

**WHO MEETING ON ESTIMATING
APPROPRIATE LEVELS OF VITAMINS
AND MINERALS FOR FOOD
FORTIFICATION PROGRAMMES:
THE WHO INTAKE MONITORING,
ASSESSMENT AND PLANNING
PROGRAM (IMAPP)**

GENEVA, SWITZERLAND, 22 JULY 2009



**World Health
Organization**

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Declarations of Interest Participants of the WHO Meeting on Estimating Appropriate Levels of Vitamins and Minerals for Food Fortification Programmes: The WHO Intake Monitoring, Assessment and Planning Program (IMAPP) reported the following:

A. Seal declared a patent, trademark or copyright that might be enhanced or diminished by the outcome of the meeting. This relates to the development of NutVal spreadsheet application (a non-commercial free-ware). P. Guinot declared that within the past three years he was employed by Roche Pharmaceuticals, who has an interest related to the subject of the meeting. The other participants declared they had no conflicts of interest.

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ABBREVIATIONS

AI	Adequate Intake
ARS	Agriculture Research Service of the United States Department of Agriculture
A2Z-USAID	A2Z: The USAID Micronutrient and Child Blindness Project
CDC	US Centers for Disease Control and Prevention
CV	Coefficient of Variation
DRI	Dietary Recommended Intake
EAR	Estimated Average Requirement
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FBF	Fortified Blended Foods
HANR	Harmonized Average Nutrient Requirement
HNRV	Harmonized Nutrient Reference Value
HUNL	Harmonized Upper Nutrient Levels
IOM	Institute of Medicine
NHD	Department of Nutrition for Health and Development
NRV	Nutrient Reference Value
PAHO	Pan American Health Organization
RDA	Recommended Dietary Allowances
RNI	Recommended Nutrient Intake
t	tonne
UL	Tolerable Upper Intake Level
USAID	United States Agency for International Development
USDA	United States Department of Agriculture
WHO	World Health Organization

1. INTRODUCTION

Food fortification with vitamins and minerals is currently considered as one of the main approaches to improve vitamin and mineral intake in populations. In 2006, *Guidelines on Food Fortification with Micronutrients* were published by the World Health Organization (WHO) in collaboration with the Food and Agricultural Organization of the United Nations (FAO) to provide technical guidance for the implementation of food fortification programmes as a public health intervention.

In designing an effective food fortification programme, calculating the vitamins and minerals to add to foods to be fortified, as well as the amounts, is a complex task that requires knowledge about usual dietary intakes, potential food vehicles, and other micronutrient-related interventions being implemented simultaneously. When defining nutritional goals, it is important to assure that the levels of micronutrients added are both safe and efficacious for all population groups consuming the fortified food vehicle. A meeting convened in Washington DC, United States of America in 2006 organized by A2Z, United States Agency for International Development (USAID), the US Centers for Disease Control and Prevention (CDC), and WHO/PAHO on *The Use of Food Intake in Designing, Monitoring and Evaluating Mass Fortification Programs* identified that food consumption data can be useful for establishing the nutrient gaps, assessing the contribution of fortified foods to the total intake of vitamins and minerals, selecting potential food vehicles to be used, and monitoring and evaluating ongoing programmes.

To facilitate use of the methodology described in the WHO/FAO *Guidelines on Food Fortification with Micronutrients* for determining the appropriate level of vitamins and minerals to add to a food vehicle, WHO is working in collaboration with the University of Hawaii, Iowa State University, and the United States Department of Agriculture, Agriculture Research Service's (USDA, ARS) Western Human Nutrition Research Center in Davis, California, to develop a software tool that will enable public health managers to calculate the optimal level of additional micronutrients for food fortification with user-friendly software, using locally available data.

The Department of Nutrition for Health and Development (NHD) convened a meeting to present a draft the WHO Intake Monitoring, Assessment and Planning Program (IMAPP) and solicit feedback from potential users.

Objectives of the meeting

- i. To present the WHO IMAPP software for estimating the amount of micronutrients to be used in food fortification.
- ii. To understand the synergies of this software tool with the existing USAID Food Fortification Formulator program.
- iii. To solicit feedback on the software program from potential users.
- iv. To review plans for finalizing and disseminating the software program and the feasibility of conducting training workshops.

**2. OVERVIEW OF THE
WHO INTAKE
MONITORING,
ASSESSMENT AND
PLANNING PROGRAM
(IMAPP)**
(PRESENTED BY A. CARRIQUIRY)

The primary purpose of this software program is to estimate if a given fortification strategy would be safe and efficacious for most individuals of the population groups consuming food vehicles targeted for fortification. In addition, the program could be widely used for monitoring and evaluating the adequacy of nutrient intakes of populations. WHO IMAPP is being developed in collaboration with Dr Alicia Carriquiry of Iowa State University, Dr Lindsay Allen of the USDA, ARS Western Human Nutrition Research Center, and Dr Suzanne Murphy of the University of Hawaii. The software program is a user-friendly tool that does not require extensive expertise in statistical calculations from the users. Default values are available for many of the statistical and nutritional parameters. All aspects will be clearly documented in the user's manual.

To evaluate intakes accurately, the user can provide estimated daily dietary data (e.g. from 24-hour recalls or food records) for individuals from a representative sample of the population of interest (the presenter considered that at least 100 individuals per population subgroup would be sufficient to provide an acceptable estimate). For each person, the data must contain daily nutrient intakes as well as daily intakes of potential food fortification vehicles. All food mixtures containing the potential food vehicles (e.g. flour in bread) must be disaggregated by the user prior to the analysis to ensure that total intake of the food vehicle is accurately captured. Bioavailability factors may be specified by the user for iron and zinc, or may be based on dietary patterns as described in the documentation. Using this information, the program calculates the predicted prevalence of inadequate and excessive intakes of each nutrient before and after fortification.

The nutrient parameters used for these calculations are average nutrient requirements [such as Estimated Average Requirements (EAR) from the USA/Canadian Dietary Recommended Intakes (DRI)] and safe upper levels of intake [such as the Tolerable Upper Intake Levels (UL) from the USA/Canadian DRI]. These parameters may be specified by the user or the user may choose to use the reference values available as options in the program, which have been developed for each age/gender/reproductive group. To apply the correct nutrient parameter, the user must specify the age, gender, and reproductive status (pregnant, lactating, or neither) for each person in the population. The IMAPP software then produces estimates of the prevalence of inadequate and excessive intakes for each of these groups.

To accurately estimate the usual daily intakes and therefore the prevalence of inappropriate intakes, it is crucial to adjust the intake distributions for within-person day-to-day variation of nutrient intakes. Without this adjustment, both the prevalence of inadequacy and the prevalence of excessive intakes will typically be overestimated, often by 100% or more. For this adjustment there should be multiple (two or more) days of dietary data for at least a representative subsample of the population (no fewer than 35

individuals, but preferably more). Using these data, the software can calculate the ratio of the day-to-day variation (the within-person variation) in nutrient intakes to the between-person variance, and use this ratio to adjust the intake distribution. Although not ideal, if only one day of intake is available, the software provides an option to use variance ratios from other intake data sets.

The first output of the software program is a tabulation of the prevalence of inadequate intakes and the prevalence of excessive intakes for each of the age/gender/reproductive groups before fortification. The program also can estimate the additional amount that would be necessary to add to the diet (through several fortified foods, and even several interventions) to reach the specified target prevalence of adequacy. The user may then specify the level of fortification for a food vehicle, and the software will recalculate the estimates. If the estimates are too high (exceeding upper levels) for any of the nutrients in any population subgroup, the user may specify a different level of fortification and rerun the program. If no level of fortification provides satisfactory results, then the user may wish to consider fortifying a different food vehicle, or multiple food vehicles, and repeat the above process until the expected results are obtained.

The software also provides several output data files that may be used for further analyses, such as usual nutrient intakes at each percentile from 1 to 100, estimated usual intakes before and after fortification, and other statistics associated with the usual intake distributions.

Summary of discussion on the presentation

Participants discussed how the WHO IMAPP would be applied to specific settings, such as in urban and rural areas, in countries where there is wide variability in nutrition intake for specific age groups, and during particular seasons. Using the example of iron fortification of corn *masa* flour tortillas in Mexico, participants discussed the relevant steps in using the software, including assessment of iron intake by age and gender groups, collection of information on corn *masa* flour tortilla consumption, targeting specific

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