

POPULATION DOSE

Understanding, measuring, and boosting the impact of
community health interventions

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What is population dose?

Community health initiatives, such as those focused on obesity, often seek to improve policies, programs, and neighborhood environments. Population dose is a way to describe the relative impact of these community health promotion strategies and to estimate the combined impact of multiple cross-sector strategies that focus on the same health behavior. Dose is a combination of reach—the number of people touched by a strategy—and strength—the degree to which those people change their health behavior. Dose focuses on an “average resident” to capture the impact across the *entire* community, i.e., those people exposed to an intervention as well as those who are *not* exposed. It is an *estimate* of the impact because we often have incomplete and/or subjective information about the reach and strength of interventions.

Why is dose important?

Dose methods give us a way to add and compare very diverse intervention strategies using a common yardstick. For example, using dose we can compare a strategy like building more sidewalks to increase walkability (a high-reach, but low-intensity strategy) to a strategy like a walking group that meets every day (low-reach, but high-intensity). Dose lets us add up the impact of different strategies that target the same outcome and group of people. It gives us a way of talking about how to increase the impact of our strategies—increasing the number of people reached and/or finding ways to make them stronger.

Overview of dose methods

Calculating potential or actual dose of a group of strategies in a community includes four key steps:

1. All strategies are grouped into clusters by the behavior they target. For obesity prevention, we typically use these categories: physical activity, healthy foods, fruit/vegetable consumption, and sugar sweetened beverage consumption.
2. For each strategy in a behavior outcome cluster, an assessment of the number of lives touched (reach) and impact on those lives (strength) is calculated.
3. Dose for each strategy is calculated as the product of reach and strength.
4. Finally, the dose of all strategies in a cluster targeting one outcome are added together to estimate overall population dose—population level impact on the target behavior.

Measuring reach

Reach is the percent of the people in the target population who are touched by or exposed to a strategy.

Numerator: people who are exposed. Exposure to programs means participating in them (e.g., attending an exercise class). It's harder to define exposure to environmental and policy changes, but we generally define it to mean the people who encounter the improved environment on a regular basis and are assumed to be influenced by it. Some examples of environmental exposure include:

- Number of residents living with ¼ mile of a newly renovated park or playground
- Number of people with access to vending machines that now include only healthier items
- Number of shoppers at a grocery store that now offers a greater variety of fresh produce
- Number of students at a school that installs new playground equipment

Denominator: total number in target population. First we need to define who is (and is not) included in a target population. This definition helps us understand what an "average" resident might experience, since some people will be exposed to a strategy and some will not. The target population could be defined as a county, a town, a school district or individual school, a neighborhood, a worksite, and more. This is the population whose behaviors and ultimately health you would like to improve.

Measuring strength

Strength is where we estimate the percent change in a behavior such as the percent increase in physical activity or percent decrease in unhealthy food consumption. The purpose is to quantify the impact a strategy has on reached people. Strength is also known as effect size, average percent change, or individual level impact. Strength is expressed as an average percent change in behavior for each person exposed.

Strength estimates are based on

- **Frequency of exposure** (e.g., is someone exposed all or most days, or only occasionally?)
- **Duration of Exposure** (e.g., how long is the exposure, and over what time period?)
- **Degree to which the healthy choice is the only choice** (e.g., all healthy choices in a vending machine, or some healthy choices mixed with less healthy ones?)

Measuring strength, continued...

For planning purposes, we can use default ratings based on averages of past strategy implementations, or estimates of what we hope to accomplish, e.g., based on expert opinion, potential best-case scenario effects, etc.

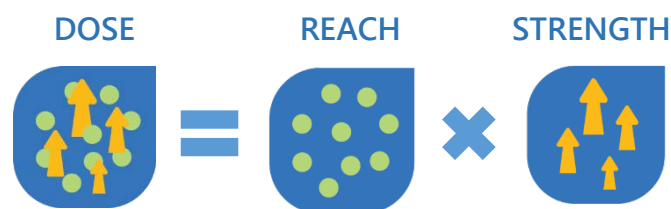
For evaluation purposes strength estimates are grounded in empirical estimates of effect sizes. We ultimately want to quantify population-level impact based on empirically derived strategy-level impact. Empirical estimates are ideally based on strategy-level evaluations or from published research studies of the same health intervention with a comparable population that systematically captured the degree of behavior change.

For strategies where we don't have quantitative data, we rely on descriptions of implementation and how they compare to strategies for which we do have evidence, to give our best estimation of effect size grouping (see table below).

Effect size groupings based on our strategy-level evaluation evidence and literature review

No effect	0%	No consistent positive effect sizes, based on our evaluations or the literature, or trivial given reach
Minimal	0.5%	Usually large reach, small touch that have small effects that can contribute to overall dose cluster
Low	2%	Low effect sizes but that are still non-zero, statistically significant, often environmental
Medium	5%	Fairly strong strategies that show significant effects, often measurable on a population level
High	10%	Usually programmatic, often very low reach, but very impactful for those who participate

Calculating dose



Finally, we calculate dose as reach times strength: the percent of people touched (reach) times the estimated impact or change in lifestyle for each person reached (strength). This gives us the dose of each strategy. We can then add the dose of strategies that target the same outcome and group of people to get population dose. We often use the term "population" dose because it applies to the whole community.

Examples of applying dose to real-life strategies

Low reach, high strength. Exercise programs are typically low reach (compared to the whole community population) but often have a large impact on participants. Therefore, depending on baseline levels of physical activity in the population targeted, the overall dose might still be significant.

High reach, low strength. Complete streets interventions are typically unlikely to have a big impact on each person reached. Most people will not change their transportation patterns or amount of walking as a result, so these strategies are typically low strength, but they do have high reach. This is an example where context is important. Sidewalk improvements may or may not stimulate changes in walking patterns depending on accessibility and what the sidewalk connects to.

High reach, high strength. School-based physical activity programs are often potentially high reach and high strength, which is very important because they are often higher dose and likely to have a significant population level impact. A PE curriculum change might add several minutes to daily physical activity for all students. Youth are often a captive audience, which makes impacting their behavior much easier than adults.

Estimating population-level impact. The population dose of individual strategies is often low, because either reach or strength is low. However, initiatives often include multiple, overlapping strategies targeting the same outcome. In the example below three individual strategies have minimal to medium impact on youth physical activity. However, added together, their combined impact is estimated to be high.

Strategy	Reach	Strength	Dose
After-school Zumba program	5% low	10% high	0.5% minimal
Encourage active transport to school	100% high	2% low	2% low
PE curriculum changes	100% high	5% medium	5% medium
Total youth physical activity dose			7.5% high

Calculations such as 7.5 are not meant to be taken literally, but rather to be indicators of whether small, medium, or large shifts in behavior might be occurring as a result of a strategy or combinations of strategies. In this example, the population dose is high. Therefore, we expect to see behavior change occurring that is significant enough to measure if we conducted a population level survey at this school.

How much is a high dose cluster?

The power of the population-health approach is that small changes in each person can produce a big overall effect. For example, one estimate is that a 2% average increase in physical activity minutes can result in a 1% decline each year in obesity rates and a 0.5% long-term decline in the prevalence of diabetes. In a community of 10,000 people, that represents 100 fewer people categorized as obese each year and 50 fewer people with diabetes. Since small doses can mean big impacts at a population level, dose $\geq 2\%$ (based on solid evidence) is considered “significant.” However, since population surveys have limited ability to detect small changes and confirm impact, we categorize dose estimates into three categories based on expert opinion:

- **Low impact:** $< 2\%$ dose—do not expect significant impact
- **Significant, not measurable impact:** 2%-5% dose—some effect, not enough to measure with a population level survey
- **Significant & measurable impact:** Dose $> 5\%$ —significant long-term effect, possible to measure change with a population survey

Increasing dose

If dose matters and high-dose strategies matter even more, how can we systematically and intentionally increase dose? How can we build dose into planning, strategy selection, and evaluation? In part, we do so by asking: “Can we reach more people, more times, more often, for a longer period, throughout the year, and across sectors?” Answering this question requires an honest, factual understanding of a strategy’s reach and strength as well as candid discussions among planners, evaluators, practitioners, and funders.

The good news is that even when dose is estimated to be low, there are many options for increasing it: by increasing reach (spreading changes to more people), increasing strength (e.g., increasing the frequency or duration of the strategy), adding strategies to strengthen a cluster of strategies, or removing some that are not as effective and are using up resources that could be put to better use.

Conclusion

Dose does matter. But what really matters is achieving the ideal of total health and well being for as many of us as possible. Dose matters because it holds the promise of helping us get there faster, more efficiently, and with more lasting results than would otherwise be the case, without the insights dose can offer about what does and does not work to improve the health of our communities.

For more information on using dose to plan and evaluate community health initiatives, please visit <http://share.kaiserpermanente.org/article/dose-creating-measuring-impact/>.