Progress of the validation of analytical chemical methods for testing and measuring cigarette contents and emissions

Report by WHO

INTRODUCTION

1. At its third session (Durban, South Africa, 17–22 November 2008), the Conference of the Parties (COP) noted the information contained in the progress report\(^1\) of the Working Group on Articles 9 and 10 of the WHO Framework Convention on Tobacco Control (WHO FCTC), and decided\(^2\) to request the Convention Secretariat to invite WHO to validate, within five years, the analytical chemical methods for testing and measuring the cigarette contents and emissions identified as priorities in the progress report of the working group, using the two smoking regimens set out in paragraph 18 of that report, and inform the COP through the Convention Secretariat of the progress made on a regular basis.

2. WHO, in consultation with the WHO Study Group on Tobacco Product Regulation (TobReg), the WHO Tobacco Laboratory Network (TobLabNet), the WHO FCTC Working Group on Articles 9 and 10 and the Convention Secretariat, identified three priorities with regard to cigarette contents (nicotine, ammonia and humectants), and five with regard to emissions in mainstream cigarette smoke (tobacco-specific nitrosamines (TSNAs), benz[a]pyrene (B[a]P), aldehydes, volatile organic compounds (VOCs) and carbon monoxide). Of the eight methods identified, TobLabNet validated the methods for carbon monoxide in 2007; TSNAs and nicotine in 2010; B[a]P and humectants in 2012; ammonia in 2015; and VOCs and aldehydes in 2016. The standard operating procedures (SOPs) for TSNAs and nicotine were completed in 2014 and for B[a]P in 2015. The SOPs for humectants, ammonia, VOCs and aldehydes are also in advanced stages and will be published before the end of 2016.

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\(^1\) Document FCTC/COP/3/6.

\(^2\) See decision FCTC/COP3(9).
3. This report follows from the previous WHO reports to COP on progress towards validation of analytical chemical methods for testing and measuring cigarette contents and emissions. Since 2014, progress includes finalization of the SOP for B[a]P. WHO has continued to work with TobReg and TobLabNet, in consultation with the WHO FCTC Working Group on Articles 9 and 10 and the Convention Secretariat, on finalizing the SOPs for ammonia and humectants, as well as the validation of VOCs and aldehydes. All TobLabNet validated methods to determine the contents and emissions of the priority cigarette chemicals are expected to be completed by December 2016. Once the remaining validation work mandated by the COP is completed, the final SOPs will be published on the WHO and WHO FCTC websites.

VALIDATION OF A METHOD FOR THE DETERMINATION OF TOBACCO-SPECIFIC NITROSAMINES IN MAINSTREAM CIGARETTE SMOKE

4. The validation of a method for the determination of tobacco-specific nitrosamines in cigarette emissions was completed in 2010. Nine TobLabNet laboratories participated, led by the Centers for Disease Control and Prevention (CDC) in the United States of America. CDC also performed the statistical evaluation of raw data in accordance with ISO 5725. The SOP is available on the WHO website.

VALIDATION OF A METHOD FOR THE DETERMINATION OF NICOTINE IN TOBACCO

5. The validation of a method for the determination of nicotine in tobacco was completed in 2010. The Food and Consumer Product Safety Authority (VWA) of the Netherlands served as the TobLabNet method validation lead laboratory. VWA, with assistance from CDC, statistically evaluated all raw data sent from participants in accordance with ISO 5725. Statistical procedures and reporting of results were followed in the same manner as the method validation of TSNAs in mainstream cigarette smoke. The SOP is available on the WHO website.

VALIDATION OF A METHOD FOR THE DETERMINATION OF BENZO[A]PYRENE IN MAINSTREAM CIGARETTE SMOKE

6. The validation of a method for the determination of benzo[a]pyrene in mainstream cigarette smoke was completed in 2015. Eight laboratories (one each in Burkina Faso, Canada, China, France, Japan and Singapore, and two in the United States) participated in the pre-validation of the method for the determination of benzo[a]pyrene. The lead laboratories, the Health Sciences Authority, Singapore

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3 See WHO’s reports to COP4, COP5 and COP6, documents FCTC/COP/4/INF.DOC./2, FCTC/COP/5/INF.DOC./1, and FCTC/COP/6/14 Add.1.
4 http://www.who.int/tobacco/en/
5 http://www.who.int/fctc
6 See document FCTC/COP/4/INF.DOC./2.
8 See document FCTC/COP/4/INF.DOC./2.
(HSA), the China National Tobacco Quality Supervision and Test Centre (CNTQSTC) and Laboratoire National Essais, France (LNE), determined that the pre-validation results were comparable, and that participants could proceed to the full validation phase. The SOP is available on the WHO website.\(^\text{10}\)

**VALIDATION OF A METHOD FOR THE DETERMINATION OF HUMECTANTS IN TOBACCO**

7. The validation of a method for the determination of humectants in tobacco was completed in 2014 with the participation of 13 laboratories for the Gas Chromatography Flame Ionisation Detection (GC-FID) method and seven laboratories for the Gas Chromatography Mass Spectrometry (GC-MS) method.\(^\text{11}\) The validation was successfully completed on two analytical instrumentation platforms, namely SOP 06: GC-FID, and SOP 06 bis: GC-MS. The humectants method validation was led by LNE and CNTQSTC. CNTQSTC performed the data processing and statistical analysis, with support from WHO and CDC. The SOP will be made available on the WHO website.

**VALIDATION OF A METHOD FOR THE DETERMINATION OF AMMONIA IN TOBACCO**

8. The validation of a method for the determination of ammonia in tobacco was completed in 2015. Participating laboratories from Canada, Greece, Indonesia, Japan, Spain, the United States and two from China, were led jointly by the Agrarian Food Quality Laboratory of Seville, Spain, CNTQSTC and CDC. The SOP will be made available on the WHO website.

**VALIDATION OF A METHOD FOR THE DETERMINATION OF VOLATILE ORGANIC COMPOUNDS AND ALDEHYDES IN TOBACCO SMOKE**

9. The validation of a method for the determination of volatile organic compounds and aldehydes in tobacco smoke is ongoing, and work on the statistical analysis will follow as soon as all laboratories have submitted their results to WHO. The participating laboratories are from Burkina Faso, two from China (four data sets from CNTQSTC and one data set from China CDC), Japan, Singapore, the Netherlands and the United States. The SOP will be made available on the WHO website.

**STANDARD OPERATING PROCEDURE FOR INTENSE SMOKING OF CIGARETTES**

10. The standard operating procedure for intense smoking of cigarettes\(^\text{12}\) is also currently being revised to include information on the validated method for carbon monoxide. The revised SOP will be made available on the WHO website.

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\(^{11}\) See document FCTC/COP/6/14 Add.1.

SUMMARY

11. This validation work has generated methods that are applicable in many laboratories worldwide. The methods validated for B[a]P may be applicable for many polycyclic aromatic hydrocarbons, and the methods validated for aldehydes may be applicable to many aldehydes and ketones. Furthermore, all cigarette validated methods above may serve as the basis for developing validation methods for other tobacco products.

12. Upon completion of all SOPs, WHO will work on disseminating the WHO TobLabNet methods to Parties and recommend the use of these methods in developing tobacco testing and disclosure regulations. WHO, in its capacity as observer, will continue to monitor developments in the tobacco product standardization work of the ISO Technical Committee 126 (ISO/TC 126).

13. The seventh meeting of TobReg on December 2015 in Rio de Janeiro, Brazil, recommended that among the remaining methods not yet validated, priority should be given to the development of TobLabNet standardized testing methods for the measurement of: (a) cadmium and lead content in tobacco; (b) nicotine in waterpipe smoke; and (c) nicotine, TSNAs, and B[a]P in smokeless tobacco products.

14. The sixth meeting of the TobLabNet on May 2016 in Maastricht, the Netherlands, highlighted the need to revise current methods or create new methods for testing the contents and emissions of other tobacco products such as waterpipes, smokeless tobacco, and electronic nicotine delivery systems (ENDS). In preparation, TobLabNet is planning to train and recruit more laboratories to conduct future validation work.

15. The validation process is costly and labour intensive. The lead and participating laboratories worked on a voluntary basis to support and accomplish the task mandated by COP to WHO. The validation was coordinated by WHO and mainly financed through in-kind contributions from the participating laboratories: United States CDC; China CDC; China CNTQSTC; Labstat Canada; NIPH Japan; RIVM the Netherlands; NVWA the Netherlands; HSA Singapore; LNE France; LNSP Burkina Faso; and Agrarian Food Quality Laboratory, Seville, Spain.13

ACTION BY THE CONFERENCE OF THE PARTIES

16. The COP is invited to note this report and provide further guidance.

13 For the list of validations with the participating laboratories, please refer to Annex 1.
Annex 1
Table 1. List of participating laboratories in the validation studies

<table>
<thead>
<tr>
<th>Participating laboratories</th>
<th>Content/Emission</th>
<th>Contents</th>
<th>Emissions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agrarian Food Quality Laboratory of Seville (Spain)</td>
<td>Nicotine</td>
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<tr>
<td>Alcohol Tobacco Tax and Trade Bureau (TTB) (USA)</td>
<td>Humectants (GC-FID)</td>
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<td>Tobacco Laboratory (LATAB) of Brazilian Health Surveillance (ANVISA) (Brazil)</td>
<td>Humectants (GC-MS)</td>
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<td>Battelle Public Health Center for Tobacco Research (USA)</td>
<td>Ammonia</td>
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<td>✓</td>
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<tr>
<td>Centers for Disease Control and Prevention (CDC) (USA)</td>
<td>B[a]P</td>
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<tr>
<td>Chemisches und Veterinäruntersuchungsamt Sigmaringen (Germany)</td>
<td>TSNAs</td>
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<td>China National Tobacco Quality Supervision and Test Center (CNTQSTC) (China)</td>
<td>VOCs and Aldehydes</td>
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</tbody>
</table>
VWA is a member of WHO TobLabNet and has participated in the validation work, as described in this table. However, by 2012, the laboratory, which performs tobacco product testing work, was transferred to RIVM, a founding TobLabNet member since 2005. Since then, VWA has ceased conducting tobacco product testing but continues to be an active member of WHO TobLabNet.
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<td></td>
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<td>Nicotine</td>
<td>Humectants (GC-FID)</td>
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<td>National Institute of Public Health (NIPH) (Japan)</td>
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<tr>
<td>National Public Health Surveillance Laboratory (Lithuania)</td>
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<tr>
<td>National Quality Control Laboratory of Drug and Food (NQCLDF) (Indonesia)</td>
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<tr>
<td>State Veterinary and Food Institute (Slovak Republic)</td>
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