# Measuring vaccine hesitancy: Field testing the WHO SAGE Working Group on Vaccine Hesitancy survey tool in Guatemala

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## ARTICLE INFO

## ABSTRACT

*Background:* Despite safe and effective childhood immunizations, decreased acceptance of vaccines has become an emerging global problem. The WHO SAGE Working Group on Vaccine Hesitancy developed a common diagnostic tool, the Vaccine Hesitancy Scale (VHS), to identify and compare hesitancy in different global settings. We field tested the VHS in rural and urban Guatemala.
*Methods:* We analyzed data from the enrollment visit of a study conducted at four public health clinics in Guatemala. Infants ages 6 weeks-6 months presenting for their first wellness visit were enrolled March-November 2016. Parents completed a demographic survey that included the 10 dichotomous and 10 Likert scale VHS questions. Chi-square or Fisher's exact for categorical and ANOVA test for continuous variables were used to assess significance levels in survey differences. We conducted a factor analysis to assess the Likert scale questions.
*Results:* Of 1088 families screened, 871 were eligible and 720 (82.7%) participated. No parent had ever refused a vaccination, and only eight parents (1.1%) had been reluctant or hesitated to get a vaccination for their children. However, only 40.8% (n = 294) of parents said that they think most parents like them have their children vaccinated with all the recommended vaccines. Factor analysis identified two underlying constructs that had eigenvalues of 1.0 or greater and a substantive lack of variability in response across the Likert scale. There were consistent differences between how study clinics responded to the ordinal scaling.
*Conclusion:* Our results suggest problems with interpretation of the VHS, especially in the presence of vaccine shortages and using a Likert scale that does not resonate across diverse cultural settings. Our factor analysis suggests that the Likert scale items are more one-dimensional and do not represent the multiple constructs of vaccine hesitancy. We suggest more work is needed to refine this survey for improved reliability and validity.
  Clinical Trial Registry: NCT02567006.

## 1. Introduction

Immunization is one of the greatest public health achievements, protecting children from serious illness and saving millions of lives every year. Despite a growing number of safe and effective childhood vaccines, decreased acceptance of specific vaccines or vaccination programs by both individuals and communities has become an emerging problem in high-income [1–3] as well as

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low-and middle-income (LMIC) countries [4]. The reasons for this are multifaceted, culture-specific, and often not completely understood. In 2012, the World Health Organization (WHO) Strategic Advisory Group of Experts (SAGE) on Immunization recognized this global challenge and established the Working Group (WG) on Vaccine Hesitancy [5]. The WG contributed to several important areas of this relatively new field of research [6–12] and created the following definition: "*Vaccine hesitancy refers to delay in acceptance or refusal of vaccination despite availability of vaccination services. Vaccine hesitancy is complex and context specific, varying across time, place and vaccines. It is influenced by factors such as complacency, convenience and confidence*" [7]. Vaccine hesitancy, therefore, occurs on a continuum between those who undoubtedly accept all vaccines to those who undoubtedly refuse all vaccines. The vaccine hesitant individual remains somewhere between these two extremes, including those who refuse certain vaccines while accepting others, delay vaccinations, or accept vaccinations but have concerns.

In order to inform interventions that improve vaccine coverage, it is important to understand the complex and interplaying factors that influence vaccination decisions and the determinants of vaccine hesitancy in a specific population. No uniform, global metric for quantifying vaccine hesitancy currently exists. While several cross-sectional surveys have been used to measure parental attitudes, beliefs, and behaviors surrounding vaccination [13–20], most of these surveys have only focused on a limited number of factors influencing vaccine hesitancy, have not had formal testing of validity and reliability, and have been conducted in high-income settings. One of the major tasks of the WG was to develop a common diagnostic tool, the Vaccine Hesitancy Scale (VHS), to identify and compare hesitancy in different global settings [12]. VHS questions are either closed-ended, Likert scale, or open-ended in nature. These questions were developed in conjunction with a global pilot test of indicators for vaccine hesitancy and a literature review for similar survey tools. Questions were further adapted from the Parent Attitudes About Childhood Vaccines (PACV) survey previously developed by Opel et al. [21] and found to be valid and reliable in a high-income population [22,23]. The PACV survey has also been adapted for use with adolescent vaccines [24], influenza vaccination [25], and a multi-ethnic Malaysian population [26]. In their work to develop a common survey tool that could be used globally to identify and compare vaccine hesitancy, the WG further adapted the PACV survey to have more global relevance, especially for LMICs.

While this effort has generated a useful initial tool to assess vaccine hesitancy and its relevance in delayed or incomplete vaccination, the WG encouraged further evaluation of the VHS to determine whether it offers both a valid and reliable estimate of vaccine hesitancy across diverse cultural settings. In the context of a larger randomized intervention study exploring the impact of a Short Message Service (SMS) technology to provide families with text message reminders for childhood immunizations, we conducted baseline assessments that incorporated both the closed-ended and Likert scale VHS questions. Our study team has worked in collaboration with the Ministry of Health of Guatemala [27]. The current study analyzes the reliability and validity of the VHS measure applied in urban and rural Guatemala using a factor analysis as described in more detail below. Our objective is to provide insight into the shared understanding of the VHS construct using the tool in diverse global settings.

## 2. Materials and methods

### 2.1. Study design

We analyzed cross-sectional data collected at the enrollment visit from a study conducted at four public health clinics of the Ministry of Public Health and Social Assistance in Guatemala. The government clinics serve a low-income population with two of the clinics located in an urban setting surrounding Guatemala City (Zona 11 and Villa Nueva) and two in the rural southwest region of the country (Colomba and Coatepeque, Quetzaltenango). Participation was voluntary and patients were not given any incentives. Of note, Guatemala experienced significant political instability during our study period, which led to considerable vaccine shortages experienced by all of our clinics. The Colorado Multiple Institutional Review Board, Universidad del Valle Ethics Committee, and Guatemala National Ethics Committee of the Ministry of Public Health and Social Assistance approved the research. Written informed consent was obtained from all parents or guardians (henceforth referred to as parent).

### 2.2. Participants

Eligible participants included parents of infants between the ages of 6 weeks to 6 months presenting for their first wellness visit. At least one parent needed to own an active mobile phone capable of receiving SMS, be able to use SMS, and be literate and able to decipher the messages for themselves or by a surrogate in the household. Children were excluded if they were not medically cleared to receive vaccines, the study clinic was not the patient's primary clinic, the consenting parent was under 18 years of age, or the parent did not speak Spanish. Equal numbers of rural and urban participants were enrolled.

### 2.3. Data collection

Data collection occurred between March to November 2016. Parents completed a demographic survey that included the 10 dichotomous (yes/no) and 10 Likert scale (strongly agree, agree, neither agree nor disagree, disagree, or strongly disagree) VHS questions. In order to maintain the original instrument, no modifications were made and no items were added. The English language survey was translated into Spanish by a native Guatemalan. A study nurse assigned to each clinic verbally administered the surveys to participants in a quiet and confidential location. Study data were collected and managed using REDCap (Research Electronic Data Capture), a secure and web-based electronic data capture tool hosted at the University of Colorado Denver [28].

### 2.4. Statistical analysis

We analyzed parent demographics and survey responses using descriptive statistics. Chi-square or Fisher's exact for categorical and ANOVA test for continuous variables were used to assess significance levels in demographic and survey differences. All statistical tests were considered to be significant at a two-tailed p value less than 0.05. To analyze reliability and validity of the Likert scale questions, we conducted an exploratory factor analysis (EFA). We first examined correlations between all survey items. We then completed a factor extraction. This is an important step to explore statistically possible linear combinations of variables and whether they represent the domains of complacency, convenience, and confidence as specified in the WG vaccine hesitancy definition [7]. We then conducted a principle component analysis, a process that helps to group those items together into factors that will maximize the variance in the data using a measure known as an eigenvalue. We retained only the factors that have eigenvalues of at least 1.0 [29]. We then explored the strength of the correlation of items within each factor and considered if any of the items within a factor might be redundant using a varimax rotation. This is a process that allows researchers to simplify factor analysis results by