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The Case for Environmental Strategies to Prevent Alcohol-Related Trauma

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Although advances in emergency and critical care reduce morbidity and mortality resulting from injury, larger reductions can be achieved through prevention [1]. In that context, alcohol-related injuries are of great strategic importance. Around a third of all trauma patients were alcohol positive when injured [2–6], so reducing the incidence of these cases will substantially reduce the overall burden due to trauma, lessen clinical caseloads, free scarce health resources, and reduce human suffering. To that end, the public health literature provides compelling evidence to support a collection of approaches known as environmental prevention strategies. These interventions limit access to alcohol, which decreases consumption in the population and reduces the incidence of alcohol-related trauma. Here we present this case, arguing that environmental prevention strategies are indispensable to efforts to reduce the overall health burden due to trauma.

Indicated, Selective and Universal Prevention

Approaches to preventing public health problems can be classified based on the populations they address [7]. *Indicated* prevention targets people identified as being at increased individual risk. Taking motor vehicle injuries as an example, suspending a person's license after a seizure uses information about individual risk to reduce the likelihood that the person will be injured or killed while driving at a later date [8]. *Selective* prevention targets subsets of the population known to be at increased risk, even though risk for individual members of the identified groups may differ greatly. Because younger drivers are generally more likely to crash while driving at night, one possible approach would be to restrict nighttime driving for all novice drivers, even though the ability (and therefore risk) of individual novice drivers will vary. This selective strategy reduces the total number of crashes [9]. Finally, *universal* prevention applies to whole populations, with no attempt to differentiate individuals based on their risk for developing problems. Seat belt laws, which apply to all

motorists regardless of their risk of crashing, also demonstrably reduce the number of motor vehicle injuries and deaths [10].

As in the case of motor vehicle injuries, a suite of indicated, selective and universal strategies seek to prevent alcohol-related injuries [11]. Supporting the indicated strategies, observational studies in emergency departments clearly show that trauma patients drink systematically differently compared to the general population. They consume more alcohol overall, are more likely to have an alcohol use disorder, and are more likely to have a prior history of alcohol-related injuries [12-16]. Interventions which take advantage of the “teachable moment” immediately following an injury may therefore reduce recidivist alcohol-related emergency department admissions [17]. Results from randomised controlled trials are mixed, but are generally supportive of strategies addressing patients who screen positive for an alcohol use disorder (e.g., brief interventions) [18].

The higher risk of injury -for people who consume greater quantities of alcohol means these individuals may benefit from interventions in the emergency department; however, the overall public health impact will likely be small. This is due to the distribution of drinkers in the population. Rose [19] first proposed in 1981 that large populations exposed to small risks will produce more cases than small populations exposed to high risks. The “prevention paradox” has since become a touchstone of preventive medicine. Kreitman [20] tested this hypothesis for acute alcohol-related harms in 1986, identifying that while people who consume more alcohol overall are undoubtedly at greater risk, the great bulk of the population drinks at lower levels, so moderate drinkers contribute more harm in total than heavier drinkers. Other studies comparing people’s average drinking and their risk of acute harm corroborate these findings, but more detailed analyses separating the behavior (drinking) from the person (drinkers) find that people who consume moderate quantities of alcohol overall but sometimes drink heavily (i.e., occasional “binge” drinkers) account for most acute problems [21-24]. Event-level analyses among trauma patients complement this finding, suggesting greater injury risk is specific to the time of intoxication [25, 26] and the relationship is dose-responsive [27, 28].

Indicated strategies targeting emergency department patients who consume large quantities of alcohol will achieve only small reductions in the overall incidence of alcohol-related trauma in the population. Selective strategies addressing those who occasionally drink heavily may have greater public health impact, but accessing this group is more difficult. Although occasional heavy drinkers contribute a large proportion of all trauma cases, there is very low probability that any individual drinking event will result in traumatic injury, meaning that most such people will never be admitted to an emergency department for an alcohol-related injury. They must be accessed elsewhere. General population surveys identify that occasional heavy drinking is more common among certain groups (e.g., young adults) [29, 30], suggesting a possible approach might be to intervene among these people or at the places they are found (e.g., universities). Alternatively, universal strategies avoid having to access these drinkers altogether by aiming to reduce average risks for all members of the population.

Environmental Prevention

Selective and universal prevention have greater potential to reduce the incidence of alcohol-related trauma in the population than indicated prevention. The public health literature provides clear guidance as to the type of strategies within these classes that are most effective. There is very little evidence to support approaches that seek to motivate behaviour change, either among selected groups (e.g., school-based education) or all individuals in a population (e.g., advertising campaigns, health warning labels) [11, 31]. In contrast, available evidence strongly supports environmental strategies that alter the physical, social and economic availability of alcohol. For example, observational studies indicate there are fewer injuries in areas where purchase prices are higher [32, 33], there are fewer alcohol outlets [34], and the legal blood alcohol concentration for drivers is lower [35]. These relationships are also dose-responsive and temporal, and natural experiments demonstrate the effects follow deliberate policy changes [31, 36]. Given the broad reach of these environmental strategies, it is often impractical to test relationships between specific interventions and specific outcomes in experimental studies, though cluster randomised controlled trials assessing collections of approaches suggest they are effective whether applied selectively (e.g., within university campuses) [37] or universally (e.g., within whole cities) [38].

Two global observations explain why environmental prevention works. First, people drink more where alcohol is more easily available. Bruun proposed some 40 years ago that having more alcohol available in a community would lead to greater alcohol consumption among local populations, and that controls on availability could reduce consumption and benefit public health [39]. The literature has supported that hypothesis over the ensuing decades, but has also emphasised that the social and spatial dynamics of alcohol availability and alcohol use are complex [40, 41]. Availability includes the full cost of obtaining alcohol (accounting for both financial and convenience costs) [42], and is not simply related to alcohol demand, but also to the characteristics and structure of the population and the regulatory environment within local areas [43-45]. Thus, making alcohol more expensive (e.g., raising purchase prices), harder to access (e.g., limiting outlet density) or harder to consume (e.g., lowering legal blood alcohol concentrations for drivers) disrupts local availability, which in turn lowers consumption among local populations.

The second global observation is that more drinking leads to more trauma cases. Aggregate studies demonstrate that populations in which overall consumption is greater experience more alcohol-related problems [46, 47], and survey studies from the general population find that people who drink more are at greater individual risk of injury [48]. Event level analyses add that, in addition to greater consumption leading to greater risk, the local physical, social and economic contexts in which drinking occurs also matter a great deal, variously raising or lowering the risks for individual drinking events [49, 50].

Putting these pieces together, it is clear that alcohol availability is related to alcohol consumption, alcohol consumption is related to the incidence of trauma in the population, and these global relationships are experienced locally by individual drinkers. Thus, environmental strategies that reduce alcohol availability will affect both the likelihood of a

drinking event occurring and the quantity of alcohol consumed when it does, reducing the risk of an emergency department admission. Because selective and universal prevention will have greater overall impact on trauma incidence than indicated prevention, an evidence based approach to reducing trauma burden would emphasise these environmental strategies.

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