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REVIEW

Screening for use of alcohol, tobacco and cannabis in pregnancy using self-report tools

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The World Health Organization has identified substance use in the top 20 risk factors for ill health. Risks in pregnancy are compounded, with risk to the woman's health, to pregnancy progression and on both the foetus and the newborn. Intrauterine exposure can result in negative influences on offspring development, sometimes into adulthood. With effectively two patients, there is a clear need for antenatal screening. Biomarker reliability is limited and research efforts have been directed to self-report tools, often attempting to address potential lack of veracity if women feel guilty about substance use and worried about possible stigmatization. Tools, which assume the behaviour, are likely to elicit more honest responses; querying pre-pregnancy use would likely have the same effect. Although veracity is heightened if substance use questions are embedded within health and social functioning questionnaires, such tools may be too lengthy clinically. It has been proposed that screening only for alcohol and tobacco, with focus on the month pre-pregnancy, could enable identification of all other substances. Alternatively, the *Revised Fagerstrom Questionnaire* could be used initially, tobacco being highly indicative of substance use generally. The *ASSIST V.3.0* is readily administered and covers all substances, although the pregnancy 'risk level' cut-off for tobacco is not established. Alcohol tools – the *4Ps*, *TLFB* and 'drug' *CAGE* (*with E: query of use to avoid withdrawal*) – have been studied with other substances and could be used. General psychosocial distress and mental ill-health often co-exist with substance use and identification of substance use needs to become legitimate practice for obstetric clinicians.

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Introduction

The World Health Organization (WHO) has identified the use of alcohol and other drugs (AOD use) in the top 20 risk factors for ill health in the global population.[1] Alcohol use disorders are implicated as highly significant contributors to years lost to disability and total tobacco-attributable deaths are rising, projected to represent almost 10% of all deaths by 2030.[1] Data for Australia indicate that tobacco is responsible for 7.8% of the total disease burden, alcohol 2.3% and illicit drugs 2%.[2] The burden of disease attributable to substance use in pregnancy women is less well documented, although a 1995 estimate indicated that between 12 and 14 million women world-wide smoked in pregnancy,[3] with an increasing acceptance of tobacco use by women.[4] Patterns of consumption of alcohol and illicit substances are also shifting, with increased use reported.[4]

With pregnancy rates typically higher in developing countries, substance use in pregnancy is poised to become a significant public health issue globally. The risks of substance use are compounded, with not only the woman's own health at risk but also the risk of deleterious effects on pregnancy progression, on the developing foetus and on the infant.[5–7] The heightened risk of placental abruption threatens the viability of the foetus and sometimes the life of the woman herself;[5] the infant is often of low birth weight and more likely pre-term;[5,7] and the risks of ectopic pregnancy and miscarriage are higher for the substance-using woman.[5,6] Increasingly, the overall impact of substance use by either partner on family functioning, and particularly on children, is being recognized.[4,8] Further, it is now known that antenatal substance use can result in continuing negative influences on development of the offspring, sometimes continuing into adulthood[9] with the now accepted link between low birth weight and the risk of diseases of adulthood, such as cardiovascular disease, diabetes and the metabolic syndrome. The risk of alcohol use has attracted particular attention, with increasing focus on the dose–response relationship and the sequelae of use, leading to attempts at classification of disorders of the newborn across the foetal alcohol spectrum, disorders likely to result in life-long disability.[10]

Screening for substance use in pregnancy

Screening is understood as a preliminary procedure used to gather information about the likelihood that an individual has a particular disease or condition, or is 'at risk' of that

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condition, and sits within a public health approach of early intervention.[11] During pregnancy, two patients (the woman and the foetus) are effectively being cared for, and there are heightened levels of risk both to the foetus and to the woman herself. Given these high levels of risk, there is a clear need for effective screening by obstetric care providers – medical practitioners and midwives. Identification of use has the clear potential for the reduction of risk, once appropriate interventions have been implemented.

Method

Journals incorporated into this review were restricted to those published in the English language. The databases: *Academic Search Premier*, *BioMed Central*, *CINAHL*, *PsychInfo*, *PubMed and Science Direct*, as well as the *Cochrane Library* were searched, where available, from 1966 to December 2008, via a series of search strategies: ''pregnan*'' AND ''screen''; ''pregnan*'' AND ''substance'' AND ''screen''; ''pregnan*'' AND ''alcohol'' AND ''screen''; ''pregnan*'' AND ''tobacco'' AND ''screen''; ''pregnan*'' AND ''cannabis'' AND ''screen''. A supplementary search was conducted in late 2011 for the years 2008–2011 in PubMed only using the same search terms. Governmental reports (such as those of the Australian Institute of Health and Welfare) and publications by government and non-government agencies focussed on women's health were also sourced from Australia, North America (including Canada) and the United Kingdom.

Results

For substance use, self-report and biological markers are the traditional tools used. These results primarily focus on tobacco, alcohol and cannabis, the substances of highest prevalence in Australian pregnant populations[12,13] and likely in the developed world generally.

Self-report tools

The investigation of the development of self-report tools for pregnant women revealed that many have not undergone any validation or statistical exploration and that use has been implemented on a somewhat *ad hoc* basis, with subsequent use leading to acceptance and further use. The more entrenched has become the use of a tool, the more the use has been legitimized. Published research on the development and trialling of self-report tools with pregnant women is heavily weighted to the United States.

Interest in development of pregnancy-specific self-report tools has been triggered by clinician concerns with the lack of veracity of self-report by antenatal patients who may feel guilty about their substance use and worried about possible stigmatization.[14,15] A study by Jacobson *et al.*[14] determined that recall of pregnancy-related substance use by women interviewed post-pregnancy was higher than that reported while they were pregnant, particularly if a woman had delivered an apparently healthy infant.

Published reviews of self-report tools in pregnancy have largely concentrated on alcohol,[16,17] although tools developed to detect a broader range of drugs have also been reviewed.[18,19] In addition, 'alcohol use' or 'substance use' questions have been embedded in questionnaires on general health,[20] broader well-being[21] and when examining the likelihood of engagement with antenatal services.[22]

Alcohol

As historically, the emphasis on pregnant women's substance use has been on alcohol, a number of tools have been developed, including the *T-ACE*,[23,24] the *TWEAK*[25] and the *4Ps*.[26] A brief questionnaire – the *T-ACE* – was developed almost 20 years ago as the first pregnancy-specific tool to enable care providers to detect risky drinking[23] although standard quantity-frequency questionnaires have also been used for both pre-pregnancy[27] and during pregnancy.[28]

In the development of *T-ACE*, Sokol *et al.*[23] added to the well-established *CAGE* a 'tolerance' to alcohol question: '*how many drinks does it take to make you feel high*?', perceiving that women may answer this honestly as it did not directly question their alcohol consumption. The 'at risk' level of drinking while pregnant was set at ⩾1 ounce (28 g) of pure alcohol daily (two standard drinks in the United States), with consumption at that level 4–5 days per week. Drinking history was elicited by querying a 1-week recall around the time of conception and a recent 2-week drinking history.[23] Discriminant analysis revealed that the items *C*, *A* and *E* were significantly related to whether or not alcohol intake was risky, with no added prediction from the '***G**uilt*' question (***G***). Responses to the '***T**olerance*' question were found to be heavily predictive of risky drinking, having more weight than any of *C*, *A* or *E*.[23] The researchers proposed a new pregnancy-specific tool – the *T-ACE* – with the '***T**olerance*' question replacing the '***G**uilt*' question of *CAGE*, and having an assigned score of 2 if it took more than two drinks to '*make* [the woman] *feel high*'; otherwise this question scored zero. The other three items had scores of 1 or zero. An overall score >2 was determined as indicative of problematic drinking that demanded care provider intervention. Even at development, the researchers acknowledged that the level for risky drinking at ⩾1 ounce (28 g) could be inappropriately high.[23] Later studies have investigated modifying the ***T***olerance scoring (of 2) to reflect two drinks, and not more than two drinks (the original scoring);[23] hence, an overall score of ⩾2 became indicative of 'at risk' drinking.[16] More recently, US researchers examining outcomes in offspring of alcohol-exposed mothers concluded that raising the *T-ACE* cut-off score to 3 still maintained high sensitivity while almost doubling the specificity.[29]

Chang[24] examined the use of both the *T-ACE* and another alcohol screening tool, the *TWEAK*. This tool, based on earlier tools, queries: ***T***olerance; whether close friends or

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relatives ***W***orried or complained about your drinking; an ***E***ye opener question; an ***A***mnesia question (*has a friend or family member ever told you about things you said or did while you were drinking that you could not remember?*); and the cut-down question ('cut' spelt with a ***K***). Chang's research confirmed earlier work[25] that *TWEAK* did not offer any advantages over the *T-ACE* in identifying risky alcohol use by pregnant women.[24]

Other researchers have developed tools for specific ethnic populations, for example, Bad Heart Bull *et al.*'s[30] *SAQ* (self-administered questionnaire) that added further questions to the *T-ACE* to interrogate bingeing and use of other substances including tobacco.

The *4Ps* is a four question tool specifically designed for pregnant women, with a positive answer to any one of the questions considered indicative of risky drinking.[26] The yes/no questions query alcohol problems for ***P***arents, for ***P***artner, use of alcohol in the ***P***ast and in this ***P***regnancy (in the month before pregnancy was confirmed). Although focussed on alcohol, this tool has potential for investigating other drugs including tobacco. Its value and its ease of incorporation into standard antenatal care were confirmed in a 2005 multi-centre, multi-ethnic study that screened for both alcohol and tobacco.[26] Earlier work by Chasnoff *et al.*[31] had concluded that screening only for alcohol and tobacco use – *Have you ever drunk alcohol? How much alcohol did you drink in the month before pregnancy?* and *How many cigarettes did you smoke in the month before pregnancy?* – could enable identification of risky substance use generally.

Another team of US-based researchers[32] adapted the *4Ps* to capture specific issues for pregnant adolescents. A fifth *P* was added – ***P***eers, recognizing the significant influence peer use can exert in this population group.

Tobacco

Tobacco screening has not attracted as much attention, despite the continuing use of tobacco in pregnancy and its recognized negative impacts. However, the tool *Four Maternal Smoking Questions*[33] has been used, as has the *Fagerstrom Tolerance Questionnaire* (*FTQ*) and its revisions.[34–36]

A variation on the quantity-frequency method of questioning has been used specifically to assess tobacco use by pregnant women.[33] Four 'maternal smoking questions' were evaluated in Californian studies within a broadly based socio-demographic questionnaire: women were eligible to participate by self-completion of either Question 1 or Question 2: *Question 1 – Tobacco use in pregnancy, yes/no, average number of cigarettes per day* – part of the *Standard Certificate of Live Birth* used widely in the United States, while *Question 2* (a question assuming that the respondent did smoke) enquired on: *average number of cigarettes per day in each trimester of pregnancy.* Women were followed-up and asked to self-complete *Questions 3* and *4*, questions that again assumed the behaviour. *Question 3* asked which '*best describes your smoking*', with five options including: '*I quit smoking since finding out I was pregnant*' and '*I wasn't smoking around the time of conception and I don't smoke now*'. *Question 4* ('*How many cigarettes did you smoke each day during the…*') was directed to smoking before pregnancy and at monthly intervals during.[32] Analysis was complicated by poor documentation of initial response rates. However, the researchers concluded that, in the *Standard Certificate of Live Birth, Question 1* should be replaced by a question that assumes the behaviour and confirms smoking behaviour both before and during pregnancy, a concept first espoused by Dolan-Mullen.[37] A Melbourne-based project team also developed guidelines for promoting smoking cessation that assumed the behaviour,[38] and it was nominated 'good practice' to ask pregnant women the following question: '*Which of the following best describes your cigarette smoking?*', with a choice of responses: *I smoke daily now, about the same as before finding out I was pregnant*/*I smoke daily now, but I've cut down since I found out I was pregnant*/*I smoke every once in a while*/*I quit smoking since finding out I was pregnant*/*I wasn't smoking around the time I found out I was pregnant and I don't currently smoke*.

Arguably, the gold standard self-report questionnaire for tobacco use is the *FTQ*,[34] which has undergone extensive validation studies, leading to the emergence of revised versions such as the *Fagerstrom Test for Nicotine Dependence* (*FTND*)[35] and the *Revised Fagerstrom Tolerance Questionnaire* (*RTQ*).[36] The original *FTQ* and subsequent versions investigate not only the amount of tobacco use ('*How many cigarettes a day do you smoke?*') but also domains highly indicative of dependence such as '*How often do you smoke your first cigarette of the day within 30 minutes of waking?*' and '*How often do you smoke when you are sick with a cold, the flu, or are so ill that you are in bed most of the day?*' Further situational challenges are questioned as in '*How difficult do you find it to refrain from smoking in places where it is prohibited, for example in church, at the library, cinema etc?*'.

Although not validated for use in pregnancy, versions of the *FTQ* have been used in several studies with pregnant women.[39,40] Research by Tate *et al.*[36] led to the revision of the original eight-item *FTQ*, which included some dichotomous and trichotomous variables, to 10 items, all of which allowed five responses on a visual analogue scale – a common psychometric technique. Their revised version (the *RTQ*) was able to measure a uni-dimensional construct, namely nicotine dependence, with estimation of severity of dependence based on the overall score.[36]

Other substances including cannabis

Cannabis and other illicit substances have more recently received greater emphasis. Modification of the *CAGE* [***C*** = ever felt you needed to *cut* down on your drinking, ***A*** = have people *annoyed* you by criticizing your drinking, ***G*** = have you ever felt *guilty* about your drinking and ***E*** = have you ever felt you needed a drink first thing in the morning (*eye-opener*) to steady your nerves or to get rid of a hangover] has been employed for detection of illicit substance use by pregnant women.[41] For the *Timeline FollowBack* (*TLFB*), a tool developed for detection of problem alcohol

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use,[42] has been used to detect cannabis use in the general population and for adolescents;[43] however, it has only been used in pregnancy for detection of alcohol use.[23]

A screening tool that has been used in a number of clinical trial situations in Ohio with the pregnant population is the *Substance Abuse Subtle Screening Inventory* (*SASSI*), which incorporates substance use related questions into a broad social functioning questionnaire. Early work focused on comparing *SASSI* results – a 78-item 'psychologic questionnaire' – with results from urine toxicology.[44] The best results were obtained when *SASSI* was used in combination with standard self-report, with limited numbers of extra women being identified by toxicological testing.[44] The researchers determined that expensive toxicological screening should be reserved for women who refused to complete the *SASSI* or if past history or general health were suggestive of substance use. More recently, the *SASSI*'s value for detecting substance use by using both direct and indirect ('subtle') items has been questioned.[45,46]

The American Psychiatric Association's *Structured Clinical Interview for DSM-III-R*[47] (and latter revisions) retains its position as a gold standard for detection of substance use. However, its length and level of complexity, although suited for specialist intervention, make it inappropriate for antenatal services.

Efforts have been directed in the AOD field to the development of a cannabis-specific screening tool[48] although, as yet, no tool has emerged for pregnant women. Frequently, cannabis screening has been within an 'other drugs' framework. In one US study, pregnant women attending a university-based antenatal clinic were administered the *Primary Care Evaluation of Mental Disorders Patient Health Questionnaire* and *CAGE* questionnaires for both alcohol and for 'drugs' (including cannabis),[49] the latter modified so that the questioning time frame was the '*12 months before you found out you were pregnant*', recognizing the salience of peri-conceptional substance use as an indicator of antenatal use. Results were analysed in relation to clinical records and enhanced disclosure of use was identified,[49] with only half of the women identified as substance users (one in five) having been recorded on medical charts. Similar discrepancies were noted for women identified with psychiatric disorders.

Further work on the '*drug CAGE*' was conducted within the *California Perinatal Needs Assessment* (*PNA*) study.[50] Again, the year before pregnancy was the enquiry period. The *alcohol CAGE* '***E***ye-opener' question ('*…did you drink first thing in the morning?*') was replaced by: '*Sometimes people feel bad when a drug wears off. Did that ever happen to you in the past year?*' and '*Did you ever take another drug when that happened?*' Positive answers to both these questions were needed to register a 'yes' response to the '***E***ye-opener' question.

Measures of 'high risk' drug use in the 12 months before pregnancy were based on fulfilment of one of three criteria, with cannabis allocated a stand-alone category: (1) five or more times using 'lighter drugs' (such as prescription drugs used non-medically or hallucinogens); (2) one or more times using 'heavier drugs' (such as cocaine, methamphetamine or heroin); or (3) five or more episodes of cannabis use to get 'high' and with use of at least 3 days per week.[50] The researchers concluded that, in this group of pregnant women – low income and accessing publicly funded health services – the value of this modified drug *CAGE* lay with identification of use of 'heavier drugs' rather than of cannabis.[41]

The *TLFB* was initially developed to measure alcohol use;[42] this was followed by research into telephone and computer-based administration.[50] *TLFB* is a retrospective calendar-based screening tool that uses techniques to enable quantification of substance use and detection of both atypical, non-patterned use and regular, more predictable use patterns.[42] 'Key dates', 'discrete events', 'black and white days' and other phenomena such as 'drinking boundaries' can all be queried. Despite extensive research and clinical applications with users of other drugs and with other behaviours,[51] its use with pregnant women[42] and with those of childbearing age generally[52] has been focussed on alcohol consumption.

A more recently developed WHO tool – the *Alcohol, Smoking and Substance Involvement Screening Test* (*ASSIST*) – is showing promise as a screening instrument for primary health care[53] and with some special populations.[54] The 8-item-paper-based questionnaire has been tested in pregnancy[55] and 'risk level' cut-offs established for alcohol and cannabis, although not for tobacco.

The *ASSIST Version 3.0*[56] covers all substance classes. *Question 1* queries lifetime use of any substance. The tool then moves to focus on current use (*in the past 3 months*) of substances nominated through affirmative responses. Questions 2–5 all have five possible responses on a Likert scale ranging from 'never' to 'daily', the responses serving a number of purposes in the assessment of substance use, including basic use patterns, measure of harmful or dependent use and the capacity or otherwise to fulfil role obligations. Question 6 gives an assessment of the reactions of others to the individual's substance use, while Question 7 gauges the individual's ability to control use. The final question (Question 8) queries non-medical use of a drug by injection, although the response does not contribute to the *ASSIST* score of primary clinical interest. Online adaptations for clinical practice are available in the United States[57] and have recently been developed in Australia.[58]

Biological markers

The testing for the presence of a drug (or a metabolite of the drug) in biological samples such as blood, urine or hair, or, for pregnant women, meconium (after birth), allows an objective assessment of substance use to be made. However, biological markers do have some limitations in pregnancy. In the context of antenatal care, it has been argued that, to prevent foetal harm from the range of possible substances that a pregnant women could use, there would need to be both regular, systematic testing of urine and/or saliva throughout pregnancy and hair sampling every few months.[59] In general, the testing of meconium post-delivery has come to be

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regarded as the best indicator of intrauterine exposure.[59] Such confirmation of maternal substance use would heighten the chance of identifying infants at risk of developmental delay and other physical and cognitive deficits in the infant, but does not alter the pregnancy impacts *per se*.

Tobacco

Of the three focus substances, tobacco use can be more effectively assessed biochemically in clinical settings than either of the other two substances.[60] Carbon monoxide measurement in exhaled breath readily confirms recent tobacco smoking,[60] although this is likely easily confirmed without testing. Cotinine, a long-acting nicotine metabolite can be measured in saliva, urine or blood to indicate longer-term smoking behaviour.[60] However, cotinine may fluctuate during pregnancy[61] and measurements are highly influenced by the increased metabolism of both nicotine and cotinine itself.[62]

Alcohol

Using biomarkers to detect alcohol use by pregnant women is compromised in that biomarkers are usually designed to measure only 'excessive' or 'heavy' alcohol consumption.[63] Further, one common marker – serum carbohydrate-deficient transferrin – may increase in pregnancy, unrelated to maternal alcohol consumption, as a consequence of an increase in total transferrin associated with gestation and the hormones of pregnancy,[64] and has, in general, lower sensitivity and specificity for women than for men, making its use for pregnant women even less convincing. Liver enzymes can be used to detect heavy alcohol use although these are less likely to be elevated in users under 30 years old.[65] Mean corpuscular volume has also been used as a biomarker for heavy drinking, with women likely to show greater elevation than men.[65] However, no single one of these tests is regarded as reliable enough to give a definitive diagnosis of alcohol dependence or abuse[66] and many primary health care providers have little training in using biomarker measurements.

Cannabis

Limited studies with pregnant women have examined biomarkers for cannabis. In a US study in Detroit, biomarker testing for cocaine, opioids and cannabis was performed on hair samples and, later, post-birth, on meconium.[59] The results for detection of a major metabolite of Δ^9-tetrahydrocannabinol (the main psychoactive chemical in cannabis) in both hair and meconium did not correlate well with maternal interview. Hair and meconium analysis had low sensitivity (21%, 22.7%) compared with maternal interview (58%), although higher specificity (90%, 97.3%) compared with specificity of 76.5% for maternal interview. The researchers concluded that the cost of hair analysis, when coupled with the unreliable results for cannabis, limits its utility for both clinicians and in research settings.[59]

The sensitivity of urine testing for cannabis is limited by the persistence of metabolites in the body, which are excreted in urine over several weeks; even in blood, heavy users would be expected to have a background level of 1–2 ng/ml, which distorts the ability to confirm recent use. Hence, it follows that the most economical biological test for cannabis, a *positive/negative* test, will certainly advise of cannabis use, but has low utility if a user's quantity and/or frequency of use is the desired outcome for the clinician.

Discussion

The use of self-report tools to screen for alcohol, tobacco and cannabis in pregnancy is the most favourable option, being convenient for the clinician and requiring no additional interpretation. Biological markers have some limitations in this population. However, their use for selected substances such as tobacco to monitor any changes in use can inform the clinician while encouraging the woman herself if she is trying to curtail substance use. Self-report tools have the added advantage of affording the clinician an immediate opportunity for intervention should the woman report substance use during pregnancy, while laboratory results are often delayed.

Those tools that assume the behaviour are likely to elicit a more honest response[37] as would questioning on pre-pregnancy use,[14] generally a less emotive topic. Although veracity is heightened in tools in which substance use questions are embedded within general health and social functioning questionnaires,[20,21] such questionnaires are likely to be too lengthy for routine clinical use.

The adoption of the recommendation by Chasnoff *et al.*[31] (that screening be only for alcohol and tobacco use and with a focus on use the month before pregnancy) would be highly likely to enable accurate identification of all risky substance use. As it is well documented that tobacco use is a good indicator of use of other substances,[67] the *RTQ* – a well-established tool for tobacco identification – could be the initial screening tool with subsequent screening for other substances if tobacco use is disclosed. Screening using the gold standard for alcohol, the *T-ACE*, could then be undertaken. Positive identification of either or both of these substances could lead into a dialogue on substance use generally. Although this screening technique would miss women using neither tobacco nor alcohol, this is unlikely to be a significant concern, given the higher prevalence of these substances relative to other substances used, including cannabis.

The subsequent screening for other substances could be accomplished clinically with use of either of the *4Ps*, the *TLFB* or the drug *CAGE* – tools all originally developed for alcohol, although having a history of use in research studies with other substances. Tools such as the *SASSI* and the Structured Clinical Interview *for DSM-III-R* are too lengthy or too complex for primary clinical practice. The *ASSIST Version 3.0* is currently the only tool that covers all substances and has been investigated in pregnancy; however, the pregnancy 'risk level' cut-off has not been established for tobacco. Its use with pregnant women would, however, enable the

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identification in a time-effective manner of most substances likely to be used in pregnancy.

Substance use is often a marker for environmental stressors such as poverty, domestic violence and ethnic discrimination, and may be linked with mental ill-health and other disorders in both the pregnant woman and other members of her family.[22,68] The identification of substance use may lead to identifying the need for intervention across a number of these significant domains, highlighting the desirability of substance use screening. It is possible that care providers perceive substance use as a 'choice' by a pregnant woman and not as deserving of care provider attention, while other health issues of concern such as elevated blood glucose, although likely to be influenced by dietary 'choice', are regarded as appropriate grounds for intervention.[68] Engagement of obstetric care providers in substance use screening needs to become just as legitimate.

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