

ORIGINAL RESEARCH

Addressing Noncommunicable Disease on Short-Term Medical Trips: A Longitudinal Study of Hypertension Treatment in Santo Domingo



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Abstract

BACKGROUND Noncommunicable diseases (NCDs) are the leading cause of mortality worldwide and pose complex challenges in developing nations. Short-term medical trips, which often operate independently of government and pharmaceutical companies, are in a unique position to address NCDs in developing nations. In 2010, the Dominican Aid Society of Virginia shifted the focus of their semiannual clinic to addressing NCDs in Paraíso, Santo Domingo.

OBJECTIVE This study analyzes the longitudinal impact of a short-term medical trip on the control of hypertension in their patient population.

METHODS Returning patients were identified through a review of medical records from 2014 and 2016. A sample of patients who only visited in either 2014 or 2016 were matched on sex and age and served as an internal comparison group. A generalized linear mixed model was applied to assess changes in blood pressure, the proportion of patients receiving blood pressure treatment, and the intensity of blood pressure treatment within and between returning and new patients over the study period.

FINDINGS There was a significant decrease in diastolic blood pressure within returning patients. Change in systolic blood pressure was significantly different between returning and new patients, with improvement in returning patients. There was a significant increase in the proportion of new patients receiving blood pressure treatment and a higher intensity of blood pressure treatment over time. The change in the proportion of patients receiving blood pressure treatment in the new patient group was significantly higher than that of the returning patient group.

CONCLUSIONS Short-term medical trips with a recurrent presence in a community may improve control of hypertension and other NCDs in developing nations. Further research into the impact that short-term medical trips may have on NCDs is needed.

KEY WORDS blood pressure, global health, hypertension, noncommunicable disease, official medical mission, short-term medical trips.

INTRODUCTION

Noncommunicable diseases (NCDs), including cardiovascular disease, diabetes, and cancer, are the leading causes of mortality worldwide.^{1,2} Several

lifestyle-related risk factors (eg, tobacco use, hypertension, and obesity) are recognized as major contributing factors to morbidity and mortality from NCDs.^{1,3,4} Developing nations are currently experiencing growth in chronic NCDs, with death rates

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inversely associated with average income.⁵ As a result, NCDs inhibit progress toward the Millennium Development Goals and are a barrier to economic development in impoverished nations.^{1,6,7} These nations disproportionately bear the burden of NCDs because it is estimated that 70% of deaths in lower- and middle-income countries are associated with NCDs and 48% of deaths caused by NCDs occur before the age of 70.^{1,3,4,8}

The increasing rates of NCDs as well as the disproportionate increase in NCDs in developing countries pose challenges for medical volunteers traveling from higher-income to lower-income countries. Participants in short-term medical trips are faced with the task of understanding the complexity of NCDs within the target population and providing a sustainable intervention, all within a very short time frame.⁹ In addition, they must take into account cultural norms of medical care and limitations within the existing medical system (eg, high cost of and limited access to medical treatment).^{9,10} Addressing the needs of patients with NCDs requires a long-term commitment, whereas participants in short-term medical trips may only have days or weeks to provide care.¹¹

Despite many World Health Organization initiatives to draw attention to NCDs, many programs to address these conditions suffer from lack of funding, inadequate resources, and little support from community and national leaders.¹²⁻¹⁴ Thus, short-term medical trips might have an advantage in that they often operate independently of pharmaceutical companies, medical equipment suppliers, and political ties. These trips offer unique opportunities to coordinate integrative solutions by engaging and supporting existing health systems to help provide continuity of care for patients with chronic NCDs.

Participation in short-term medical trips by medical students, residents, and physicians has increased dramatically over the past few decades. In 2008 alone, about 500 US-based organizations spent an estimated \$250 million on 6000 different short-term medical trips.¹⁵ Although a more recent gross estimate has not been made, this price has likely increased over the past 10 years.¹⁶ Although these organizations cite several benefits for the individuals who participate (eg, clinical skills, cultural sensitivity, familiarity with novel diseases), 95% of them lack any form of significant data collection to evaluate patient outcomes.^{17,18} Indeed, data collection and management are complicated because clinics may lack the necessary technology, data storage capacity, and reliable internet access. Although some

empirical studies of short-term medical trips exist, the focus of this research has been the social, economic, and diplomatic impacts of these trips.^{16,19} After conducting a literature search, the authors found that almost no research has examined the impact of short-term medical trips on health outcomes of patients, especially related to NCDs. To help address this gap in data, this study presents the impact of a recurring short-term medical trip on the treatment of NCDs in the Dominican Republic.

In the Dominican Republic, hypertension is the second leading cause of death and diabetes is the sixth leading cause of death; nearly 35% of Dominicans suffer from hypertension and approximately 10% have diabetes.²⁰ The Dominican Aid Society of Virginia coordinates semiannual short-term medical trips, which last 6 days, bring an average of 25 volunteers, and during which an average of 750 patients are treated in the barrio of Paraíso, a section of the Villa Mella barrio in Santo Domingo Norte. Dominican Aid Society of Virginia-led medical trips have been conducted in Paraíso since 2006. In 2010, the team began to focus on the assessment and treatment of NCDs as the impact of these conditions on the community became more apparent and as the team leadership became more aware of the previously noted impact of NCDs on developing nations. This study reports on the impact of continuity of patient care provided via a short-term medical trip on control of hypertension in a semiurban barrio in the Dominican Republic and discusses the implications of these findings for short-term medical trips overall. This study assessed hypertension given its prevalence in the community, its impact on multiple other health conditions, and as an example for studying other NCDs.

METHODS

All patients were required to be at least 18 years of age, to have a complete medical record (eg, last name and blood pressure measurements must be present), and not to be pregnant. When sex was missing, the research team used other health information in the electronic health record to complete this field when possible. If sex could not be determined with certainty, the record was excluded. Using medical records from the nonprofit Dominican Aid Society of Virginia, 2 groups were identified: the returning patient group included patients seen in both 2014 and 2016 and the new patient group was composed of patients seen only in 2014 or 2016 but not in both years. The new patient group was used as an internal

comparison group. Returning patients were identified by manual review of all patient records from each year. Patients were matched using name, date of birth, age, address, and sex. In the case of uncertainty when identifying a match, these records were reviewed by 3 members of the research team who came to a consensus on the patient's status as a returning or new patient. This process was necessary because name spellings were often inconsistent and government identification information and birthdates were inconsistently available. Once return patients were identified, information was collected from a random sample of the remaining eligible patients from 2014 and 2016 using a random number generator. Sample size was determined through a power analysis with a target of 80% power.

Data on returning patients and randomly selected new patients were entered into REDCap (Award Number UL1TR000058 from the National Center for Research Resources).²¹ If there was more than 1 blood pressure on record for a given visit, then the last recorded blood pressure measurement was used because blood pressure tends to decrease during the course of the visit. If any blood pressure medication could be identified in the patient record, the patient was recorded as receiving blood pressure treatment. If the current treatment included more than 1 medication or the use of combination pills, the patient was determined to be receiving more than 1 blood pressure treatment (a proxy for intensity of treatment). All study data were recorded at both time points for returning patients.

To assess differences in cardiovascular health metrics over time, new patients at each time point were matched based on sex and age using a global optimal algorithm to minimize the overall distance between ages.²² Analyses aimed to compare the change in blood pressure over 2 years between repeat and nonrepeat patients.

All categorical measures were summarized with frequencies and percentages, and all continuous measures were summarized with means and standard deviations. A generalized linear mixed model was applied to examine differences in systolic blood pressure (SBP) and diastolic blood pressure (DBP) as well as changes over time in the proportion of patients receiving blood pressure treatment and more than 1 blood pressure treatment over the 2-year period both within and between groups (repeat and nonrepeat). Receipt of any blood pressure treatment and receiving more than 1 blood pressure treatment were measured as binary outcomes. An indicator for clinic year (2014 or 2016), group assignment (repeat or

Table 1. Summary of Categorical Measures by Group

Categorical Measure	Frequency (%)	
	Returning Patients	New Patients
Sex (female)	36 (82%)	30 (71%)
BP treatment in 2014	25 (57%)	15 (36%)
BP treatment in 2016	25 (57%)	32 (76%)
>1 BP treatment in 2014	15 (34%)	5 (12%)
>1 BP treatment in 2016	17 (39%)	13 (31%)

BP, blood pressure.

nonrepeat), and the interaction between year and group were included as fixed effects. Separate subject-level random effects were fit for each group to account for within-subject dependence because of the use of repeated measures and to account for possibly different variation within each study group.

The power analysis, new patient matching, and generalized linear mixed model were completed using SAS Version 9.4 statistical software (SAS Institute Inc., Cary, NC) with inferences made at the 5% level. Random numbers for the sample were generated by the *sample* function and graphical representations of the data were created using the *ggplot2* package in R statistical software Version 3.3.0 (R Core Team, Vienna, Austria).²³

RESULTS

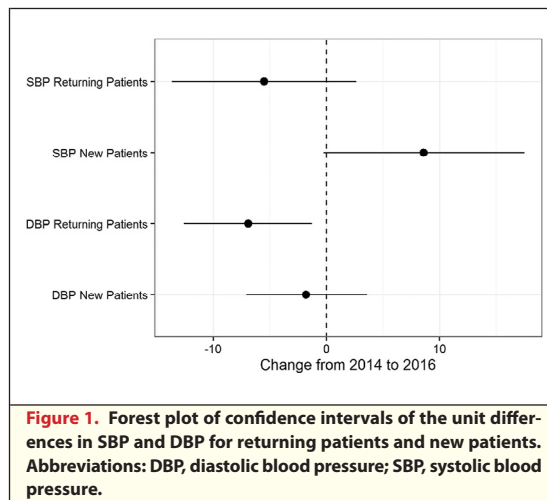
There were 44 total returning patients. On completing new patient matching, a total of 42 matched pairs were identified. The final sample consisted of 86 patients, with 44 observations in the return group and 42 observations in the nonreturn group. Summaries of categorical measures by group can be found in [Table 1](#), and summaries for continuous measures by group can be found in [Table 2](#).

Returning patients had a mean decrease in SBP of 5.5 mm Hg and a 6.9 mm Hg mean decrease in DBP, the latter of which was statistically significant

Table 2. Summary of Continuous Measures by Group

Continuous Measure	Mean (SD)	
	Returning Patients	New Patients
SBP in 2014	134.9 (19.7)	129.6 (19.1)
SBP in 2016	129.4 (18.7)	138.2 (21.8)
DBP in 2014	88.6 (14.4)	83.6 (9.4)
DBP in 2016	81.7 (12.1)	81.8 (14.6)

DBP, diastolic blood pressure; SBP, systolic blood pressure; SD, standard deviation.



($P = .18$ and $P = .02$, respectively). New patients had an increase of 8.6 mm Hg in SBP and a 1.8 mm Hg decrease in DBP on average. Neither of these findings were statistically significant ($P = .06$ and $P = .51$, respectively). Changes in SBP and DBP over time within each group as well as their confidence intervals can be seen in Figure 1. Significant differences in mean SBP change between groups were found ($P = .02$), indicating greater declines in mean SBP among returning patients. No significant differences in mean DBP change were found between groups ($P = .19$).

Equal proportions of patients in the returning group received some form of blood pressure treatment at both time points (57%), whereas significantly more patients in the new group were receiving blood pressure treatment in 2016 than in 2014 (36% vs 76, respectively; $P = .001$). Over time, the proportion of new patients receiving blood pressure treatment increased by 40% whereas there was no change in the proportion of returning patients receiving blood pressure treatment; thus, this change over time was significantly different between the 2 groups ($P = .01$). There was a 5% increase in the proportion of patients in the returning group receiving more than 1 blood pressure treatment (34% in 2014 and 39% in 2016; $P = .66$). The new group had a significant increase of 19% more patients receiving more than 1 blood pressure treatment; 12% of patients received more than 1 treatment in 2014 compared with 31% in 2016 ($P = .04$). Although the sample of new patients experienced a 15% larger increase over time than returning patients in the proportion receiving more than 1 blood pressure treatment, this difference between groups was not significant ($P = .18$).

DISCUSSION

The purpose of this study was to examine the effectiveness of addressing chronic NCDs, specifically hypertension, in the context of a short-term medical trip. DBP decreased significantly among returning patients seen in both 2014 and 2016. In returning patients, there was also a significant trend toward improvement in overall blood pressure control, compared with a slight increase in SBP among new patients. This improved blood pressure control among returning patients is more striking considering that new patients had greater increases in blood pressure treatment intensity but not better blood pressure in the context of limited access to health systems and necessary resources. The role of participants in short-term medical trips may be in facilitating treatment as needed or in helping sustain access to medications that may otherwise be unavailable.

The modest mean reduction in SBP and DBP for returning patients in 2014 and 2016 (5.5 mm Hg and 6.9 mm Hg, respectively) is comparable to those found in accepted hypertension interventions even though only the latter was statistically significant. The DASH (Dietary Approaches to Stop Hypertension) diet, for example, produced a mean DBP reduction of 3.5 mm Hg between the control diet and the high-sodium phase of the DASH diet.²⁴ In a recent study, common antihypertensive medications reduced DBP by 4.5-8.1 mm Hg over 24 hours.²⁵ Such findings support those of the present research, indicating that the DBP reduction among returning patients reported in this study is similar to that found as a result of typical antihypertensive interventions.

In the treatment of hypertension, measurements of blood pressures are an efficient way to address the impact of medications and treatment. However, blood pressure measurements are a disease-oriented (or proxy) measure as opposed to a patient-oriented measurement. Patient-oriented outcomes (death, hospitalization, development of heart failure, stroke, etc.) are more important measures of benefit in treating any chronic illness. Given the limitations of this project, however, and the fact that blood pressure measurements are widely used in assessing the treatment and control of hypertension, using this proxy measure for this study is appropriate. Future research facilitated by the establishment of an electronic health record allowing for better coordination of care and patient follow-up may allow assessment of the impact of hypertension treatment on patient-oriented measures.

The present study results indicated an overall increase in the proportion of patients presenting for treatment during this 2016 short-term medical trip who were undertreated for hypertension or who were taking 2 or more medications for hypertension. This increase was driven by the proportion of patients seen in 2016 only who were receiving treatment for hypertension. A number of factors may have influenced this finding, including a reorganization of the public health system to provide more primary care, increased awareness of the importance of treating hypertension, increased insurance coverage, or other enhanced access to medications. It is also possible that some patients seen only in 2016 were seen during the interval short-term medical trip in 2015 and may have initiated hypertension medications during those encounters. The increased proportion of patients already under treatment for hypertension in 2016 compared with 2014 is probably a combination of many of these aforementioned factors. Further review of interval short-term medical trip records could be used to identify patients seen between 2014 and 2016. Finally, it is possible that, because participants in the short-term medical trip described in this study have begun to focus increasingly on treating NCDs versus acute illness, the patient profile presenting to this site is also shifting to include a higher proportion of patients with NCDs seeking follow-up care and medications. Additional analyses of existing data may aid in examining these factors.

Given the significant morbidity and mortality in developing nations as a result of NCDs and the accompanying long-term cost of medications, short-term medical trips may play a useful role in bridging gaps among patients who might otherwise be unable to adhere to a necessary medication regimen. Short-term medical trips may also play a role in identifying patients who are asymptomatic or unaware of a developing NCD, initiating treatment, and referring patients to the local health care system for additional assessment. Over time, the preferred approach would be for participants in a short-term medical trip to partner with local health care systems to facilitate follow-up for newly diagnosed patients and to ensure communication between the short-term medical trip group and the local clinicians, such that effective NCD treatment can be coordinated. A future goal of short-term medical trips also may be to help develop lay health workers to provide follow-up care for patients (blood pressure checks, etc.) while similarly allowing regular access to medications. Finally, short-term medical trip participants may be able to partner with other in-country medical and nursing

personnel to provide medical care in the community at times when the short-term medical trip group is not present, including clinical reassessments and continued provision of necessary medications.

Although the measured changes in blood pressure for patients seen during these short-term medical trips in 2014 and 2016 are small, they are promising. Future research into the role of short-term medical trips in addressing NCDs is necessary, and use of more accessible data storage systems (databases, electronic health records, etc.) may allow for a more effective and detailed examination of the impact of patients' attendance at short-term medical trip clinics on longitudinal trends in NCD treatment and control.

The costs of short-term medical trips are significant and, although some of these support in-country medical care, many of the resources support the presence of the short-term medical trips' members. As a result, it is necessary to consider the ethical implications of short-term medical trips, especially as they involve assessment and treatment of NCDs. Crump and Sugarman *et al.*²⁶ proposed an ethical framework for training experiences in global health, which apply to the short-term medical trip described here and to any other short-term medical trip that offers training opportunities for students and residents. The final guideline, to collect and analyze data to evaluate the impact of these trips, should be extended to include collection and evaluation of data on the impact of the short-term medical trip on health outcomes both for individuals and at the community level. Classic medical ethical principles include those of autonomy, beneficence, nonmaleficence, and justice.²⁶ Unless short-term medical trip groups are engaged in data collection and assessment, adherence to these ethical principles cannot be readily determined. Short-term medical trip participants should use clinical and community-generated data and feedback to ensure that they are providing assistance without inadvertently causing harm, that patients in the target community have equal and just access to the care provided by short-term medical trip members, and that patients are able to make informed decisions about their health care.

Treatment of chronic conditions is best provided in a setting characterized by continuity of care and appropriate follow-up. Past attempts in this project to connect patients with the local public health system using paper-based personal health records or "pasaportes de salud" (health passports) have not been successful. It is important that short-term medical project groups continue to seek out, develop, and

support models of care that enhance communication and mutual support between these teams and the local health care system.

Limitations. A limitation of the matching algorithm used to match new patients is that the 1-1 matching excluded 2 patient records, resulting in a smaller overall sample size. Despite efforts to exclude ineligible patients before data entry, some records of pregnant women and those without enough information had to be excluded at the point of data entry, requiring a second round of randomization to reach the target sample size.

It is possible that returning patients had better blood pressure outcomes because they were more likely to adhere to medical care, including regular use and refill of medications and more frequent follow-up visits. Our study was not designed to assess that possibility. This study only assessed changes in 1 NCD (hypertension) and was only able to use blood pressure measurements instead of patient-oriented outcomes. It is unclear if the measured changes in BP from 2014 to 2016 are significant enough to anticipate clinical benefits, though these decreases are of the same magnitude of the changes resulting from established hypertension treatments.²⁵ It is also unclear if the improvement in blood pressure control would extend to other improvement in other NCDs such as diabetes mellitus, asthma, or coronary artery disease.

A further limitation of this study is that changes in blood pressure may be attributable to factors outside our short-term medical trip. The Dominican Republic's public health system has been reorganizing over the past years, which may have increased access to hypertension treatment outside of our medical trips. Additionally, changes in public health campaigns may have affected patients' diet and exercise regimens. Despite these efforts, the authors have not noted any significant changes in health care access or public health information in this specific community. The risk of outside confounders is still an important consideration, though one shared by any longitudinal study of the treatment of chronic health conditions. Future research could include more in-depth assessment of health care access as well as patterns of diet and exercise among community members to further determine the relative impact of treatment provided by short-term medical trips. It is also important to consider that patients who were seen as part of this medical outreach project might have been more motivated to access care and might be more likely to initiate and sustain medical treatment compared with

patients only seen once or not seen at all as part of this short-term medical trip.

The study was also limited by the inability to compare patients seen as part of this medical outreach project with patients seen in the local Dominican health system. The senior author (MR) sought comparison medical records at both the nearest public health primary care center and at the cardiology clinic of the local second-level hospital. In both cases, there were no comparison data from 2014. This lack of information made it impossible to compare blood pressures in patients seen by the short-term medical trip group with overall community trends outside this setting.

An additional challenge of this project was the difficulty of data collection and the quality of available data. Given the fast pace of the clinic, the lack of continuity among clinical volunteers, and inconsistent record keeping, documentation of individual patient records is challenging. These challenges are likely faced by many short-term medical trips working in developing nations and they affect the ability to complete longitudinal or retrospective analyses. This limitation could also be viewed as a strength because our data represent a real-world scenario yet still indicate significant results.

CONCLUSIONS

Based on these results, short-term medical trips with a recurrent presence in a community may improve control of hypertension in developing nations. Improvement in hypertension control was statistically significant and appears clinically relevant. Future research should assess the impact of short-term medical trips on hypertension and other chronic NCDs. This research is critical despite the challenges of data collection, storage, and analysis. Given the large number of health professionals and students participating in short-term medical trips combined with the associated costs of short-term medical trip participation, outcomes research focused on health benefits to the partner communities is ethically necessary. Effective communication between short-term medical trips and the communities they serve should include dissemination of the clinical results of these studies as well as feedback from community members. As such, next steps for the Dominican Aid Society of Virginia include communicating the findings from this study to patients receiving care and soliciting feedback from these patients regarding the care they receive from this short-term medical trip group.

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