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*Health policy*

# Applying clinical epidemiological methods to health equity: the equity effectiveness loop

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Focusing on the average effects of interventions on health may miss important differences within populations. Examining these effects across gradients in wealth allows the identification of the interventions most likely to reduce health inequalities

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## Introduction

The world achieved impressive health gains during the 20th century.[1] However, health worldwide is distributed unevenly, according to socioeconomic status.[2–4] Unfair and avoidable health inequalities have been termed health inequities.[5] Modern health policy must ensure that poor people are included in the benefits of development.[6]

## Objective

We propose the "equity effectiveness loop" framework (fig 1) to highlight equity issues inherent in assessing health needs, effectiveness, and cost effectiveness of interventions, and the development and evaluation of evidence based health policy. This framework provides a method to calculate the "equity effectiveness ratio," which assesses the impact of various factors on the gap in the effectiveness of interventions across socioeconomic gradients. Although we illustrate the application of this approach when data are available on the economic gradient across individuals, if social-group attributes are also known, the approach could be applied for other equity factors as illustrated by the PROGRESS concept: place of residence; race, ethnicity, and culture; occupation; sex; religion; education; socioeconomic status; and social capital, which reflects categories across which disadvantage may exist.[7] Including equity issues is an improvement on the iterative measurement loop, which focused on averages and thus ignored the distribution of health effects.[8 9]

Information on the distribution of both "risk" and "response" across the wealth gradient is critical for going beyond mere measurement to designing strategies to reduce the health gap between rich and poor.

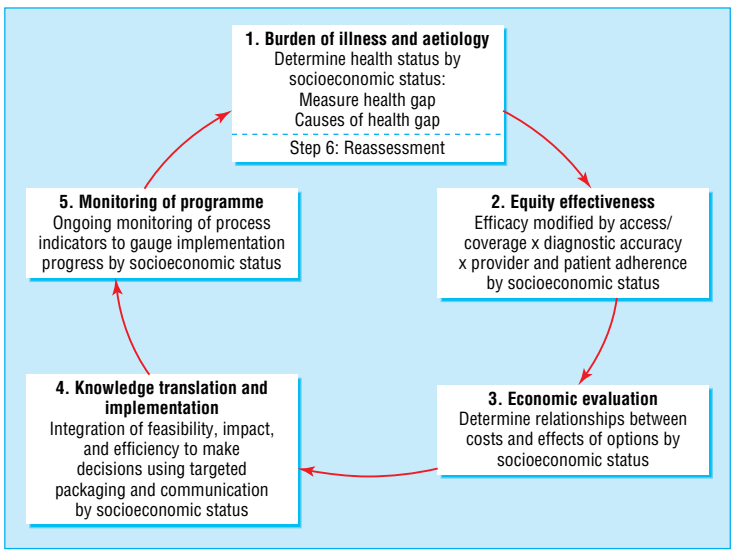


**Fig 1** Equity effectiveness loop

## Methods

This equity effectiveness loop provides a framework for developing and evaluating population health interventions and policies that explicitly focus on narrowing the gap between rich and poor, using the best available evidence. This framework integrates the concepts of individual risk and socioeconomic status with intervention effectiveness from a population health perspective.

We will illustrate this framework with two interventions: nets treated with insecticide for malaria prevention (an acute infectious disease in low income

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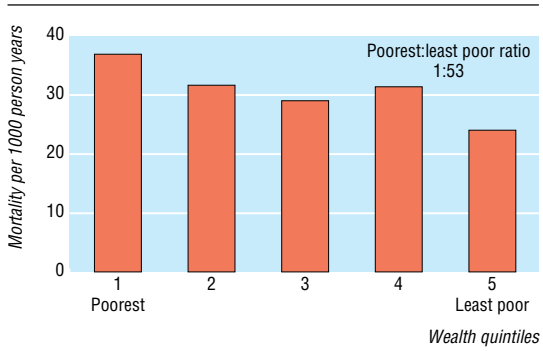


**Fig 2** Mortality under age 5 by wealth quintiles across a small rural area in a setting where malaria is endemic[54]

countries), and total joint arthroplasty for osteoarthritis (a chronic disease in industrialised countries). For malaria, we compare the poorest and least poor across all steps, since "richest" is not appropriate in low-income country settings. For osteoarthritis, we compare richest and poorest.

## Results—step by step through the equity effectiveness loop

### Step 1: Burden of illness

This step measures the burden of illness and its gradient by socioeconomic status. This includes downstream (individual), and upstream (societal) determinants of health (psychosocial, biological, cultural, political, and environmental).[4–5 10–12]

*Malaria*—Although malaria is preventable, controllable, and curable, more than 300 million cases are reported each year. Malaria compounds poverty and impedes economic development.[13] Although the risk of malarial fever varies little across socioeconomic quintiles,[14] an important gradient between least poor and poorest quintiles is present in the risk of adverse outcomes (fig 2).[15]

*Osteoarthritis*—Osteoarthritis is the fourth highest cause of global morbidity[16] and a leading cause of lost productivity at work and decreased quality of life.[17 18] A significant socioeconomic gradient is present in osteoarthritis even after adjusting for lifestyle risk factors (fig 3).[19–22]

### Step 2: Differential equity effectiveness

Controlled studies provide estimates of efficacy—that is, how well an intervention can work in ideal circumstances.[23] Community effectiveness measures how well an intervention works in real settings and systems at the community level. Community effectiveness is often substantially lower than efficacy because of a staircase effect (fig 4). This staircase effect is the result of lower awareness, access, or coverage; screening, diagnosis, or targeting; compliance of providers; and adherence of consumers. Poor people probably have a greater reduction in efficacy at all four steps and therefore a greater staircase effect than the least poor people. We need to assess equity issues across each step to identify barriers to implementation related to gradients in wealth. The table illustrates stepwise reductions in efficacy that are greater in the poorest subpopulations. This staircase effect therefore disadvantages people who are already disadvantaged.

We use a simple, multiplicative model to estimate community effectiveness in the table. This model assumes that individual factors are not highly correlated (even with optimal diagnosis, a patient's adherence may be low). By using this model, efficacy is multiplied by the factors of access, diagnostic accuracy, compliance of providers, and adherence of consumers for the poorest and the least poor. We then calculate the equity effectiveness ratio of the least poor to the poorest. Access, diagnostic accuracy, compliance, and adherence are based on composite data from a variety of studies, with some guesswork based on clinical experience where data are lacking. The table aims to illustrate the potential of this framework to illuminate specific barriers related to wealth to implementation and effectiveness across the gradient between least poor (or richest) and poorest. The conclusions are not to be taken as empirical. This framework estimates real effectiveness of interventions in least poor (or richest) and poorest subpopulations and highlights those areas that, if improved, could have the greatest impact on improving the effectiveness of interventions for the poor subpopulations.

*Malaria*

The relative efficacy of treated bed nets on childhood mortality[24] is unlikely to differ across socioeconomic status since the risk of malaria is similar across socioeconomic gradients in areas of comparable endemicity. However, the absolute difference may be greater in the poorest people, who start with higher baseline mortality.[24 25]

We estimate hypothetical access on the assumption of achieving the World Health Organization's targets of 60% coverage by 2005, with a coverage ratio for the poorest to the least poor of 0.57, as seen in small scale social marketing projects.[26] Diagnostic accuracy in targeting people in greatest need depends on providers' knowledge and is likely to be high for least poor and poorest people alike. The compliance of providers depends on how bed nets are delivered. If nets are sold compliance is higher for the least poor, but even when bed nets are freely provided it remains high, even in the poorest.[27] Typical adherence of consumers in trials of

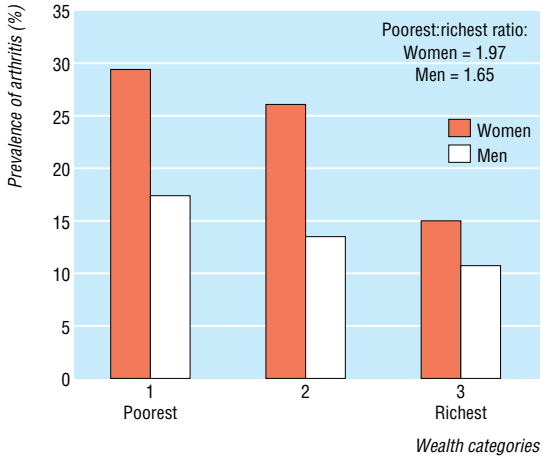


**Fig 3** Prevalence of arthritis by wealth in Canada (as an example of an industrialised country)

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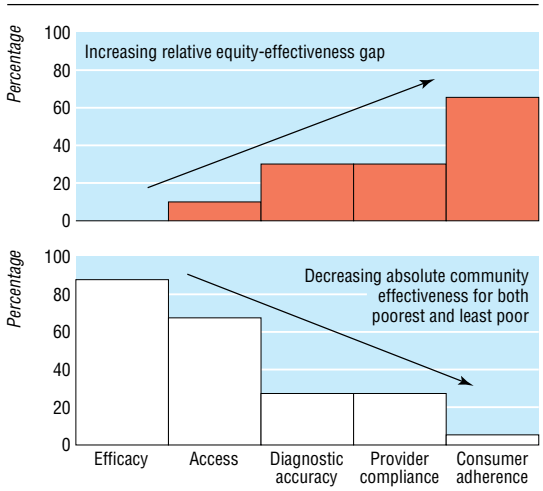


**Fig 4** Staircase effect of increasing gap and decreasing effectiveness across four factors, illustrated by using hypothetical estimates for total joint arthroplasty. As efficacy is multiplied by each of the four modifiers of access, diagnostic accuracy, provider compliance, and consumer adherence, the staircase effect causes decreasing community effectiveness and increasing relative gap between poorest and least poor from zero gap in "ideal" efficacy conditions to a ratio of least poor to poorest in "real life" of 1.6 (shown in the table)

bed nets is around 70%.[24 28] We have postulated greater adherence in the poorest because of higher exposure to nuisance biting mosquitoes and less adherence in the least poor because of access to other mosquito avoidance technologies (such as screened windows).

We calculated community effectiveness for a reduction in child mortality of 7.7% in the least poor and 5.6% in the poorest. This represents 39% and 28% of the potential achievable efficacy of 20%.[24] The least poor achieve 1.4 times the impact of the poorest. This framework and hypothetical data imply that access is the major barrier to achieving optimal efficacy in this scenario. Once access is addressed, other factors in the staircase with large differences across socioeconomic status would need to be addressed to optimise effectiveness.

These conclusions are limited by guesswork for access and adherence. Empirical studies by socioeconomic status are lacking and are required to determine which factors pose the major barrier to achieving improved effectiveness and equity effectiveness.

*Osteoarthritis*

Disparities in the use of arthroplasty across income, education, and race result from these same factors. Controlled before-after studies have shown an efficacy of 86% for improved quality of life after arthroplasty. We define access as having a doctor who raises consideration for arthroplasty. A survey of 1105 people in Ontario who were eligible for arthroplasty found that 83.3% of the richest and 75.8% of the poorest were receiving care from a doctor for their arthritis.[29] Diagnostic accuracy refers to recognition of need for arthroplasty by the patient's doctor. We estimate diagnostic accuracy at 50% in the least poor and 43% in the poorest; this estimate is based on the proportion of individuals from this same cohort whose arthritis care provider had discussed arthroplasty as a treatment option. Once a patient is referred to an orthopaedic surgeon, we define the compliance of the provider as the surgeon's recognition of need and appropriate recommendation for surgery. Concerns that arthroplasty is overused have been dispelled.[30] We chose an estimate of 98%, postulating that once a patient sees an orthopaedic surgeon, he or she will receive surgery if needed. We used the proportion "definitely or probably willing" to consider arthroplasty from the same cohort to estimate the adherence of consumers: 36% of the richest and 28% of the poorest.[29]

Multiplying these factors gives a community effectiveness of only 14.7% and 7.7% in the richest and poorest, respectively. The richest achieve 1.6 times greater benefits from arthroplasty than the poorest. Over 85% of the potential efficacy is lost in both rich and poor, mainly because of poor access and adherence of consumers. Interventions are urgently needed to tackle perceived barriers and low willingness to undergo arthroplasty. The barriers of access and adherence of consumers are greater in the poorest groups.

**Step 3: Economic evaluation**

This step assesses the efficiency (health benefits (number of disability adjusted life years avoided) obtained for a specific cost (direct, indirect, and where possible intangible costs)) of the intervention. Assessing the efficiency requires adequate evidence of efficacy and valid estimates of cost. Assessing the equity issues related to cost effectiveness implies a trade-off between cost efficiency and population health equity. Priority funding of interventions with the best cost effectiveness ratios might increase differences between richest (or least poor) and poorest because the cost of reaching poor people may be higher and health benefits may be lower. One promising method to assess equity issues related to cost effectiveness is the development of an equity and quality adjusted life year (EQ-QALY), as a complement to established measures of the difference between rich and poor, such as the concentration index.[31 32]

Ratios of poorest to least poor (or richest) subpopulations for community effectiveness: the differential "staircase" effect. Values are percentages unless otherwise indicated

| | | Modifiers of efficacy | | | | | |
|---|---|---|---|---|---|---|---|
| | Efficacy | Access | Diagnostic accuracy | Provider compliance | Consumer adherence | Community effectiveness | Least poor (richest):poorest equity effectiveness ratio |
| **Treated bed nets for under-five mortality due to malaria** | | | | | | | |
| Least poor | 20 | 75 | 95 | 90 | 60 | 7.7 | 1.4 |
| Poorest | 20 | 43 | 95 | 80 | 85 | 5.6 | |
| **Arthroplasty for disability due to osteoarthritis** | | | | | | | |
| Richest | 86 | 83 | 50 | 98 | 36 | 12.6 | 1.6 |
| Poorest | 86 | 76 | 43 | 98 | 28 | 7.7 | |

*Community effectiveness is the product of the efficacy modifiers of access, diagnostic accuracy, compliance of providers, and adherence of consumers.

*Malaria*
Bed nets treated with insecticide are a simple, safe, and cost effective method of protection against malaria.[33] However, one of the reasons for the wealth gradient in malaria prevention using bed nets is that the least poor have greater purchasing power and access to information and markets than poorer people—an important issue for social marketing programmes.[15] The degree to which these wealth gradients persist or the pace at which they are mitigated is a measure of the extent to which these bed net strategies may benefit the poor.

*Osteoarthritis*
Despite the high cost of arthroplasty, studies have shown very favourable cost effectiveness ratios.[34–37] Cost effectiveness by wealth gradients is not available. Developing interventions to reach populations with low income and low education might be more expensive because of the need for increased intensity, multifaceted interventions, and appropriate reading level. This will result in less favourable cost effectiveness ratios, unless reducing the gap between rich and poor is considered in assessing cost effectiveness, by using methods such as the EQ-QALY described above.

**Step 4: Knowledge translation and implementation**
Translation of knowledge is defined as the process that transfers research results from producers of knowledge to its users, for the benefit of the population. Moving beyond the traditional domain of academic publication, it comprises three interlinked components of uptake and translation: exchange, synthesis, and ethically sound application of knowledge.[38] This step entails uptake and translation of knowledge into action.[39–42]

Therefore we must develop new, effective means of packaging and communicating evidence on effectiveness across wealth gradients to the different policy, community, and practitioner groups or individuals responsible for each of the components of community effectiveness—access, diagnostic accuracy, compliance of providers, and adherence of consumers.[40] Evidence that interventions using knowledge translation are efficacious is currently lacking in most sectors.[43–46] One exception is the work of the International Clinical Epidemiology Network, which is developing methods explicitly to consider equity issues in developing and applying clinical guidelines.[47] By targeting the wealth gradient in knowledge translation strategies, we support the operational research agenda for optimising the benefits to the poor of key interventions.

*Malaria*
Social marketing of treated bed nets is an active implementation strategy, including the identification of barriers through extensive market research and public opinion surveys, followed by professional and innovative marketing strategies to tackle these barriers. Social marketing increased coverage from 10% to 50% in three years in Tanzania.[48] Social marketing also helps in closing the gap in coverage between the poorest and the least poor over time.[15] Other approaches may close this gap faster.

*Osteoarthritis*
Disparities in the rate of arthroplasty use by socioeconomic gradients need to be dealt with. A patient's socioeconomic position, ethnicity, or sex may influence the encounter between patient and doctor.[49 50] Current initiatives to educate the population about osteoarthritis and indications for surgery and to develop culturally sensitive decision support tools to elicit patients' preferences for treatment need to take socioeconomic position into account.

**Steps 5 and 6: Monitoring and reassessment**
Monitoring identifies the importance of process assessments and intermediate outcomes to assess success in affecting mortality and morbidity by socioeconomic group and deciding whether further remediable need exists; if so, an additional iteration of the equity effectiveness loop is needed. The Whitehall cohort study, for example, showed that even with equitable access to cardiac care, the social deprivation gradient still produces disparities in outcomes,[51] indicating a need to tackle other causes of disparities.

International approaches to monitoring equity may be useful for this step. The Global Equity Gauge Alliance has developed "equity gauges" to track gaps in health by assessing key indicators, involving the public and advocacy.[52] The Health Metrics Network will enable performance based monitoring of interventions and health systems, with a focus on equity issues, to promote policy decisions based upon evidence.[53]

## Summary points

To reduce the gap in health between rich and poor, a strategic approach is needed to designing and implementing interventions and policies that are effective in low income settings

The "equity effectiveness loop" provides a way of checking that the effects of interventions are examined across the gradients in wealth

By helping to determine which factors are likely to have the greatest impact on reducing health inequalities the framework should improve the targeting of interventions

## Discussion

For equity to be achieved, factors that are known to lead to inequalities need to be reversed. This equity effectiveness loop can provide a useful framework to assess the barriers to reversing health inequities and to use as a basis for implementing equity oriented change and improved opportunities for health for disadvantaged populations. This might be used by groups and agencies responsible for making decisions on access to resources—for example, the National Institute for Health and Clinical Excellence and the World Health Organization—to ensure that equity issues are considered systematically.

This framework needs to be validated by empirical studies to show how it could be used to design and target interventions to reduce the gradient in health in effectiveness of interventions. Furthermore, because the evidence still has gaps, we need to organise available information systematically and identify the potential gaps explicitly so that an informed decision may be made, whether it be a recommendation for funding, further study, or remedial action. The Cochrane Collaboration Equity Field will assemble evidence on these interventions.