

# How and why do interventions that increase health overall widen inequalities within populations?

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## Introduction

Health inequalities\* between groups within populations defined by place of residence, race, ethnicity or culture, occupation, gender, religion, age, education, income or other measure of socio-economic position (SEP) are widely observed [7, 8, 16] and, in many contexts, growing [17]. Reducing health inequalities has thus become an important objective of governments worldwide [18, 19]. However, evidence for strategies to reduce health inequalities is limited and systematic reviews have failed to offer substantive analyses or contribute to theory [20, 21].

Contemporary health strategies at international, national and local levels share the twin aims of improving overall health and reducing inequalities in health between groups within the population. Although common sense may suggest that these aims should be achievable in tandem, an intervention that improves the health of a population overall may also increase inequalities in health [22-25].

Variations in the provision of, and response to, many interventions according to SEP have been noted and, to date, have generally been described in terms of the 'Inverse Care Law' (ICL) [26]. However, the ICL narrowly describes variations in provision of medical care according to need, not variations in effectiveness of a range of interventions according to SEP. In this chapter, we review past attempts to theorize this problem and present evidence suggesting that inequalities can be introduced at all stages of the planning and delivery of interventions that affect health. When such inequalities are patterned according to socio-economic variables, they may be due to reliance of interventions on voluntary behaviour change and other limitations of intervention design. Conversely, strategies that use regulation (resulting in compulsory behaviour change) or incentives (leading to discrete resource gains) may have beneficial effects on socio-economic equity. The widespread nature and implications of such inequalities generated by interventions makes them of importance to policy makers, practitioners and researchers of all disciplines. Systematic approaches are required to research and tackle this apparently universal phenomenon.

Background: 'inverse' laws and the equity-effectiveness trade off

### ***The inverse care law***

The ICL states that "the availability of good medical care tends to vary inversely with the need for it in the population served" [26]. As health and the need for health care are closely associated with SEP, the ICL has been interpreted to suggest that the most socio-economically deprived communities will have the least access to good quality medical care. Although the ICL originally focused on the provision of primary health care, the term has now been applied to a variety of aspects of health care including service utilisation [27], length of consultation [28], willingness of general practitioners to prescribe antidepressants [29], satisfaction with antenatal care [30] and use of health promotion services [31]. In general, these non-specific applications of the ICL focus on socio-economic deprivation, rather than absolute need for services, and rarely identify that they are using socio-economic deprivation as a marker of need for services. Because of this widespread, loose interpretation of the ICL, the meaning of the term has become increasingly confused and non-specific, although its appeal as a rhetorical device has not diminished [32]. This is perhaps surprising, since it was conceived in a "rambling polemic", with no empirical basis, no testable explanatory framework, and no suggestions for ways to intervene [32].

### ***The inverse prevention law and inverse equity hypothesis***

Recently, there have been a number of formal attempts to develop the idea underlying the ICL for a wider range of health interventions - in particular, preventive and population level strategies. The

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\* Health inequities are inequalities or differences in health between populations or groups within populations that are considered unfair and avoidable.<sup>1,2</sup> The term inequality is used throughout this chapter, although it is impossible to make the necessary value judgements to designate observed differences 'unfair and avoidable' in the space available, nor is it central to the arguments presented here.

concept of the “inverse prevention law” was no more than a throwaway line in the influential UK government’s Acheson Report on health inequalities, published in 1999 [33]. It alluded to the idea that there seems likely to be a concept analogous to the ICL for prevention, whereby those most likely to benefit from preventive measures (i.e. those most at risk and, often, those living in the most deprived circumstances) tend to be least likely to receive them. Whilst many would endorse this hypothesis, no evidence was produced to substantiate this claim in the report.

Victora et al (2000) provided an empirical basis for their proposed ‘inverse equity hypothesis’ (IEH), drawing on studies of child health in Brazil [25]. The IEH, described as “a corollary of the ICL”, identifies the process by which new public health interventions lead to an initial widening of socio-economic inequalities, due to preferential uptake by the most advantaged, before inequality narrows and overall health improves, due to subsequent uptake by the less advantaged groups in the population. This ‘trickle down’ effect was subsequently attributed to the theory of diffusion of innovations [34, 35]. Building on the initial concept in a subsequent paper, Victora expands his explanation to suggest that there are multiple ways in which the poorest may be disadvantaged. He uses this to explain that the poorest suffer from compound disadvantages such as reduced host resistance through poor nutrition, greater exposure to risks and reduced access to health interventions through lower educational attainment and greater levels of illiteracy, as well as poorer quality services because few professionals wish to work in the poorest areas [35]. The IEH remains a general theory developed for low-income countries with no specification of causal pathways, and thus does not identify specific ways to intervene (apart from “universal coverage” with health resources), nor provide supportive evidence for interventions to reduce ‘inverse equity’.

### ***The equity-effectiveness loop***

In 1985 Tugwell and colleagues suggested that effectiveness of (clinical) interventions should be looked at iteratively because many stages in the intervention process may contribute to overall or ‘community’ effectiveness [36]. More recently, Tugwell suggested that the potential existed for inequality to be introduced at different stages in clinical systems [24]. In other words, the efficacy of an intervention in different socio-economic groups may be modified by equity of access to the intervention, diagnostic accuracy, provider compliance and consumer adherence, all contributing to differential overall effectiveness by SEP. This framework suggests a systematic method for exploring the relationship between effectiveness and equity, although does not distinguish clearly between provision of an intervention and responses to it, and thus ignores some important points at which inequalities could be introduced. A “staircase” effect is proposed, whereby factors that modify efficacy do so in a multiplicative way leading to an estimate of community effectiveness that is the product of efficacy and each successive modifier. To take an example: an intervention may be efficacious in 50% of those to whom it is delivered appropriately, but the condition for which it is efficacious is only diagnosed in 80% of those with the condition, only 60% of those diagnosed gain access to the intervention, only 90% of providers deliver the intervention as intended, and only 70% of consumers adhere to the intervention as intended. Its overall community effectiveness will thus be the product of the efficacy, multiplied by each of these modifiers (i.e.  $0.5 \times 0.8 \times 0.6 \times 0.9 \times 0.7 = 0.15$ ). In other words, the intervention would have an overall community effectiveness in 15% of the target population. Furthermore, if the magnitude of any of these five modifiers of the efficacy of the intervention varied by SEP, then a socio-economic gradient of effectiveness would be observed. Tugwell presents no direct evidence to support a multiplicative effect and it is possible that modifying factors affect efficacy in different (mathematical) ways.

Tugwell et al’s paper suggests some intervention examples (e.g. social marketing to promote chemical impregnated bed nets for malaria prevention), but does not identify key characteristics of interventions that may widen or narrow inequalities, suggesting that this will be the role of the newly formed Cochrane Collaboration Equity Field [24].

### ***Intervention-generated inequalities<sup>†</sup> and outcome gradients***

The theories presented above, when considered together, suggest that *all* processes in the planning and delivery of an intervention have the potential to widen inequalities between groups within the target population, distinguished by a range of factors, such as gender, age, ethnicity or SEP. These inequalities, whilst individually small, may act additively or multiplicatively (or in other mathematical relationships), leading to significant and measurable inequalities in final outcomes. Such potential inequalities seem likely to occur in all public sectors and systems (e.g. education [37] and criminal justice [38]), though we only present evidence for health systems here. Similarly, although evidence exists for such effects in relation to ethnicity or race [39] and gender [40] (and we assume place, religion and age) we focus here on evidence for intervention-generated inequalities by SEP, measured by factors such as educational attainment, occupational class and income.

Figure 1 identifies key stages in the intervention process at which inequalities can be introduced and illustrates these with examples relating to cardiovascular disease. The provision of interventions to improve health includes the processes involved in assessing needs for services and specific interventions. Intervention-generated inequalities could occur, for example, when a community survey is used to assess the need for a specific intervention. Socio-economic variations in response rates [6] may lead to under-estimation of need in the most socially disadvantaged groups. Similarly, poorer groups and those from ethnic minority groups are often less well represented in trials and other evaluative studies, leading to bias in assessment of outcome effects across the socio-economic spectrum [13].

[Figure 1 about here]

Research that does not control for the potential confounding effects of SEP can lead to false conclusions [41]. It has also been reported that the Framingham equation underestimates cardiovascular mortality risk more in manual, compared to non-manual, groups [5] and the Rose Angina Questionnaire elicits different responses from people of different ethnic origin in the UK [42]. Likewise, there is evidence that both services in general and specific interventions are delivered unequally, with the benefit in favour of more affluent groups [3, 9, 10, 29, 43-48]. Importantly this extends to the offer of preventive interventions, in particular in primary health care [49-51].

Individuals may also respond to health interventions in a manner that increases social inequalities in health. For example, there are well documented socio-economic variations in uptake of a number of public health interventions, including physician visits [52], cancer screening [49], screening for Down's syndrome [53], immunisations [54], correct use of folic acid pre-conception to prevent neural tube defects [55] and breast feeding [56]. Use of safety equipment, such as seat belts [57] and bicycle helmets [58] is also often socio-economically patterned as is compliance with therapeutic interventions [4].

Efficacy of interventions can also be socially patterned. Econometric models predict that traditional interventions to reduce cigarette smoking, such as health education and smoking restrictions, are likely to have the greatest effect amongst more affluent smokers [12]. Evidence also suggests that smoking cessation interventions are less effective among more socially deprived groups [11]. In two studies charting the effects of the 'Back To Sleep' campaign to prevent sudden infant deaths (SIDS) in the 1990s, significantly lower responses to the educational intervention were demonstrated among

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<sup>†</sup> We have used the term 'intervention-generated inequalities' throughout to describe unequal outcomes of any stage of an intervention process. The term 'iatrogenic' could be used in cases where these inequalities are introduced by a doctor, but is too specific a term to use in all cases.

poorer and ethnic minority families in the UK [59] and USA [60]. In a study evaluating the effects of cycle helmet legislation in Canada, despite a sizeable initial effect on all social groups, narrowing the pre-existing socio-economic inequality, six years after the legislation was introduced, the effect was sustained in the more affluent, but not the more deprived social groups, resulting in wider inequality than before the intervention [61]. This result suggests that the overall effectiveness *and* equity of an intervention may vary with time following the intervention.

Whilst the majority of stages of the provision of, and responses to a health intervention (as shown in figure 1) might be expected to lead to increased social inequalities in health, it is also possible that unequal outcomes of steps in any intervention process can favour the deprived rather than the affluent and so reduce inequality, as illustrated in figure 2. Examples include the effect of water fluoridation on child dental health [62], legislation on bicycle helmet use [63] and price increases on cigarette smoking [12]. There is also some evidence that financial incentives to general practitioners lead to decreased socio-economic inequalities in cervical screening and childhood immunisations [64]. Financial incentives targeting individuals may also reduce pre-existing socio-economic inequalities [65].

[Figure 2 about here]

Thus, within any single planning and delivery pathway, socio-economic gradients may oppose one another at different stages, and theoretically even cancel each other out. However, in most cases it is more likely that they are typically cumulative, such that small socio-economic gradients in the same direction at each step combine (e.g. additively or multiplicatively, or in another mathematical relationship) to produce the substantial socio-economic gradients in morbidity and mortality that have been widely measured (Tugwell's so-called "staircase" effect [24]). The nature and magnitude of such cumulative effects are likely to vary from case to case<sup>‡</sup> and require empirical evaluation.

Interventions may also have unexpected side effects and these might have a greater impact on some population groups than others. For example, the introduction of a school-based bicycle safety education programme paradoxically led to more cycling-related injuries, especially among the poorest children. This may have been due to inadvertent encouragement of risk-taking [66]. Methods are needed to explore such inequitable side effects of interventions, as well as the main (intended) effects.

Characteristics of interventions that increase or decrease socio-economic inequalities

A common attribute of interventions that lead to increased socio-economic inequalities in health appears to be a reliance on voluntary behaviour change [23]. Thus, for example, although governed by law, ultimately the decision to wear a seat belt rests with the individual, leading to a social patterning in seat belt wearing [57]. Likewise, although we might intend that a policy to screen all women aged over 50 for breast cancer should apply equally to all women, without some compulsion to attend, uptake of screening remains voluntary and can result in inequality [67]. Whilst such factors may be a key source of socio-economic inequalities, it is important to recognise that health related choices might not be entirely 'free' or independent in every situation. Nor should choice necessarily be removed from public health interventions [68] – but it should be recognised as a potentially important cause of widening inequalities.

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<sup>‡</sup> In proposing this idea we have, for simplicity, assumed that socio-economic gradients are linear. Whilst this is often the case, it is not always so and more complex relationships may also exist.

The example of water fluoridation illustrates what can happen when a public health intervention circumvents such a voluntary behaviour change [23]. An obvious attribute of water fluoridation in a geographical area served by a single supply is that it is universally delivered and taken up, except perhaps by a very small number of people who chose to drink entirely bottled water or have their own well. However, although largely effective, water fluoridation does not entirely eradicate socio-economic inequalities in dental health [62] because fluoride is not the only determinant of dental health - sugar consumption and tooth brushing, both voluntary behaviours, also play a role and are socio-economically patterned [69].

Other methods of delivering public health interventions that may circumvent reliance on voluntary behaviour change include financial incentives [64] or disincentives [12], making services more accessible to deprived groups [64], or targeting interventions specifically at lower social groups [70]. This suggests that many structural factors can affect service use and that these may facilitate or curtail 'choice' in ways that may not be obvious or measurable. Evidence to support this comes from a number of studies where financial and material barriers to intervention effectiveness in poorer groups have been identified, including sudden infant death syndrome (continued bed sharing)[59], ability to afford bicycle helmets [71], and ability to afford up front payments for elective surgery [72].

There are two important implications of these findings. The first is that, to reduce inequalities as well as improve health, a single intervention modality (such as a policy that is not supported by education) may not be enough. Conversely, interventions that combine a range of methods, such as a policy measure, educational interventions, a technology and resource incentives, as seen for example in UK immunisation programmes [73], may help to reduce or avoid intervention-generated inequalities. Secondly, interventions that are delivered in the same way to all recipients may result in differential outcomes. Resultant inequalities may be, for example, because the less affluent or educated are less able to access the intervention, understand it or engage with it. The problem with 'one-size-fits-all' interventions has been recognised [74-76] and is likely to be another characteristic of interventions that may widen inequality. The corollary of this is that interventions that are tailored for the needs of individuals or sub-groups within a target population may be more likely to result in outcomes that are more equitable, and there is much evidence to support this supposition [77, 78]. The specific effects of each intervention component need to be evaluated quantitatively to confirm this hypothesis.

Implications for policy, practice and research

The potential for any or all stages in the planning and delivery of interventions that affect health to generate or widen socio-economic inequalities means that policy-makers, practitioners and researchers should be aware of them and the implications they may have. Those developing policy and planning services should be aware of the socio-economic biases in who responds to consultative exercises and who lobbies for change, and the potential for inequitable effects of interventions. The techniques of prospective health equity impact assessment [79] are rapidly evolving and should be routinely used to assess the potential for any element or stage of a intervention to result in widening inequality. Those delivering services should be aware of socio-economic variations in uptake and outcome of therapeutic or preventive interventions. The techniques of health equity audit [80], closely related to health equity impact assessment, should be routinely employed by professionals implementing and monitoring interventions in practice. Those trialling and implementing health interventions should be alert to the possibility that adherence and efficacy may vary according to SEP. To this end, we believe that investigating the effect of health interventions according to SEP should become a routine aspect of intervention evaluation, a proposal now endorsed by the Cochrane and Campbell Collaborations [24].

Although we have focused here on socio-economic inequalities, it is likely that similar cumulative differences in provision and response occur according to other variables such as gender, age and

ethnic group [39, 40]. Researchers need to be aware of the meaning and relevance of different measures of SEP (such as education, income and social class) and, more generally, measures of 'difference' between population groups when researching the unequal outcomes of interventions. Furthermore, whilst most of the examples referred to here are from developed countries, it seems likely that the phenomenon of adverse outcome equity is universal [9, 24, 25, 35]. Programmes of research are needed to assess the evidence for the theories discussed here, including systematic reviews of intervention equity, secondary analyses of existing trial and disease register data, and prospective studies of differential intervention effectiveness. Qualitative studies may also be needed to understand the processes leading to inequalities quantified in evaluative studies. The concept of socio-economic, and other, intervention-generated inequalities therefore sets a wide-ranging agenda for health equity research.

One further consideration needs exploration. Tugwell et al refer to the trade-off between equity and effectiveness [24]. However, in any health system we also trade-off effectiveness against efficiency. For example, the National Institute for Health and Clinical Excellence (NICE) in the UK has a remit to identify not only the most effective, but also the most cost-effective interventions on which the National Health Service (NHS) should spend its scarce resources. An inequitable outcome is sub-optimally effective, yet an intervention tailored to individual needs might be significantly more costly, as shown by smoking cessation services in the UK [81]. Thus, there is also likely to be an implicit trade-off between equity and efficiency in much health care and public health decision making. The consequences of this are profound: we have to think about effectiveness, efficiency *and* equity routinely in intervention research; and we have to make explicit decisions about equity-effectiveness and equity-efficiency trade-offs in delivering public services. We also need to become more aware of the effects on equity of current policies within health systems, such as the strong current UK NHS focus on performance targets and efficiency [82].

### Conclusions

Whilst the ICL identifies an important aspect of the nature of health care, it has now been so widely and loosely interpreted as to become confusing. A number of theories have been proposed to extend the ideas that originated in the ICL and others have contributed supportive evidence or ideas. In this chapter, we have attempted to synthesize this range of evidence and propose a framework for understanding, researching and tackling inequalities resulting from health interventions. A joint health equity group has recently been established by the Cochrane and Campbell collaborations [24]. An important first task will be to define terminology, since none of the terms that have been proposed to replace ICL [24, 25, 83], adequately describe the phenomenon, its consequences or approaches to understand or tackle it.

Practitioners, policy makers and researchers should be aware of the widespread potential for intervention-generated inequalities as they may bias a wide variety of results. Further research is required to clarify the causes of intervention inequalities, to determine their ability to account for social inequalities in health and, importantly, to identify cost-effective strategies to reduce or avoid them.

The widespread belief that the ICL cannot fully account for social inequalities in health, as exemplified by the Black report's assessment that "unequal usage [of health care] will never be more than a partial explanation" [8], may be the case. However, if socio-economic inequalities at all stages of the planning and delivery of interventions that affect health are considered, it is likely that they will account statistically for a larger proportion of socio-economic inequalities in health than the ICL alone. Taking this approach should ensure that addressing intervention-generated inequalities will become an important public health endeavour, as suggested by Derek Wanless in his 2004 report to the UK treasury entitled "Ensuring good health for the whole population" [84].

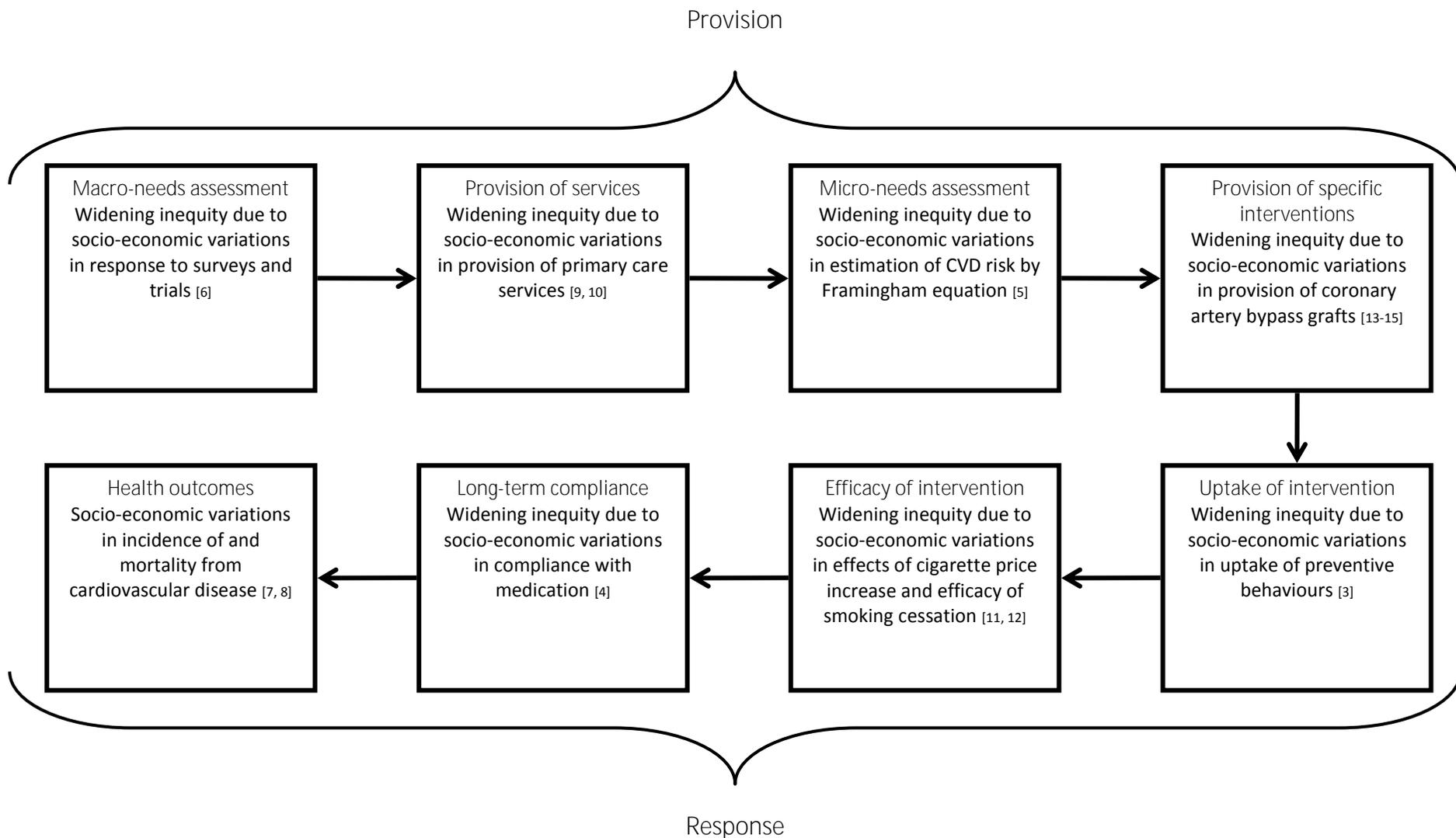


Figure 1 – Points during the planning and delivery of interventions to prevent and treat cardiovascular disease where socio-economic outcome inequalities might occur, and examples of reported inequalities

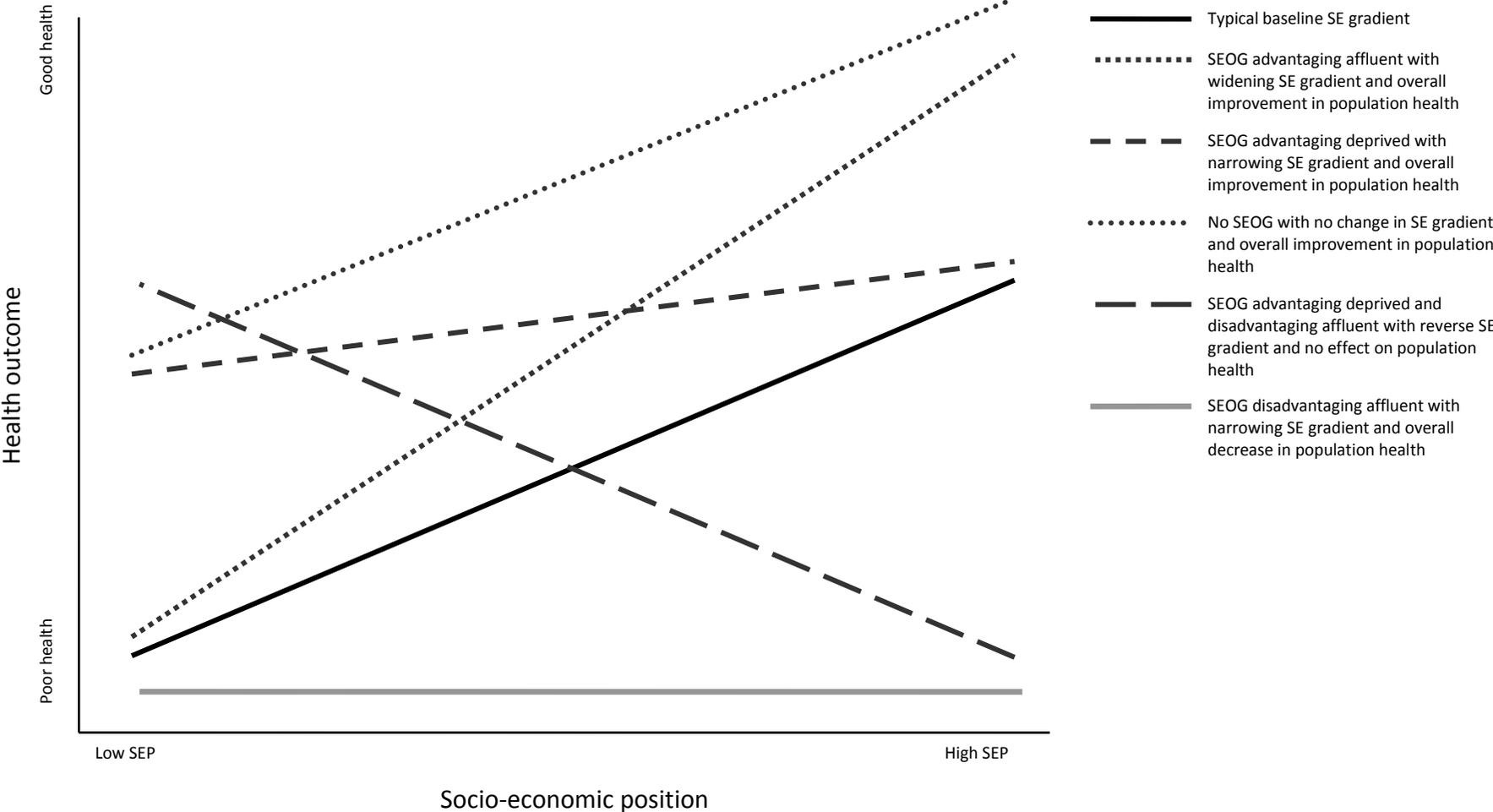


Figure 2 – Schematic representation of potential socio-economic outcome inequality gradients resulting from an intervention that affects health (SE=socio-economic; SEOG=socio-economic outcome gradient)

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