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Acceptance of a New Technology for Management of Obstetric Hemorrhage: A Qualitative Study From Rural Mexico

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We conducted a qualitative study to explore responses to a low-technology first-aid device for management of life-threatening obstetric hemorrhage in rural health facilities in Mexico. This entailed in-depth, semistructured interviews with clinical and administrative staff (n = 70) involved in pilot studies of the nonpneumatic antishock garment (NASG) at primary health care facilities and rural hospitals. We found that staffs' response fell into four categories: owning, doubting, resisting, and rejecting. Overall, there were positive reactions to the garment as a relevant technology for saving women's lives. Findings will be used for future implementation of the garment and other new technologies.

Obstetric hemorrhage is the number one killer of women in low resource settings and a public health problem that requires innovative solutions. Our

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research team and coauthors of this study of the acceptance of a new technology, the nonpneumatic antishock garment (NASG), have been conducting efficacy trials in various countries. We provide information on how this life-saving, first aid device was viewed and came to be accepted by diverse professional health care workers in the rural states of Puebla and Oaxaca in Mexico. We categorized participants' responses into four groups that describe their perceptions and deal with a variety of issues such as health care worker training, commitment to their communities, and empowerment. We pose important considerations for the introduction of this new device into functioning health systems in the future and may model challenges faced with the acceptance of similar technologies.

BACKGROUND

An estimated 535,900 women die annually from complications of pregnancy and childbirth; the majority of deaths occur in developing countries (Hill et al., 2007). Globally, obstetric hemorrhage is the leading cause of maternal mortality. Although obstetric hemorrhage is manageable in developed countries, many women in developing countries lack access to the necessary life-saving treatment: medication, blood transfusion, and surgery (UNFPA, 2007).

The NASG is an emergency first-aid device, which decreases blood loss, restores vital signs, and can be used for management of obstetric hemorrhage and shock until definitive treatment is available (Brees, Hensleigh, Miller, & Pelligra, 2004; Miller et al., 2007; see Figure 1). Thaddeus and Maine (1994) described a model to explain how three delays in obtaining treatment—the decision to seek appropriate medical help, reaching an adequate obstetric facility, and receiving quality obstetric care at the health facility—contribute to the great majority of maternal deaths in low resource settings. Due to its simplicity, relatively low cost (\$170 per garment), and reusability of approximately 30 times, the NASG could be an important tool in decreasing poor outcomes for women by addressing these treatment delays.

The NASG has not been studied in randomized clinical trials, but it has been studied in pre–post intervention trials in tertiary care hospitals in Nigeria and Egypt (Miller, Hamza et al., 2006; Miller, Ojengbede et al., 2007; Miller, Turan et al., 2007; Miller, Turan et al., 2006). We also conducted a pilot study of the NASG in lower-level rural health facilities in Mexico. Although the NASG was rapidly adopted in the Nigeria and Egypt pilots, initial use of the NASG in Mexico was lower than expected. This was an area of concern, and we wanted to investigate why there was slower uptake in Mexico and if there were any indicators that would suggest similar difficulties would be encountered elsewhere. We realized that although there is promising evidence of NASG use for improving health outcomes in experimentally controlled scenarios, it must be accepted by women and their families, communities,

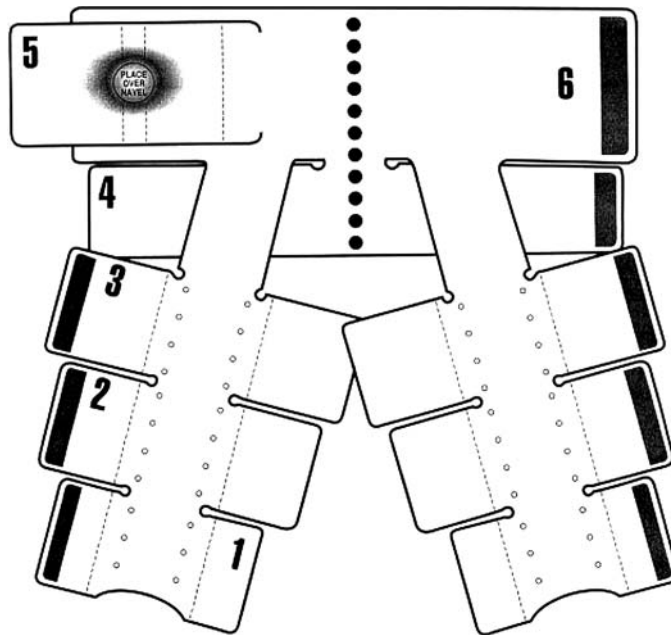


FIGURE 1 Schematic representation of the NASG, where segments 1–3 are wrapped around each leg and segments 4–6 around the buttocks and lower abdomen.

and health care providers for its full potential to be realized (Miller, Martin, & Morris, 2008; Simmons & Shiffman, 2006).

Authors that have reported on the introduction of new reproductive health technologies, such as the female condom, manual vacuum aspiration (MVA), medical abortion, or postabortion care, have demonstrated the pivotal role of providers in the implementation of new policies and technologies (Billings, Crane, Benson, Solo, & Fetters, 2007; Coeytaux, Moore, & Gelberg, 2003; Jones & Henshaw, 2002; Mantell et al., 2001; Mantell, Scheepers, & Karim, 2000). Adoption of new technologies, for provider and patient alike, is strongly influenced by provider perceptions and context-specific resources (Greenhalgh, Robert, Macfarlane, Bate, & Kyriakidou, 2004; Kotwal, 2005; Sanson-Fisher, 2004) among other factors. To better understand these perceptions and contexts, we conducted a qualitative study exploring provider responses to the introduction of the NASG within the larger pilot study of the NASG in Mexico.

METHODS

Our purpose in the pilot study was to determine the efficacy of the NASG within the rural public health system, the Mexican Institute of Social Security “Oportunidades” (IMSS-O), which provides free health services to the uninsured population of low socioeconomic status. We conducted the pilot study

from May 2004 to August 2005 in two Mexican states, Puebla and Oaxaca. We implemented the study in two types of IMSS-O facilities, 12 primary health care units or *unidades medicas rurales* (UMRs), and five secondary-level rural hospitals or *hospitales rurales* (HRs), which are referral sites for the UMRs.

Clinical staff at study sites were introduced to the NASG and trained in a standardized protocol for management of obstetric hemorrhage including the use of the NASG. The principal investigators conducted these “direct,” skills-based trainings at HRs. All staff members, including UMR personnel, were trained together. At each facility we installed job aids, step-by-step algorithm posters of the NASG protocol. Hospital and UMR staff conducted further “indirect” trainings for personnel who could not attend the direct training and for new staff, including rotating medical residents. Additionally, the study’s field coordinator conducted one-on-one training sessions both at UMRs and HRs as necessary.

Within this pilot study we conducted a qualitative study to obtain a more in-depth understanding of responses to the NASG. We developed a semistructured interview guide to evaluate circumstances that facilitated and hindered NASG use in Mexico based on the Diffusion of Innovation framework (Rogers, 1995) and Knowledge-Transfer and Change Theory literature (Denis, Hebert, Langley, Lozeau, & Trottier, 2002; Grol & Grimshaw, 2003; Simmons, Brown, & Diaz, 2002).

We held semistructured interviews, which explored training, perceptions, and experiences with the NASG. We chose a private place in the participant’s workplace for the interviews and tape recorded them with the participant’s consent. There were three interviewers: the Mexico study’s site coordinator and field coordinator and a public health master’s degree student. We obtained institutional review board (IRB) approval from the University of California, San Francisco, and the Population Council and IMSS-O for all study procedures.

Participants ($n = 70$) for the nested qualitative study were health providers from HRs and UMRs in Puebla and Oaxaca, and IMSS-O central office personnel from both states and Mexico City who were involved in the NASG pilot study. We used purposive sampling in order to capture a wide range of experiences with NASG use from participants who had never used the NASG to others who had used it multiple times, and in a variety of contexts. Some participants were interviewed more than once. We also held a few interviews at tertiary-level hospitals, which are Ministry of Health facilities and not part of the IMSS-O network, and where study patients were referred for specialized care.¹ These study participants differed from the rest because they were not part of the pilot study and thus were not trained

¹ IMSS-O is a network of health care services that includes up to secondary health care, and patients that require specialized treatments are referred outside of this network to alternative providers of public services such as the Ministry of Health.

on the NASG because it was not implemented in the tertiary-level hospitals. They were included in the qualitative study, however, to document perceptions of providers who had little to no information on the NASG, but who occasionally encountered the NASG if women were transported to these facilities with the NASG.

Following Grounded Theory methodology, we conducted data collection and analysis simultaneously (Glaser & Strauss, 1967), modifying the interview guide as the project evolved. Once we had exhausted information on all the different contexts in which the NASG was introduced and reached saturation in our data, we concluded the data collection. We transcribed and analyzed interviews and field notes in Spanish using ATLAS.ti (Scientific Software Development, Berlin, 2003–2005, Version Win 5.0). We compared participants by location, level of care, their clinical title, gender, type of training on NASG (direct, indirect, or none), and experience with the NASG. By categorizing these responses we were able to compare similarities and differences within, between, and among these groups, and to draw on common patterns of response and themes expressed. Once we concluded our data analysis, we held meetings with UMR and HR staff and IMSS-O administrative personnel to share, obtain feedback, and validate our findings.

RESULTS

Seventy health care providers from varying occupations and facility levels were interviewed in three states (Table 1). We categorized responses to the NASG into four trajectories: owning, doubting, resisting, and rejecting. Through comparisons of these trajectories we elucidated contexts and

TABLE 1 Participants by Location, Level of Facility, and Profession

Participants information	<i>N</i>
State	
Oaxaca	33
Puebla	41
Mexico City	3
Facility level	
Primary health care units (UMRs)	7
Rural hospitals (RHs)	64
Tertiary level hospitals	6
Profession	
Nurse/auxiliary nurse	10
Medical student	6
General practitioner	15
Medical specialist (certified or resident)	22
Administration	17
Total*	70

*Some participants were interviewed more than once.

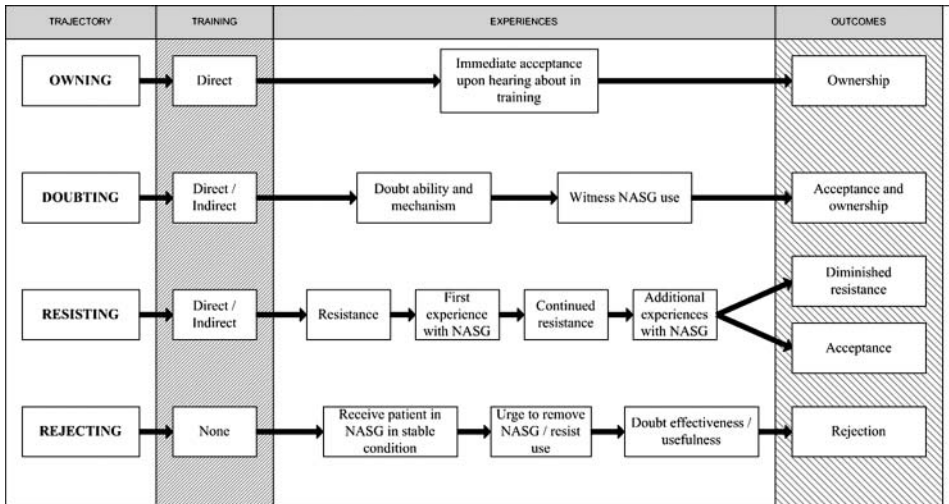


FIGURE 2 Four trajectories of response to NASG introduction.

conditions that affected the degree and rapidity of acceptance or rejection of the NASG (see Figure 2).

Owning

Upon introduction of the NASG, several participants responded with immediate acceptance after training, and this acceptance was sustained throughout the project period, and translated into NASG “ownership” (Simmons, Brown, & Diaz, 2002). Owners accepted the NASG regardless of their understanding of the mechanisms of action, and before witnessing its use. The owning trajectory consisted mostly of staff at the community level (UMRs) who received direct training and later became leaders in the diffusion of the NASG.

One owner was an auxiliary nurse at an UMR who applied the NASG to a hemorrhaging woman. She explained:

She [the patient] was stable at all times and that made me feel much calmer, and also I felt that the fact she had the NASG on was going to prevent her from further hemorrhage. (Auxiliary Nurse, UMR)

As there was no access to treatment at the UMR, the nurse transported the patient to a higher-level facility herself. After a 2½ hour drive, they arrived at a Ministry of Health hospital that was not an NASG study site (the road to the study referral hospital was not passable). Staff at this hospital knew nothing about the NASG and wanted to remove it. This premature removal could have rapidly destabilized the woman; however, the nurse strongly opposed and defended the correct protocol—to leave the patient in the

NASG until she received definitive treatment. Her determination, in spite of gender and power and status differentials, reflects her strong ownership of the NASG.

Doubting

The most frequently observed trajectory was doubting. For this trajectory we included participants who received either direct or indirect training and who expressed doubt after the training, but who reversed their opinion immediately upon witnessing a real case with the NASG. Following experience with NASG use, they expressed acceptance and sometimes even ownership of the NASG. Initially, doubters were skeptical about the NASG's mechanism of action and whether it could resuscitate women with hypovolemic shock secondary to obstetric hemorrhage. They were afraid to use the NASG for the first time and did not typically use it on their own volition, but only when someone else suggested or ordered its use:

In the beginning I was very doubtful. . . . I thought, "What is this," but after getting to know the NASG better, after having experience with it and seeing how patients recover, I think the NASG is excellent. (Director, HR)

Doctors and nurses expressed doubt for different reasons. Doctors doubted the NASG's mechanism of action, while nurses were more concerned with the holistic well-being of the patient. One nurse drew a comparison between nurses' and doctors' responses to new procedures:

The doctors have been trained in a different way. I see that doctors think, "I know a lot and I need to prove things on my own to see if they really work," while we [nurses] are more convinced of the information we receive. (Nurse, HR/UMR)

Resisting

Resisters opposed using the NASG even after witnessing a successful resuscitation. They needed to witness numerous cases before accepting the NASG or at least before decreasing their resistance to it. On the whole, resisters often were less open to using new technologies. They showed similar characteristics to those identified as the late majority or laggards in the Diffusion of Innovation literature, people whose personal traits, such as being traditional, isolated, or suspicious, prevented or delayed the adoption of an innovation (Rogers, 1995; Simmons, Brown, & Diaz, 2002). We observed the resisting trajectory mostly in HRs and typically among senior medical specialists and surgeons who were accustomed to the clinical protocols they had performed for years and to reliance on their surgical skills to manage obstetric

hemorrhage. One obstetrician described himself as being resistant to change and slow to adopt new technologies:

Something similar happened with the introduction of the manual vacuum aspiration (MVA) for uterine evacuation. One goes through traditional training and is taught to do dilation and curettage procedures. For me, it took more than a year [to adopt MVA]. I had read about it, I had practiced doing MVAs, but I still felt the uterus was not completely empty. I think that when we start to see the NASG is useful, the same thing will happen. (Obstetrician, HR)

Despite initial resistance, we found that with experience using the NASG, even some of these health providers eventually became owners.

Rejecting

Rejecters expressed both doubt and resistance to the NASG, and they did not alter their perceptions throughout the study period. Rejecters were typically obstetricians from tertiary-level hospitals. Doctors in the tertiary-level hospitals differed from all other study participants, as they were not involved in the introduction and training of the NASG and many previously were not aware of its existence. On four occasions these doctors inadvertently received NASG patients referred from HRs, all of which were women in stable condition but with a history of severe hemorrhage. Since they did not witness the dramatic recovery typical of NASG use for shock treatment, they remained doubtful of the NASG's effectiveness. As one doctor from a tertiary hospital in Oaxaca said:

I don't know exactly how it works. . . . I would have to witness a case where a patient in shock is actually stabilized with the use of the NASG. The patients I've seen have been stable when they arrive at the hospital and are not bleeding anymore. (Doctor, Tertiary Hospital)

Like obstetricians from the tertiary-level hospitals, residents who recently had been trained in tertiary-level training institutions and sent to HRs (NASG study sites) where they rotated for 4 month periods as obstetrical experts, also rejected the use of the NASG. They had no previous contact with the NASG in their medical training, and they rarely received direct training on the NASG by study staff. Furthermore, many lacked the motivation to become more involved with NASG use because of their brief rotation at the HRs.

Conditions for Positive NASG Responses

To understand the differences in uptake of the NASG, we examined the contexts that promoted ownership and contexts in which initial doubts and

resistance became acceptance, as compared with the contexts most likely associated with rejection. We found that the following conditions were associated with positive responses to NASG use: greater need, smaller facility, lower staff turnover, direct training by study investigators, and personal commitment to the community.

The need for first-aid for obstetric hemorrhage was so great in the UMRs that personnel there rapidly accepted or owned the NASG. Owners were more likely to work in geographically isolated areas, making long transport necessary, and in facilities that commonly lacked trained staff and supplies needed for prompt management of hemorrhage and shock. Staff in the who could compare the experience of a woman dying from hemorrhage during transportation to transporting a woman in the NASG who survived, rapidly became owners.

Participants spoke about a number of characteristics of smaller-size facilities, which prompted positive responses to NASG use. Lower staff turnover, fewer staff to train, and a higher percentage of staff who attended direct or individualized training sessions are specific factors that led to its diffusion. Nurses had more decision-making power at the UMR than did nurses in the hospitals, which allowed them to take more ownership of the NASG. Workloads were lighter at UMRs; thus staff had more time to practice with the new technology. Also, the majority of UMR staff lived and worked in the community, which created a stronger incentive to use and disseminate NASG information in their community, for example, with health promoters.

The majority of UMR staff members were introduced to the NASG by study investigators. This produced a positive initial response as staff felt “*special*” that outsiders from recognized institutions (a foreign university and a Mexico City based international nongovernment organization) had come to teach them about the NASG:

I feel very happy that you have included us, which is different than when the training is by a person you already know. You say to yourself, “There is someone coming from far away. I am important.” (Auxiliary Nurse, UMR)

Conditions for Negative NASG Responses

By examining the context in which doubts, resistance, and rejection occurred, we learned more about the conditions that hindered NASG uptake. These included the following competing resources for obstetric hemorrhage and shock management such as access to blood transfusions and surgery, larger staff size and high turnover, rigid hierarchical structure, indirect or no training, and a “tertiary hospital level mentality.” This *in vivo* code was used by a few doctors to describe a way of perceiving health care as reliant on

highly technological interventions that could be performed only by medical specialists at tertiary care facilities.

With other treatment resources available at HRs, the need for the NASG was not as great, and providers expressed difficulty deciding where the NASG fit in their hemorrhage management protocols. Providers at such facilities were less inclined to use the NASG because they felt more comfortable using treatments with which they were familiar and which were not under study. Other contributing factors to the lower NASG use in the HRs included heavier workloads and a faster pace.

The problem is when you actually have an emergency, you forget you have the NASG. That's when we have to intervene and remind them: "Do you know that this is an obstetric hemorrhage patient? Put the NASG on!" If we don't do it that way, they continue giving them traditional management. (Director, HR)

Large staff sizes and high turnover made NASG training and diffusion more difficult. Some participants reacted negatively to the NASG because it was introduced by the principal investigators who were viewed as "outsiders." For example, some doubters expressed distrust, stating that they and their patients were being "experimented on so that the city-based and foreign researchers could become rich" (Doctor, HR).

Despite commitments made by HR leaders to replicate training for those unable to attend direct trainings and for new staff, some employees did not receive any training. Doctors from tertiary-level hospitals were less likely to have received training on the NASG, and this appeared fundamental to their initial doubt and resistance.

Participants working in the more hierarchical structure of the HRs seemed to respond more negatively toward the NASG. Resistors and rejecters often were in positions of power. These providers were not interested in learning how to use the NASG, which reduced opportunities for the staff to witness positive results. In one HR, a resistant obstetrician was responsible for triage in the emergency department, and this seriously hindered diffusion of the technology throughout the hospital. Furthermore, in higher-level facilities some categories of staff were unable to implement certain procedures due to the strict hierarchical roles. This restricted the nurses' ability to apply the NASG, unlike in UMRs where nurses were able to initiate NASG use.

One anesthesiologist from an HR in Puebla commented that the biggest obstacle to using the NASG was what he called the "tertiary hospital level mentality." He discussed the fact that residents are trained in the latest treatment options at tertiary-level hospitals, whereas we presented the NASG as an experimental device at lower-level facilities, thus diminishing the credibility of its use with this group of providers.

DISCUSSION

Consistent with previous authors who have reported on technology introduction, NASG use was influenced by the diverse settings and clinical backgrounds of providers involved. The setting, training, profession, gender, and need for its use highlight a spectrum of factors that must be taken into account for future introduction of the NASG and other technologies (Greenhalgh, Robert, Macfarlane, Bate, & Kyriakidou, 2004; Mantell et al., 2000, 2001).

Whilst we trained nurses and doctors together, according to our results, need for tailored trainings for personnel by profession and at different levels of care would have been more effective (Landrum, 1998; Lee, 2004). Doctors reported a need for content based on published evidence of the physiologic effects of the NASG and how to introduce it into the algorithm of obstetric hemorrhage management. In contrast, nurses appeared less concerned with these technical aspects and often also felt intimidated about asking questions on application and removal of the NASG during the trainings, due to the doctors' presence. UMR personnel responded more favorably to the NASG, but they desired a training that focused more on practical aspects such as how to transport patients wearing the garment. Another training issue was the selection of facilitators. For UMR staff, outside experts providing the training was a positive factor, whereas for HR doctors, and tertiary hospital doctors, the NASG would have been better received had it been introduced by an insider who is well-respected and influential (Kohl & Cooley, 2006; Rogers, 1995).

Most of the resistance to NASG use came from specialist doctors in higher-level facilities. Thus, in a health system where doctors determine the use of the NASG, it may be beneficial to introduce it in the tertiary level of care and medical schools at the same time. Although there is not as much need for this resource in tertiary hospitals or medical schools, it would ensure that specialists and residents were trained prior to treating patients with the NASG and potentially could help validate the effectiveness of the technology and help overcome many of the barriers for acceptance that emerged in our study. Furthermore, our experiences introducing the NASG in tertiary care hospitals in Nigeria and Egypt suggest that staff with more frequent exposure to the NASG due to a higher volume of patients experiencing obstetric hemorrhage are more likely to accept and become more confident with this experimental emergency first-aid device.

Limitations

Although we assured participants that responses would be kept confidential, we were associated with IMSS-O central office personnel, which may have made participants less inclined to voice negative opinions. Also, our field

coordinator visited some sites more than others, which may have introduced a selection bias. Further, although an individual's response to a new technology may change over time, most participants were interviewed only once, which did not capture possible transition of response. We did conduct interviews from beginning to end of the pilot study, however, and we categorized participants' responses by degree of exposure to the NASG for our analysis, which we believe helped to mitigate this limitation. Finally, we introduced the NASG as part of a clinical efficacy trial involving, for example, filling out extensive case report forms. It was difficult to determine how much of an influence this played in the uptake of the NASG.

CONCLUSION

According to our preliminary results of pre–post intervention trials in Egypt and Nigeria (Miller, Hamza et al., 2006; Miller, Turan, Ojengbede et al., 2006), the NASG is a promising technology that can be used to reduce maternal mortality due to obstetric hemorrhage in low resource settings. As we learned, however, providers' responses to even a simple and potentially life-saving technology is greatly dependent on the context, the need, the way it is introduced, and who it is introduced by; the type and frequency of training; and the experiences and needs of the potential users. These factors need to be assessed and considered prior to introduction of not only the NASG, but also of other new technologies, into functioning health systems.

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