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DEVELOPING INDICATORS TO MEASURE THE IMPLEMENTATION OF THE WESTERN CAPE ALCOHOL HARMS REDUCTION STRATEGY IN SOUTH AFRICA

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ABSTRACT

This manuscript describes a process to develop a set of indicators to monitor and evaluate the implementation of the Western Cape Alcohol-Related Harms Reduction (AHR) White Paper in South Africa and provide a final set of indicators. Drawing on the framework in Andréasson et al. (2009), a logic model with categories and types of indicators (i.e. prevention, determinants, consumption, and alcohol-related harms) was used to develop an initial set of 255 indicators. The methodological process followed involved a) scoping of a large electronic database maintained by the South African Medical Research Council, b) a comprehensive literature review and, c) reaching out to18 international key informants. Iterative communications with stakeholders from diverse government entities via email, telephone calls and individual and multi-person face-to-face meetings, together with a consensus process involving the study team was used to refine the indicators. The final set included 176 indicators; 108, (61.4%) of these were "core" indicators, and 68 (38.6%) were "expanded" indicators, meaning they added to the core indicators in given areas which would be useful to have but are of a lower priority or are likely to be less easy to obtain. Of the core indicators, 45 (42.4%) were deemed by policy makers/researchers in the Premier's office as "high-level indicators," denoting that they were the most essential. This manuscript demonstrates that it is possible to develop evidence-based, location-specific indicators to evaluate policy implementation.

Keywords: Indicators, alcohol, policy, South Africa

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The World Health Organization has recently made substantial efforts to expand the use of alcohol-related indicators at international (World Health Organization, 2018; Pan American Health Organization, 2017), provincial (Canadian Substance Use Costs and Harms Scientific Working Group, 2018), and even at city (CityHealth, 2020; World Health Organization, 2019) levels. Developing alcohol-related indicators is urgent for South Africa given that it is one of the countries in sub-Saharan Africa with the highest levels of heavy episodic drinking (HED), and the 6th highest country globally in terms of the amount of absolute alcohol consumed per drinker per day at 64.6 grams (World Health Organization, 2018), and the levels of hazardous consumption and harms appear to be rising (Ferreira-Borges et al., 2017; Institute for Health Metrics and Evaluation (IHME), 2018).

The South African Comparative Risk Assessment Collaborative Group estimated that in 2000 alcohol was responsible for 43.9% of road traffic injuries, 41.2% of cases of epilepsy, 17.3% cases of hypertension, 4.4% cases of ischemic heart disease and 25.2%–40.4% cases of cancer. For injury burden, alcohol was estimated to be responsible for 20.2% and 40.9% of unintentional and intentional injuries respectively (Schneider et al., 2007). The associated health burden rose with risky drinking patterns. For instance, compared to abstainers, low drinkers had 40% higher risk of hypertension, while moderate drinkers had twice the risk and heavy drinkers had four times the risk (Schneider et al., 2007). In 2017, the Global Burden of Disease updated the alcohol population attributable fractions at the country level. They estimated that 14.9% (7.6-21.2%) of road traffic deaths, 22.8% (13.7-34.1%) of hypertension deaths, 5.1% (0.7-10.7%) of ischemic heart disease deaths, and 9.3% (8.0-10.9%) of cancer deaths in South Africa were due to alcohol (Institute for Health Metrics and Evaluation (IHME), 2018).

South Africa is divided into nine provinces each with its own legislature, premier and executive council. The Western Cape Province is the 4th largest in respect of area per kilometre (Alexander, 2019). This province continues to be heavily burdened by harmful alcohol use with provincial data showing that 9.0% of women in the Western Cape report past 30-day binge drinking versus 22.8% of men (NDoH, StatsSA, SAMRC, & ICF, 2019) and this is the 2nd highest province in South Africa in terms of alcohol's ranking in terms of burden of disease risk factors (7th out of 20 causes) and in terms of causes of age-standardised, risk attributable disability adjusted life years lost per 100,000 population. Only the Eastern Cape Province had alcohol ranked higher, in 6th place (Achoki et al., 2022). One of the historical contributing factors to high rates of HED in the province is the legacy of the 'dop system', the arrangement by which workers under the former apartheid regime were given alcohol as a benefit of employment (London, 1999). While the consequences of this historical institutionalization of harmful alcohol consumption remains widespread, more recently the problem of alcohol-related trauma was further magnified as a result of the numerous alcohol sales bans that were implemented as part of the government's response to the COVID-19 pandemic.

To address the long-standing burden of alcohol harms, the Western Cape Provincial Cabinet in 2015 agreed that an alcohol-related harms reduction policy should be developed to guide the province's

approach to the regulation of alcohol (Western Cape Government, 2017). This decision was not only based on high rates of HED but also on the need to address gaps in alcohol legislation. Current alcohol legislation at national and provincial levels aims to regulate the activities of licensing and enforcement of the production, distribution and sale of alcohol but it does not adequately take into consideration the impact of alcohol-related harms on society, nor does adequately address the consequences of harmful drinking, which the Western Cape (WC) alcohol-related harms reduction policy aims to do (Western Cape Government, 2017).

While developing alcohol-related indicators for the country is ideal, it should be noted that there are some instances where many of the targets and indicators for national level policy apply at the local or regional level, as in the case of health status and social problems, while some aspects of alcohol policy, such as taxation or restrictions on alcohol marketing and sponsorship, cannot be decided at a local or regional level (Commonwealth of Australia, 2001). The same applies to South Africa hence the decision by the WC cabinet. The main areas of provincial competence relating to alcohol in South Africa relate to the retail sale of alcohol, regulation of microbrewing, provision of treatment and prevention of alcohol problems via the health sector, and enforcement of drink driving laws via police employed by local municipalities.

Effective approaches to addressing alcohol-related harms at a national or even provincial/state level requires clear, measurable objectives and targets to improve population health, and to determine the success of any strategies implemented. It is not enough to have well-developed policies: The attainment of or progress towards achieving targets and objectives needs to be monitored and evaluated using measurable indicators (Commonwealth of Australia, 2001). There is now a science around good indicator development, and the methodological considerations for the development of alcohol policy indicators are not unique. According to Andréasson, Nilsson and Bränström (2009), the choice of alcohol-related harm indicators should be guided by theory. They argue that the choice of indicators should be guided by at least three criteria: validity (being free from systematic error), reliability (being free from random error, i.e. replicable), and (data availability, and that one option guide the development of alcohol policy indicators is to apply a systems model where consumption of alcohol and associated harms are related to several environmental factors. Following on from this Andréasson et al. (2009) grouped indicators into four categories: determinants of consumption, consumption, harm and preventive activity. According to this model, the *determinants* of consumption and social and medical harm include domains such as social norms and attitudes, price, physical availability, and enforcement as well as indicators of preventive measures such as efforts to limit availability and the provision of information. They refer to consumption and harm indicators, such as per capita consumption of alcohol or number of alcohol-related traffic fatalities as primarily reflecting the *effects* of preventive activity or lack of activity. They refer to determinants, such as availability of alcohol for youth, and preventive activity, such as improved age control, as being *intermediary* variables. They indicate that these are middle links in a causal chain, with the ultimate goal of alcohol policy

being to reduce alcohol-related harm. They propose that one way that this can occur is from increased preventive activity such as through political decisions that reduce availability and enforcement of related regulations, and that at a later stage this should result in reduced per capita consumption, improved drinking patterns and reduced harm (*outcome* variables).

The goal of this study was to generate a set of locally specific, evidence-based indicators suitable for monitoring the implementation of the range of interventions specified in the AHR White Paper (Western Cape Government, 2017). The target policy areas and proposed interventions in the AHR White Paper include pricing and the economy, unlicensed outlets and the illicit liquor trade, law enforcement, alcohol and the road environment, health and social services, community- based action, and education and awareness, and the evaluation of short- and long-term outcomes in terms of alcohol consumption and related-harms.

METHOD

Logic model

The logic model (Fig. 1) used to guide the development of these indicators brought together concepts from the WC AHR policy (Western Cape Government, 2017), Andréasson et al.'s (2009) systems model framework (described above), and the results of a scoping literature review undertaken as an initial step in developing the indicator set.

The logic model grouped indicators into Andréasson et al.'s four categories: determinants of consumption, consumption, harm and preventive activities. These categories aligned with main foci of the AHR policy and the stages of indicators sought (i.e., determinants, intermediary, and outcome variables). The ultimate goal of alcohol policy is to reduce alcohol-related harm (Babor et al., 2010). One way this can occur is from political decisions that reduce alcohol's economic or physical availability and enforcement of related

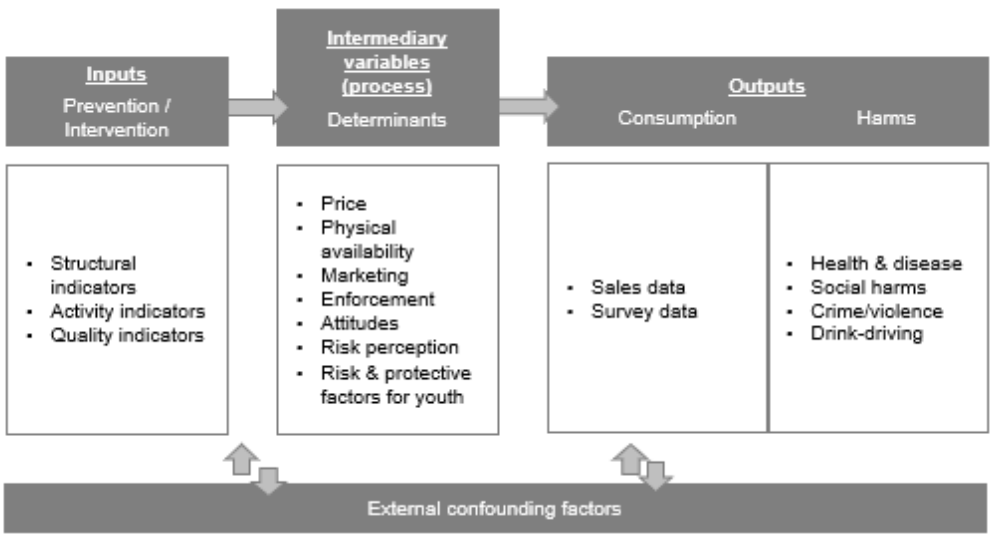


Figure 1. Logic model

regulations. Therefore, prevention strategies and interventions are the *inputs*, while consumption and harm indicators primarily reflect the *effects* or *outcomes* of these strategies or can indicate a lack thereof. Determinants are *intermediary* variables; they are the middle links in a causal chain (Andréasson et al., 2009).

Strategy to develop and source indicators

To source indicators considered for inclusion we followed a number of steps between May and November 2019. Phase 1, the preparation of the initial draft indicator set, involved three steps. First, the first author (CDHP) performed a literature search of using selected scientific search engines (Pubmed and Google Scholar) as well of the Alcohol, Tobacco and Other Drug Research Unit (ATODRU)'s electronic database of 12,600+ records on published and unpublished literature on the topic of alcohol and drug use. The following keywords were used in the searches, with no restriction on date or study design and with the search limited to the English language: [alcohol] AND [indicator*] AND (([consumption] OR [drinking]) OR ([harm] OR [health] OR [death]) OR [policy). Second, a select group of international alcohol research experts in the area of alcohol indicators known to the first author (CDHP), who has 30 years' experience of working in alcohol research and has been involved in alcohol policy work with the WHO since 1996, were contacted and were given an indication of the goal of our research and then a list of key documents we had obtained on alcohol policy indicators as part of the literature searches described in the first step above. They were asked if there was any other publications/material that would be of value in preparing the alcohol policy indicators that we had overlooked. Third, the team proposed new indicators in cases where we were not able to source well-established indicators used elsewhere to address interventions listed in the AHR White Paper. This took place through different members of the team suggesting indicators and then through a consensus process involving the first and third through fifth authors who met regularly.

Phase 2 involved a further refinement of the indicators, a process involving four steps. First, parts of the draft indicator set pertinent to particular sectors (e.g. traffic police) were shared in written form via emails (by third and fifth author, n=14) and in telephonic (n=6) or individual face-to-face (n=21) meetings involving the first and third through fifth authors with mid-level/senior functionaries in different government departments in the Western Cape province, the City of Cape Town and from the national Departments of Health, Social Development and Community Safety. They were identified by the study team in collaboration with officials working in the policy section of the provincial Premier's office. The stakeholders were asked about the suitability of the indicators that were presented to them and how feasible it would be to collect the data to prepare the indicators and whether there were other indicators that should be collected in areas related to their sector. Second, there were two larger face-to-face meetings held with groups of stakeholders in the provincial government (one with the Strategic Management Information Group in July 2019 and another with a larger group of stakeholders in November 2019). We elicited feedback on the appropriateness of the indicators and specifically the feasibility of collecting the information needed to populate indicators. Third,

throughout the process the study team (authors on this paper) engaged with each other either face-to-face or by email to comment on and fine tune the indicator set as it developed. Fourth, at times we sought input from colleagues in the Office of the Premier which had contracted with the South African Medical Research Council to prepare indicators to support the implementation and monitoring and evaluation of the AHR White Paper. As part of this latter process indicators were categorised according to the four components of the logic model and sectors where indicators would most prominently align (e.g. health, law enforcement, social development, justice, premiers office, community safety and education) and a determination was made on the feasibility of collecting information needed to prepare the indicators. The internal consensus process was driven by the need to establish indicators that would cover the intervention areas identified in the Western Cape AHR White Paper and also provide indicators of consumption and harm, involved data that was already available and if not currently available was possible to be collected in the short to medium term (availability) and meet the conditions of validity and reliability. The full process of developing the final set of indicators is depicted in Fig. 2.

RESULTS

Findings of the scoping review, literature searches and selected international experts (Phase 1)

Key publications: Dozens of published articles and other documents (e.g. unpublished

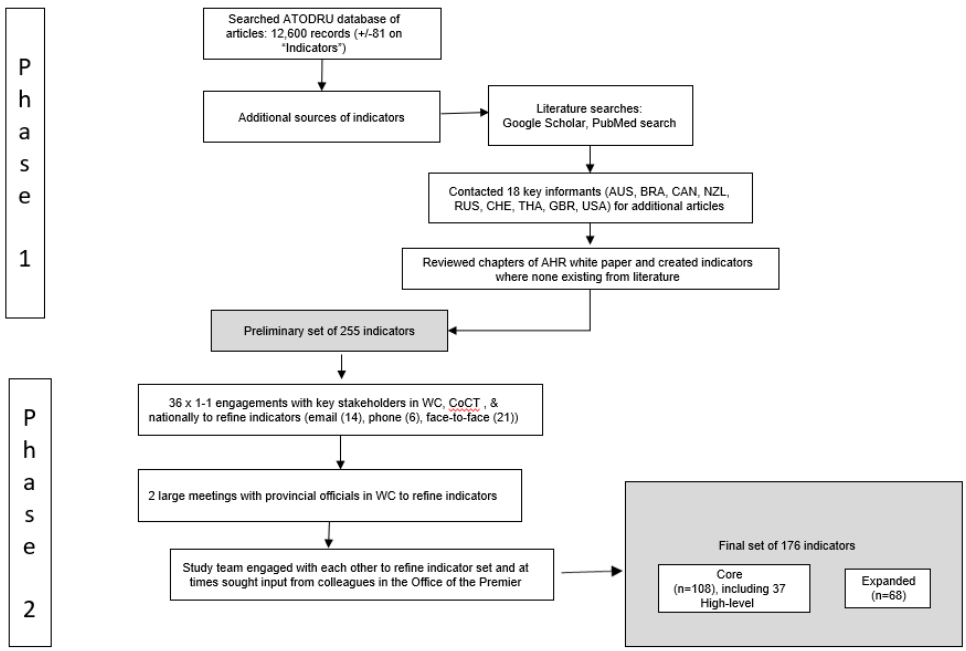


Figure 2. Process to develop and acquire indicators for the Western Cape Provincial AHR Policy Evaluation

reports) were identified as a result of the first three steps undertaken as part of Phase 1. The most relevant of these are referred to in the section below and in Table 1 (last column).

Graham (2005), for example, presented provincial- (or state-) level indicators and indicator data for Nova Scotia in Canada that focused on three domains: 1) use, 2) patterns of use, and 3) alcohol-related harms. Another article that outlined the development and early progress of establishing an alcohol monitoring system in Canada, Stockwell et al. (2009), focused on the development of alcohol and drug-related indicators for British Colombia. Their system involved collecting data from general population surveys, school students and high-risk populations, administrative datasets on serious harms, and alcohol sales. By contrast, Chikritzhs et al. (2003) in Australia used methods guided by the WHO *International Guide for Monitoring Alcohol Consumption and Related Harm* to describe trends in risky alcohol use and serious alcohol-related harms for all Australian states and territories (World Health Organization, 2000). Their main data sources were national household surveys, mortality statistics, hospitalization data, data on alcoholic beverage consumption from the Australian Bureau of Statistics and the Distilled Spirits Industry Council of Australia, and wholesale alcohol sales data from individual Liquor Licensing Departments (Chikritzhs et al., 2003).

Determinants: The publications identified by the scoping review and literature searches suggest that the most important determinant of the level of alcohol consumption is the *price of alcohol*. Countries with higher prices tend to have lower levels of alcohol consumption (Wagenaar et al., 2010). In several studies, the price elasticity of alcohol has been estimated for all alcoholic beverages combined as well as for separate beverages (Wagenaar et al., 2009). Research has also shown that reductions in consumption also lead to subsequent changes in alcohol-related harm (Andréasson et al., 2009). Lloyd (2014) suggest that it is also useful to monitor over time the price of alcohol in relation to non-alcoholic soft drink prices (or bread/milk).

Physical availability of alcohol also affects consumption (Campbell et al., 2009; Sanchez-Ramirez and Voaklander, 2018). Availability is the product of the number of outlets and the number of hours these outlets are open. In developing indicators in this area, it has been suggested that it might be necessary to develop more nuanced indicators by whether the outlet is for on- or off-consumption of alcohol and the type of outlet (e.g. tavern, bar, or hotel), because the evidence shows different types of outlets are associated with different consumption patterns and harms (Sherk et al., 2018; Livingston, 2008; Trangenstein et al., 2018). According to Andréasson et al. (2009), availability can be set in relation to population size and expressed as weekly business hours per 1000 population. Outlet density should be related to the population density in the community to provide a metric that is interpretable to stakeholders and also to land area to track changes in density over time. Area is the preferable denominator for outlet density when used over time because it is stable over time.

Apart from legal availability, in a country like South Africa estimates should also be made of smuggling and illicit production. It may be useful to also ask about

three aspects of informal and illicit alcohol: 1) the proportion of small businesses that sell alcohol, 2) the proportion of sales to taverns (licensed outlets in poor areas) that are sold on to shebeens (i.e., unlicensed alcohol outlets that sell alcohol where value added- and business taxes are not levied) and other unregulated outlets, 3) the number of applications for license extensions (to extend hours), and 4) the number of applications for a new license in a given area, particularly if outlets transition from unlicensed to licensed establishments. In addition, physical availability policies cover preventing illegal diversion to underage minors, e.g. through "social sources" (e.g., friends, family members, other adults, etc.) (Flynn and Wells, 2014). For this reason, Giesbrecht et al. (2013) emphasize assessing the proportion of online sales and also sales through home deliveries, because both of these mediums have high potential for abuse.

The articles identified through the review indicated that other possible indicators related to alcohol marketing to consider the amount of money spent on alcohol marketing, the number of violations of accepted rules of conduct (Andréasson et al., 2009), and overexposure of adolescents to alcohol marketing. A subjective indicator could ask community members whether they have noticed increased marketing activity by the liquor industry in the past year in the area they live.

The effectiveness of national alcohol control policies depends largely on the *level of enforcement*. This applies especially to drink-driving countermeasures and alcohol sales in licensed premises and grocery stores. The articles identified suggested that useful indicators to include here could be the number of breath tests in traffic that are conducted by the police, and the number of visits by enforcement authorities to licensed premises and to grocery stores (Andréasson et al., 2009). In addition, reference was made to a six-item indicator of the perceived level of enforcement which has proved useful for assessing how well measures aimed at reducing underage drinking in USA states are implemented and enforced (Paschall et al., 2012).

Public opinion is very important as a determinant of alcohol consumption *per se* as well as public efforts to reduce consumption. There appear to be many potential variables of interest in this field: *norms and attitudes* regarding total abstention from alcohol; what constitutes moderate and heavy drinking; views on drunkenness, drinking in certain situations such as before driving, at work, etc. However, knowledge on which variables could serve as indicators in this field is fragmentary (Andréasson et al., 2009). There are two kinds of possible indicators of attitudes: indicators of public acceptance of different alcohol policies (e.g. policies aimed at limiting per capita consumption of alcohol) and indicators of attitudes to drinking more broadly (e.g. to alcohol abstention during pregnancy, alcohol use at the workplace or while driving, and during youth) (Andréasson et al., 2009).

An important determinant of alcohol consumption is *risk perception*, of which two kinds were identified from the review: the perceived risk of alcohol for health or well-being and the risk of detection of certain alcohol-related crimes or misdemeanors (Andréasson et al., 2009). A large scientific literature has also identified *risk and protective factors for early initiation into drinking* as well as risky drinking during adolescence. The most

important of these determinants involve price and easy access to alcohol, biological factors, psychosocial factors in the home environment, school environment and peer relations. Risk perception and risk and protective factors can be measured using surveys.

Consumption: Research has also shown that reductions in consumption also lead to subsequent changes in alcohol-related harm (Babor et al., 2010). Alcohol consumption can be assessed through sales data and survey data, and both data sources have strengths and limitations. Strong associations have been found between *sales* and consumption of alcohol on the one hand, and between sales and alcohol-related harm on the other (Andréasson et al., 2009). Regarding sales at licensed premises, possible indicators are sales in liters 100% ethanol per capita, total, as well as broken down to beverage type and broken down to regional and municipal level. It is desirable that a special youth indicator is developed, where among other things, sales of alcopops can be monitored (Andréasson et al., 2009). Sales data is, however, not always a good indicator on the local level as many consumers buy their alcohol in municipalities other than the one in which they live. It is often difficult also to obtain.

The World Health Organization (2009) proposed 17 indicators relating to alcohol consumption. Of these, the following four indicators can generally be sourced from routinely-collected production, import, export, sales/taxation data or other sources: 1) recorded adult (15+ years) per capital consumption in liters of absolute alcohol (LAA), 2) unrecorded adult (15+ years) per capita consumption in LAA, 3) total (recorded and unrecorded combined) adult (15+ years) per capita consumption in LAA, and 4) total (recorded and unrecorded) adult (15+ years) per capita consumption per drinker in LAA. While the World Health Organization (2009) indicator set relates to national data, there is no reason why the data could not also be sourced for a province such as the WC. However, these official administrative data will not capture any unlicensed alcohol outlets ("shebeens"), which were a major focus of the AHR.

Survey data are an important complement to sales data. Survey data often provide detailed demographic information on risk and protective factors that is not collected in sales records; this can permit estimates such as the distribution of consumption according to gender and age, drinking patterns, and proportion of at-risk and dependent drinkers. The World Health Organization (2009) recommends collecting several of the survey indicators (e.g., lifetime abstention, past-year abstention, past 30-day consumption, past 30-day heavy episodic drinking, and maximum intensity) separately for adolescents and adults, because youth are more vulnerable to alcohol's effects. In addition, survey data are often the only source for consumption of alcohol obtained outside of legal channels, including the extent of non-registered alcohol consumption and adolescent consumption from social sources. According to the Commonwealth of Australia (2001), two to four yearly surveys are more likely to identify the cumulative effect of changes, but only indicators with recall periods shorter than 12 months would be useful in this type of effort.

There are three commonly-used methods to measure alcohol consumption in surveys: quantity-frequency, graduated

frequencies, and short-term ("yesterday") recall formats. The quantity-frequency method is the shortest and the most commonly used (Johnson, 2014). However, it asks participants to report one value for their "average" number of drinks, and they tend to answer with their modal consumption on drinking days, which underestimates heavier drinking occasions (Greenfield, 1986; Armor and Polich, 1982) and this ultimately biases calculated volumes downward when compared to other measures (Kühlhorn and Leifman, 1993; Midanik, 1994; Rehm et al., 1999; Bloomfield et al., 2013). The graduated frequency method aims to construct a 'universe' of participants' drinking. It first asks for their maximum number of drinks consumed and then asks for the frequency of drinking occasions for each group of graduated categories of numbers of drinks consumed on an occasion (Bloomfield et al., 2013). The graduated frequency method may overestimate consumption (Midanik, 1994) and researchers have found substantial portions of respondents who listed more than 365 drinking days (Poikolainen et al., 2002; Gmel and Rehm, 2004). Finally, in the short-term recall method, participants simply list all of the alcohol they consumed within a short timeframe (e.g., past 7 days or yesterday). The strength of this method is also its limitation: reducing the recall period limits forgetting but if researchers try to extrapolate from it to obtain drinking patterns or volume of consumption, they may misclassify irregular drinkers. Gmel and Rehm (2004) recommend a beverage-specific quantity-frequency design for efforts to link consumption to harms.

Additional survey questions are required to assess detailed drinking patterns, which can impact risk for alcohol-related harms. Examples of this type of indicator include the proportion of drinking occasions during which participants drank alcohol with meals. This has been shown to be protective against alcohol-related harms (Gentry, 2000; Ramchandani et al., 2001). These data are necessary to calculate the pattern of drinking score (Rehm et al., 2003; Gmel et al., 2007). Two survey indicators specific to youth are age of first drink and age of first intoxication, which can be markers for future problems (Prescott and Kendler, 1999; Guttmannova et al., 2011; Guttmannova et al., 2012; King and Chassin, 2007).

Surveys can also be used to triangulate data that may be underreported in administrative datasets, such as the number of persons who are dependent on alcohol. However, additional data on alcohol dependent persons may be needed to adjust results from general population surveys as the share of total alcohol consumption by persons in this group is high (Andréasson et al., 2009). At a more targeted level, another potentially useful and difficult to monitor health indicator proposed by Flewelling et al. (2009), is the percent of pregnant women reporting any use of alcohol during the last three months of pregnancy.

Alcohol-related harm: With regard to this area, some countries have high-quality health statistics that are routinely collected in national registries. For others, conditions related to acute intoxication or chronic alcohol consumption can be tracked through hospital discharge records coded with International Classification of Diseases (ICD) diagnostic codes (Canadian Substance Use Costs and Harms Scientific Working Group, 2018). Morbidity data can

be expressed not only in terms of numbers of admissions but also in bed days, which permits an estimate of the total health care costs of alcohol-related injury and illness (Commonwealth of Australia, 2001). However, when using hospital discharge records in this way, it is important to understand if they assign a "primary" ICD diagnostic code for each visit. Without a primary diagnostic code, it can be difficult to determine which ICD code to select to identify alcohol-related hospitalizations. Further, appears to be essential for hospital records to have either identifiable information or a flag to identify when a de-identified patient revisits the hospital in order to prevent double counting cases of the same disease within a given time period. Furthermore, when selecting the types of alcohol-attributable harms to include in indicators, it appears to be essential to consider the priorities of the current stakeholders, that have reliable associations with alcohol consumption, and have valid and available data. The number of deaths and patients treated for liver or pancreas disorders are often used for alcohol indicators because these digestive disorders are highly sensitive to changes in consumption at the population level due to their dose-response association with alcohol use (Rehm et al., 2010; Samokhvalov et al., 2015). Emergency department data on the non-fatal burden injuries are also of interest, because alcohol is a leading contributor to injury (Cherpitel et al., 2015). Four injury indicators of interest include poisonings, assaults, falls among young adults, and injuries caused by single vehicle traffic crashes (Andréasson et al., 2009). Alcohol-related deaths caused by traffic crashes, alcohol poisoning, liver cirrhosis, assaults, alcohol dependence, alcohol psychosis, and suicides are also leading priorities. Other potential priorities recommended by Andréasson et al. (2009) include foetal alcohol spectrum disorders and number of admissions for residential treatment programmes. However, the number of admissions for treatment can hinge on availability. For similar reasons, researchers may want to consider comparing rates or age-standardized rates over time to avoid biases that may arise from changes in population size, programme implementation, and/or demographics.

An alternative approach has been to focus on only obtaining data for those diseases and injuries wholly attributable to alcohol". This approach would minimise critiques about partial causation, but may require longer time periods for some of the chronic causes to develop in response to changes in consumption and/or policy. Chikritzhs et al. (2003) list various alcohol-related conditions according to whether the condition is acute (20 conditions) or chronic (22 conditions) by sub-category and list the ICD-10 codes. Rehm & Scafato (2011) provide a useful table for 17 major categories of disease attributable to alcohol and discuss the potential of each for being used as indicators in a monitoring system for the European Union. Among other things, they discuss the latency of effect on a population level, the strength of the relationship of each to alcohol, the reliability of the outcome and relationship of each to morbidity and mortality. In particular, they refer to the usefulness of diseases such as (alcoholic) liver cirrhosis and alcohol poisoning if valid data is available. Chikritzhs (2009) also makes a strong case for using indicators where alcohol is not specifically measured, but where cases are highly likely to be alcohol related, such as road crashes and violent

assaults at certain times of the day. She calls these "surrogate measures."

There was substantial overlap between the indicators proposed by Andréasson et al. (2009) and the (World Health Organization, 2009). WHO proposed 16 indicators (2 core, 9 expanded and 5 additional) relating to the assessment of alcohol-related harm. Of these, the indicators that were most relevant to the AHR White Paper included the age-standardized death rates per 100,000 persons of liver cirrhosis, traffic crashes, poisoning, violence, alcohol liver cirrhosis, alcohol-related traffic crashes, alcoholic poisonings and alcohol-related violence. In addition, three other chronic harms were related: the prevalence of fetal alcohol spectrum disorders and the 12-month prevalence of alcohol use disorders and alcohol dependence.

Alcohol is the drug that causes the most harms that are borne by persons other than the user (Nutt et al., 2010), such as social problems, such as family discord, assaults, vandalism and workplace problems. Unfortunately, reliable data are missing for most of these categories (Andréasson et al., 2009). Nayak et al. (2019) describe a measure of alcohol-harm to others (AHTO) containing 10 items that cover events in the last 12 months caused by "someone who had been drinking." The harms include: 1) being harassed, bothered, called names, or otherwise insulted; 2) feeling threatened or afraid; 3) having clothing or belongings ruined; 4) having house, car or other property vandalized; 5) being pushed, hit, or assaulted; 6) being physically harmed; 7) being in a traffic accident; 8) being a passenger in a vehicle with a drunk driver; 9) having family problems or marriage difficulties; and 10) having financial trouble (Nayak et al., 2019). Based on previous work (Karriker-Jaffe and Greenfield, 2014), Nayak et al. assessed the prevalence of AHTO using five indicators that collapsed sets of two items that measured similar harms as follows: harassment/threats (1-2), property ruined/vandalism (3-4), physical aggression (5-6), driving-related (7-9), and family-financial (9-10) harm caused by someone who had been drinking. These pairwise constructs have been associated with alcohol control policies (Greenfield et al., 2019), specifically availability and pricing policies (Trangenstein et al., 2020). Similarly, Lloyd (2014) proposed a number of possibly useful indicators falling in the area of community perceptions of harm, including an assessment of 1) the % of adults (15+) indicating that alcohol use is problematic in the area in which they live, 2) the level of exposure to alcohol-related violence, 3) community members' experience of drinker-related nuisance experiences, and 4) community perception of enforcement of liquor regulation.

Crime is the only category within the social field where there are reliable statistics available, although data for more serious crimes are more reliable than those for minor offenses (Gove et al., 1985). Crime categories of greatest interest for alcohol indicators are drunk driving, assaults and crimes against the alcohol act (smuggling, illegal sales and illegal production) (Andréasson et al., 2009). A meta-analysis using data from 13 countries found that approximately 48% of homicide victims tested positive for alcohol (Kuhns et al., 2011), and similar methods using data from nine countries estimated that 37% of homicide perpetrators were intoxicated at the time of the homicide (Kuhns et al., 2014). However, crime indicators are vulnerable to changing policing procedures and priorities (Pepper et al., 2010).

The effects of having limits on blood alcohol concentrations (BACs) for drivers and even reducing allowable limits are largely dependent on the level of enforcement by police and efficient sanctions. According to (Andréasson et al., 2009), a useful indicator here including a measure of enforcement is police statistics on positive breath tests and, if possible, calculation of the percent of positive tests using the total number of breath tests performed.

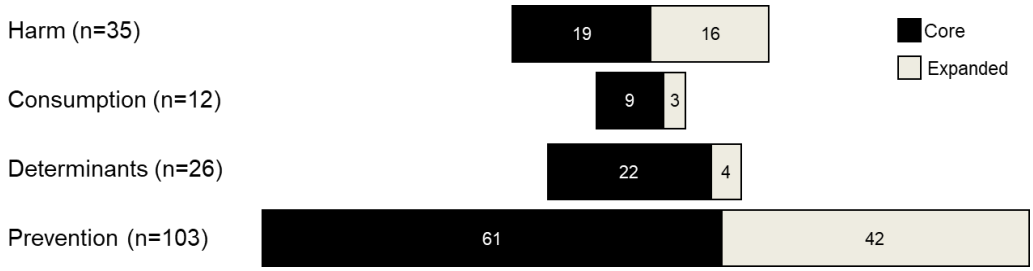
Indicators of prevention: Preventive activity within the alcohol field deals aims to modify the upstream determinants of alcohol consumption and harm (i.e., price, physical availability, marketing, enforcement, risk perception, and norms and attitudes) through programs and/or policies. Programs are often implemented at the local or community level and are short-lived, while policies are established through legislative changes. Policies may be implemented at all levels of the ecologic model: local, community, state/provincial, or national. Andréasson et al. (2009) recommend dividing policies into structural indicators and preventive activity indicators. Within this framework, structural indicators refer to things like prevention policies, budgets and staffing.

Activity indicators should reflect programs that are located within organizations/institutions where the determinants of alcohol consumption and harms can be modified. Examples include serving practices in licensed premises and age control, brief interventions in primary health care facilities, surveillance and enforcement activity within the police department, home and family programs, youth and leisure activities, and media advocacy (Andréasson et al., 2009). Alcohol treatment is a programme that draws special attention within this field, and the World Health Organization (2009) recommends seven treatment indicators relevant to the AHR White Paper: 1) availability of treatment for alcohol use disorders in primary care, 2) number of beds for alcohol use disorders per 100,000 persons, 3) outpatient treatment slots for alcohol use disorders per 100,000 persons, 4) inpatient treatment admissions due to alcohol use disorders, 5) screening and brief interventions for alcohol use disorders, 6) counselling to pregnant women with alcohol use disorders or alcohol problems, and 7) percentage of persons who have seen a treatment provider who have been asked about their alcohol problems.

Overview of final set of indicators (Phase 2)

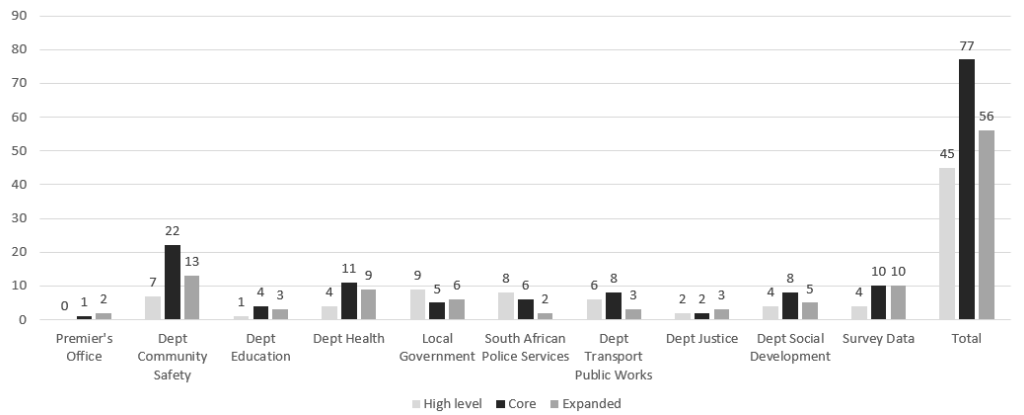
Based on the literature generated from the first three steps in Phase 1 and as part of our internal process to fill in gaps to cover areas where indicators were needed for the AHR White Paper, an initial set of 255 indicators was developed. There were 176 indicators using data in the final set arising from the four steps in Phase 2, which involved a further refinement of the initial draft indicator set. These indicators used data from eight sectors and/or departments: Health; Social Development; Community Safety, including the WC Liquor Authority; Transport and Public Works; South African Police Services (SAPS), including Metro Police data; Education; Justice; Local Government; and Survey Research. Fig. 3 provides a summary of the indicators by sector/department, with Fig 3A indicating the breakdown of core and expanded indicators drawing on the framework in Andréasson et al. (2009): prevention, determinants, consumption and harm.

A. *Number of core and expanded indicators by category of indicator (i.e. preventive, determinants, consumption, alcohol-related harms)*



Note: Each of the areas of each box is proportional to the number of indicators that fall in that category

B. *Number of high-level, core and expanded indicators by sector/department*



Note: High-level indicators are part of core indicators. The total number of indicators is 176 (but there are 2 that overlap with to sectors/departments

Figure 3. Summary of the final set of core and expanded indicators by sector/department and logic model component

The final indicators were categorized as "core", or "expanded." *Core indicators* (n=108, 61.4%) were deemed by both policy makers and researchers as essential and could be reliably measured using basic information. *Expanded indicators* (n=68, 38.6%) were identified as those which complement the core indicators by expanding and/or shifting their focus to include further indicators in given areas which would be useful to have but are of a lower priority or are likely to be less easy to obtain. The expanded indicators apply universally, but they are not the first priority in resource poor settings. We also identified a sub-set of *high-level indicators* (HLIs) among the core indicators (n=37, 33.3% of the core indicators). HLIs are the indicators that were deemed by the Deputy Director: Strategic Programmes in the Office of the Western Cape Premier and the research team as being the most important for measuring outcomes/impact, input/process variables and background factors. The determination of which indicators should be HLIs was made based on

multi-pronged criteria, including: 1) use by other jurisdictions, 2) availability and ease of collecting information, 3) self-assessed relevance to assessing factors impacting on achievement of the objectives of the AHR Strategy, and 4) assessing factors associated with how well the Strategy is being implemented and whether it is achieving its objectives.

Examples of core indicators were organized by broad areas (determinants, consumption, harm, prevention/intervention), data collection feasibility, and data source (of different) are listed in Table 1. Our assessment is that in the Western Cape it is possible to prepare about three-quarters of the core indicators as data are already being collected and can be transferred to accessible repositories. For at least a further 10% we have the necessary data available, but there is no mechanism in place to transfer it to accessible repositories. For a further 10%+ there is currently the institutional capacity to collect the data, but no current mechanism in place to do so. In addition, the supplemental appendix contains a detailed breakdown of the high-level indicators with metadata, including indicator definition (if required), type (input, process, outcome, impact),

Table 1. Example of South African Alcohol Harm Reduction (AHR) core indicators by logic model component* and topic area

Example	Data collection feasibility[a]	Source (if published)
1. *Prevention activities (inputs)*		
1a. Alcohol & the road environment		
Number of first-time impaired driving offenders referred for compulsory alcohol interventions	A	
Number of people reached for evidence-based alcohol road safety awareness	A	
1b. Community-based action		
Percent of budget allocated to foetal alcohol spectrum disorder & universal prevention	C	
Number of alcohol-related integrated community programmes coordinated by local drug action committees	A	
Number of neighbourhood watch structures that received training in monitoring & reporting on alcohol trade	A	
Number of established local drug action committees	A	
1c. Education & awareness		
Number of alcohol-related referrals from Safe Schools Call Centre	A	
Number of employee wellness alcohol-awareness & education programmes conducted in department	NA	
Number of schools/institutions of learning where screening & referral services in place	A	
Number of substance-abuse after-school education & awareness programmes	A	
1d. Health & social services		
Number of adults screened at social services for alcohol problems using AUDIT	B	
Number of antenatal services that implement screening and brief interventions for hazardous & harmful alcohol use	C	WHO Regional Office for Europe (2017)

Example	Data collection feasibility[a]	Source (if published)
Number of patients screened at primary health services for alcohol-related problems	C	
Number of specialised services for alcohol-related treatment for youth	A	
Number of trauma units/ERs that implement screening and brief interventions for hazardous and harmful alcohol use	C	
1e. Physical availability		
Number of Designated Liquor Officers reports submitted	A	
Number of municipalities who provide a budget for local drug action committee-coordinated programmes	B	
1f. Law enforcement		
Percent of licensed premises that refuse to sell to underage minors during controlled purchase operations	C	Begg et al., 2014
Perceived enforcement of underage drinking laws	NA	Paschall et al. (2012)
Total budget spent on liquor enforcement	A	
2. Determinants (process)		
2a. Law enforcement		
Number of arrests for illegal distribution of alcohol	A	Andréasson et al. (2007)
Number of arrests for illegal selling of alcohol	A	Andréasson et al. (2007)
Number of outlets prosecuted for serving underage youth & where successful conviction obtained	B	Andréasson et al. (2007)
Number of drivers screened for drunk driving in heavy motor vehicle	A	
Number of drivers screened for drunk driving in light motor vehicle	A	
Number of drivers screened for drunk driving in public transport operation vehicles	A	
Number of arrests for drunk driving	A	
Number of persons charged for drunk driving	A	
Number of arrests for being drunk or under the influence of alcohol	A	
Number of arrests for introducing, possessing or consuming liquor in bathing/ban area	A	
2b. Marketing		
Adolescent exposure to alcohol marketing	NA	Lloyd (2014)
2c. Physical availability		
Ability of adolescents (15-17 years) to purchase alcohol at licensed outlets	NA	Flynn & Wells (2013)
Number of licensed micromanufacturing liquor outlets	A	Andréasson et al. (2007)
Number of licensed off-consumption liquor outlets	A	Andréasson et al. (2007), Begg et al., 2014
Number of licensed on-consumption liquor outlets	A	Begg et al., 2014
Number of on-consumption outlets closing later than 1 am	B	Andréasson et al. (2007)

Example	Data collection feasibility[a]	Source (if published)
3. *Consumption (outputs)*		
3a. Self-reported consumption among adults		
Percent of adult drinkers engaging in heavy episodic drinking (≥60g absolute alcohol) 1+ time per week in past 12m	NA	WHO (2009), Graham (2013), Rehm & Scarafato, (2011)
Drinking frequency among adults	NA	WHO (2009)
Percent of lifetime abstainers 15+	NA	WHO (2009)
Percent of past-year abstainers	NA	WHO (2009)
3b. Self-reported consumption among youth		
Average age of first drink	NA	WHO (2009)
Proportion of adolescents (10-17 years) consuming alcohol in past 12 months	NA	WHO (2009)
Proportion of adolescents (10-17) engaging in heavy episodic drinking (≥60g absolute alcohol) 1+ time per week over past 12m	NA	WHO (2009)
Proportion of adolescents (10-19 years) consuming alcohol in past 30 days	NA	WHO (2009)
4. *Harms (outputs/outcomes)*		
4a. Community perceptions		
Proportion of adults (15+) indicating that alcohol use is problematic in the area in which they live	NA	Lloyd (2014)
4b. Crime		
Proportion of population (17+) that report driving while intoxicated	NA	
4c. Law enforcement		
Proportion of breathalyser readings above the limit (all ages)	A	
Proportion of breathalyser readings above the limit in age group 18-24	A	
4d. Morbidity		
Number of emergency department gunshot-related admissions	A	
Number of emergency department stabbings-related admissions	A	
Rate of serious night-time assaults (6pm-6am) per 100,000 persons	A	Commonwealth of Australia (2001)
4f. Mortality		
Age-standardized death rates for liver cirrhosis per 100,000 persons	A	WHO (2009), Chikritzhs (2009)
Age-standardized death rates for traffic crashes per 100,000 persons	B	WHO (2009), Chikritzhs (2009)
Age standardized death rates for violence per 100,000 persons	B	WHO (2009), Chikritzhs (2009)
Rate of assaults per 10,000 persons	A	WHO (2009), Andréasson et al. (2007)

*see top level headings in italics

Abbreviations: NA Not applicable; AUDIT Alcohol Use Disorders Identification Test;

[a]A = Data are already being collected and transferred to accessible repositories; B = data are being collected, but there is no mechanism in place to transfer it to accessible repositories; C = the Western Cape as the institutional potential or access to collect the data, but they are not currently being collected.

responsible department(s), periodicity (frequency), province (or sub-area), field testing required, and core or expanded. The supplemental appendix also provides metadata for five AHR indicators. Confidence intervals for some of the alcohol harms indicators can be calculated using these metadata and a Byars' approximation or the Wilson score method, following methods outlined in Begg et al. (2014).

DISCUSSION

This manuscript described the process for creating a set of comprehensive indicators to monitor the implementation of alcohol policy changes in the WC Province of South Africa, where alcohol consumption and harms have been persistently high. To date, most of the alcohol-related indicator data come from high-income countries, including Australia (Chikritzhs et al., 2003; Commonwealth of Australia, 2001), Sweden (Andréasson et al., 2009), Canada (Stockwell et al., 2009), and the United States ((Flynn and Wells, 2014; Flewelling et al., 2009). Thus, this manuscript presents one of the first efforts to describe a process to create sub-national alcohol-related indicators in a middle-income country. Our process was guided by a logic model coming from Andréasson et al. (2009), a comprehensive literature review of the literature, and ongoing communications with diverse local and international stakeholders to ensure that they were comprehensive and adhered to the basic requirements of good alcohol indicators. Given the broad focus of the WC AHR Strategy and the way in which it drew on indicators used in the countries above and WHO indicators (World Health Organization, 2009), the resulting indicator set is without a doubt larger than any one of the indicators sets upon which it drew.

This process revealed several opportunities that could result from inter-departmental collaboration implementation of the WC AHR. Many stakeholders expressed an interest in ongoing collaborations with ATODRU and among each other. For example, there are plans in place to develop more integrated data systems across departments in some areas (e.g., Transport, SAPS, and Health). These changes may present a window to add data standards related to alcohol and/or review the level of precision of collected data. In addition, other departments were willing to cooperate on an ongoing basis to the process of developing the alcohol indicators. This type of multisector collaboration can prevent feasibility issues and increase buy-in to the final set of indicators. Finally, the Department of Social Development has the technical expertise and technological resources to calculate and map hotspots using the SAPS and Department of Social Development data. By showing geographic patterns, this type of map can help "tell the story" of the burden of alcohol's harms in WC in ways that traditional statistics cannot. The coronavirus pandemic in South Africa has also brought into focus the high level of harm from alcohol-related trauma and the burden this poses on hospital resources, and it should be noted that the Health Ministerial Advisory Council has supported the notion of making alcohol-related trauma presentations a notifiable condition (Savides, 2020). This could be done either by clinical assessment or using some form of biomarker, e.g. finger prick testing, breath alcohol testing, sweat or some novel method of transdermal assessment.

Despite these positive developments, other collaborations proved more challenging. Some departments were not willing to cooperate, and others provided contradictory responses about what data were collected and maintained within the department. Furthermore, some departments do not share data, and there were possibilities for overlap of data for indicators from different sources, for example, Justice and SAPS. While this could introduce confusion, it may also present opportunities to triangulate or validate data estimates. Finally, some sectors (e.g., Department of Justice National Prosecuting Authority and SAPS Forensics) were approached about data availability, but national permission is required for their office to release data. It is also worth noting that good denominator data (e.g., population or land area for each province) is necessary for some indicators. These administrative data will need to come from provincial and/or national census data (e.g., Statistics South Africa) or other sources. Consequently, the Provincial Government Western Cape and the Premier's Management Committee should champion an opportunity for the alcohol indicators to go on the national agenda. Attention from the national government may help facilitate data acquisition, inter-departmental collaboration, and possibly also instituting mechanisms for collecting additional data. In particular, developing and implementing the new survey measures would require substantial resources, especially if they follow the recommendation to administer them every year (Commonwealth of Australia, 2001). As the provincial and national government consider additional data collections, the high-level indicators should be prioritized, especially those that measure health and other outcomes.

We also encountered several common data collection challenges. For example, some departments (e.g. SAPS, Department of Social Development) collected data on alcohol and drugs together as part of a single indicator (e.g. alcohol and drug impaired driving), and these new indicators required information about alcohol alone (Darke et al., 2009; Duke et al., 2018). In addition, the WC Liquor Licensing Authority does not collect data by license type (e.g., bar, hotel, and online), even though some types of outlets are associated with greater levels of harms, and the types of harms depend on the type of outlet. It is common for jurisdictions to not disaggregate more finely than on-trade vs. off-trade licenses. In California, after separating bars/pubs from restaurants, Gruenewald et al. (2006) estimated that every six bars explained one assault at the ZIP code level from 1996-2002. Livingston (2008) analyzed data from 186 postcodes in Melbourne and found that hotels, nightclubs, restaurants, and bars were associated with harms in inner-city and inner-suburban areas and off-trade outlets played a larger role in suburban areas. Regarding types of harms Livingston theorized that bars influence the level of acute, intoxication-related harms while off-trade outlets contribute to chronic harms (Livingston, 2011).

Once the indicators are computed, a next step could be to calculate a composite indicator that combines several data points, weighting them according to the scientific evidence (Brand et al., 2007; WHO European Office for the Prevention and Control of Noncommunicable Diseases, 2017; Carragher et al., 2014). Most composite indicators focus on national policies, but it is possible to create them at the state- or provincial-level (e.g. Naimi et al. (2014))

and/or focus on the extent to which policies are implemented (Parry et al. (2013)). These composite indicators would allow the WC to routinely assess associations the comprehensive preventive environment and short- and long-term outcomes. Any detected associations between the policy environment and outcomes that are important to stakeholders could facilitate further buy-in to the indicator- and/or policy development processes.

There are several limitations to the approach used to develop these indicators that should be considered. For a start the full list of 176 indicators proposed, core plus expanded, would be beyond the capability of most countries and regions within countries to collect and there would likely be many gaps in any resulting indicator set. This list, however, should be seen as a starting point for discussions on what is feasible, and in the short term it is likely that the Western Cape government will only be able to complete indicators for a subset of them, but in the medium to longer term could work on adding others and also decide on which they will not bother to work on. The 176 indicators meet three of the five standards as set out by UNAIDS (UNAIDS, 2015) in that they are needed and useful (Standard 1), have technical merit (Standard 2), and are fully-defined (Standard 3). The validity of most of the indicators is likely not to be contested as many have been discussed over many years and in some instances practically applied. The reliability of these indicators is less clear and is a topic for further research. Many of the indicators were based on the peer-reviewed literature; however, for some, especially those in the expanded list, it is not yet clear that it is feasible to collect and analyse the data (Standard 4). Nevertheless, our own consideration is that the feasibility of preparing the core indicators is possible in roughly three-quarters of cases (column 2 Table 1). Similarly, while some indicators have been field-tested and used in practice (Standard 5), field testing is still required for others and this is indicated on the excel spreadsheet (Supplemental Appendix). Further, much of the field testing and other research has been confined to high-income or high-resourced countries, so it is unclear the extent to which those findings generalize to South Africa.

CONCLUSION

These indicators were selected based on their potential to inform policy decision making within South Africa. Once they exist, outcomes of the evaluation and monitoring systems should be made widely available to policy makers, health specialists, law enforcement officials and others concerned with alcohol issues in a timely and transparent fashion, noting both the strengths and limitations of the design. The indicators should be used to develop, update or restructure policies by identifying gaps in policy protections, distributions of consumption and related harms, and linking consumption and harms to policies. Ideally, key data various indicators should also be presented in relevant departmental budget speeches on an annual basis and by the Premier and other Members of Executive Council so fiscal decisions can consider the full picture of alcohol's economic role including its direct sales receipts and its negative externalities on society. Given the recent surge in interest in alcohol indicators, our process of developing indicators and the resulting draft et of locally-specific, evidence-based

indicators may be of interest to other jurisdictions that are working to create their own indicators to suite local needs.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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