undermines the possibility of identifying the basis of this change in causal frameworks as the explanation of the explanatory model is contained within itself). The fusion of screening technologies and individual practice produced more opportunistic surveillance and with it a multidimensional biographical space enveloping each separate patient. This process was reinforced by the vestiges of the population screening project which, in the face of psychological, ethical and medical challenges, moved the focus of the medical gaze towards the subjective and autonomous patient who was a model of individual decision-making and informed choice.

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Supporting Information

Additional Supporting Information may be found in the online version of this article:

Figures S1a–S1f. Illustrative Ngrams of some basic concepts. The graphs show the frequency of keywords in a given year as a proportion of the total number of words in the database for that year.

Figures S2a–S2f. Illustrative graphs showing number of times indicated concept occurred in specific medical journals over 10 year periods. (BMJ = British Medical Journal; JAMA = Journal of the American Medical Association; Lancet; NEJM = New England Journal of Medicine; AJPH = American Journal of Public Health)

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