

AMERICAN THORACIC SOCIETY DOCUMENTS

Research Needs on Respiratory Health in Migrant and Refugee Populations

An Official American Thoracic Society and European Respiratory Society Workshop Report

Jesse Roman*, Giovanni Viegi*, Marc Schenker, Victoria D. Ojeda, Eliseo J. Pérez-Stable, Benoit Nemery, Isabella Annesi-Maesano, Sanjay R. Patel, Stefania La Grutta, Fernando Holguin, Anas Moughrabieh, Christian Bime, Anne Lindberg, Giovanni B. Migliori, Gerard de Vries, Julio Ramírez, Stefano Aliberti, Charles Feldman, and Juan C. Celedón; on behalf of the American Thoracic Society and the European Respiratory Society

THIS WORKSHOP REPORT OF THE AMERICAN THORACIC SOCIETY (ATS) AND THE EUROPEAN RESPIRATORY SOCIETY (ERS) WAS APPROVED BY THE ATS OCTOBER 2018 AND THE ERS JUNE 2018

Abstract

Migrants represent a diverse population comprising workers, students, undocumented individuals, and refugees. Worldwide, approximately 1 billion people were considered migrants in 2016. Notably, about 65 million of these migrants were forcibly displaced from their homes, and 20 million were considered refugees. While the geopolitical consequences of such migration continue to be considered, less is known about the impact of these events on the respiratory health of migrants and refugees. In recognition of this knowledge gap, the American Thoracic Society and the European Respiratory Society brought together investigators with diverse and relevant expertise to participate in a workshop and develop a consensus on research needs on the respiratory health of migrants and refugees. The workshop focused on environmental and occupational hazards, chronic noninfectious diseases, and

respiratory infectious diseases, which were presented by experts in three distinct sessions, each culminating with panel discussions. A writing committee collected summaries prepared by speakers and other participants, and the information was collated into a single document. Recommendations were formulated, and differences were resolved by discussion and consensus. The group identified important areas of research need, while emphasizing that reducing the burden of pulmonary, critical care, and sleep disorders in migrants and refugees will require a concerted effort by all stakeholders. Using best research practices, considering how research impacts policies affecting migrant and refugee populations, and developing new approaches to engage and fund trainees, clinical investigators, and public health practitioners to conduct high-quality research on respiratory health of migrants and refugees is essential.

Keywords: research needs; respiratory health; migrants; refugees

*Co-first authors.

ORCID ID: 0000-0002-6139-5320 (J.C.C.).

You may print one copy of this document at no charge. However, if you require more than one copy, you must place a reprint order. Domestic reprint orders: amy.schrivner@sheridan.com; international reprint orders: louisa.mott@springer.com.

Correspondence and requests for reprints should be addressed to Juan C. Celedón, M.D., Dr.P.H., Division of Pulmonary Medicine, Allergy and Immunology, Children's Hospital of Pittsburgh of UPMC, 4401 Penn Avenue, Pittsburgh, PA 15224. E-mail: juan.celedon@chp.edu.

This article has an online supplement, which is accessible from this issue's table of contents at www.atsjournals.org.

Ann Am Thorac Soc Vol 15, No 11, pp 1247–1255, Nov 2018

Copyright © 2018 by the American Thoracic Society

DOI: 10.1513/AnnalsATS.201807-478ST

Internet address: www.atsjournals.org

Contents

Introduction

Workshop Agenda

Environmental and Occupational Exposures

Chronic (Noninfectious) Diseases Respiratory Infectious Diseases

Conclusions and Future Directions

Introduction

In 2016, approximately 1 billion people (more than 14% of the world's population) were migrants: 250 million international migrants and 763 million internal migrants. Notably, about 65 million migrants worldwide were forcibly displaced from

their homes; of these, 20 million people were considered refugees (1). Thus, migrants represent a diverse population comprising workers, students, undocumented individuals, and refugees.

Migration is fueled by seeking better opportunities in wealthier countries or escaping conflict, persecution, or natural

disasters (2). The numbers of migrants, and countries affected by migration, are increasing. In 2008, approximately 31 million international migrants (or ~6% of the population) lived in the 27 states of the European Union (EU), and more than one-half of those migrants originated from Central and Eastern Europe. Since 2010, there has been substantial migration into the EU from the Middle East and Africa; more than 120,000 people arrived in the EU by sea in 2016. On the other side of the Atlantic Ocean, the United States is home to 47 million international migrants, with Mexicans accounting for approximately 28% of foreign-born people. An estimated 40% of transnational migration is between countries in the southern hemisphere.

Whereas considerable attention is given to the geopolitical consequences of migration, less is known about its impact on migrants' health or the health care systems of their host nations. Migrants to the United States or the EU, particularly those fleeing their countries because of poverty or conflict, are affected by medical conditions or behaviors that are common among residents of their host nation (e.g., tobacco use and asthma), which are influenced by their previous or current living circumstances, including infection (e.g., tuberculosis [TB]), sleep-related disorders, and post-traumatic stress disorder (PTSD). Moreover, migrants often have limited access to health care in their host country because of lack of health insurance, language and cultural barriers, challenges in the identification of undocumented or recent migrants, and limited policies or resources to address their medical needs (1). Such problems are accentuated when a host country has to care for large waves of refugees over a short period of time, as was the case when more than 400,000 Syrians sought asylum in Germany in 2015 (3).

In recognition of the need for improved understanding of the effects of migration on respiratory health, the American Thoracic Society (ATS) and the European Respiratory Society (ERS) brought together investigators with diverse expertise to develop a consensus on research needs related to respiratory health in migrants and refugees, with emphasis on international migration. To facilitate such consensus, the ATS and the ERS held a workshop focused on the topic during the ATS meeting in May 2017 in Washington, D.C., with a follow-up meeting during the ERS meeting in September 2017 in Milan (Italy).

Workshop Agenda

The workshop participants (*see* the online supplement) were chosen on the basis of their research expertise and interests, and were vetted for conflicts of interest according to the policies of the ATS and ERS. While recognizing that some migrants are healthy and may be at lower risk for respiratory diseases (the "healthy migrant" effect), the workshop largely addressed the detrimental effects of migration on respiratory health. The workshop thus focused on environmental and occupational hazards, chronic noninfectious diseases, and respiratory infectious diseases, which were discussed in three distinct sessions; each session concluded with panel discussions. Literature searches were conducted by group members, using traditional and biomedical search engines. Each of the three session leaders collected summaries from speakers and prepared document sections for review by the writing committee established among the co-chairs of the working groups. This committee collated the information into a single document. Recommendations were formulated and differences were resolved by discussion and consensus (*see* Table 1).

Environmental and Occupational Exposures

Environmental and occupational exposures are major risk factors for the development and progression of respiratory disorders. Of these, workshop participants focused on climate change, air pollution, tobacco use, and occupational hazards.

Climate change. Global warming and related climate changes affect respiratory health directly through temperature, humidity, and extreme climate events (such as storms, floods, wildfires, and droughts), or indirectly by increasing air pollution, pollens, and molds, and by changing the habitat, thus promoting vectors for transmission of infectious diseases (4). Climate change may particularly impact migrants and refugees, due to coexisting exposure to environmental hazards (5) or inadequate access to health care (6). Forced displacement of people is associated with acute respiratory infections and tuberculosis (5), and migration from rural to urban areas has been linked to allergic diseases such as asthma (7). Over the coming decades, the number of people escaping

the consequences of climate change (desertification, famine, flooding, extreme weather, and natural disasters) will likely increase. Thus, research on this public health threat is needed (7).

Air pollution. Air pollution is a ubiquitous risk factor for morbidity and mortality from respiratory diseases (8). Global estimates of the population-attributable fractions of disability-adjusted life-years (DALYs) due to total occupational risks, and indoor and ambient air pollutants, are as follows: asthma, 44%; chronic obstructive pulmonary disease (COPD), 35%; lung cancer, 17–45%; and acute lower respiratory infections, 35% (9, 10). More than 4,241,000 deaths and 103 billion DALYs are attributed to ambient air pollution worldwide (11). In 2014, approximately 83% of Europeans lived in areas above the World Health Organization (WHO) Air Quality Guidelines for PM_{2.5}, and PM_{2.5} exposure was estimated to cause up to 428,000 premature deaths in 41 European countries (12). Moreover, people who migrate to industrialized nations such as the United States are more likely to be exposed to traffic-related air pollution than nonmigrants (13). Little is known about outdoor or indoor pollutants and respiratory health in migrants and refugees. In a Palestinian refugee camp, the prevalence and incidence of respiratory conditions (such as influenza, asthma, and bronchitis) were associated with poor housing conditions characterized by dampness and mold, dust and smoke, burning of biomass fuel, and crowding (14).

Tobacco use. Tobacco use is the main cause of preventable death worldwide. Immigrants to the United States from Latin America and Asia generally smoke at lower rates than white and black adults in the United States, but this phenomenon varies by sex, acculturation, and national origin.

Immigrant men tend to smoke at higher rates than women: in 2015, only 7% of Latinas and less than 3% of Asian women reported current smoking (15). However, acculturation was significantly associated with 1.12 to 1.57 increased odds of smoking among Latinas in two nationwide studies. Among Latinos and Asians of both sexes, acculturation is associated with unchanged or lower smoking rates, but tobacco use differs by national origin. Puerto Ricans or Cubans and Vietnamese or Koreans smoke at higher rates than other Latinos or Asians, respectively (16, 17). In the Hispanic

Table 1. Key recommendations for research on respiratory health in migrants and refugees

Research Need	Recommendations	Examples	References
Understanding the consequences of indoor environmental exposures, air pollution, and climate change	Epidemiological studies of the indoor environment, air pollution, climate change, and respiratory diseases in migrant and refugee populations	Transnational longitudinal studies of traffic-related air pollution and airway diseases (i.e., across the U.S.–Mexico border)	Annesi-Maesano <i>et al.</i> , 2016 (4) D’Amato <i>et al.</i> , 2015 (7) Thurston <i>et al.</i> , 2017 (8) Cohen <i>et al.</i> , 2017 (11)
Assessing the joint impact of acculturation, sex, country of origin, and socioeconomic status on tobacco use	<ul style="list-style-type: none"> • Determine both social and economic status (at the individual, family, and community levels) using validated instruments, while also examining sex, country of origin, and acculturation • Capture basic measures of acculturation in all studies of migrant populations, and use comprehensive measures of acculturation for in-depth studies 	<ul style="list-style-type: none"> • Use of the MacArthur sociodemographic questionnaire, which captures data on resources, prestige, and perceived social status within the community • Always include place of birth, place of origin, self-reported race/ethnicity, and duration of residence and fluency in the predominant language in the adoptive country • Bidimensional Acculturation Scale for Hispanics (BAS), Acculturation, Habits, and Interests Multicultural Scale (AHIMSA) 	Adler and Stewart (71) Marin and Gamba, 1996 (72) Unger <i>et al.</i> , 2002 (73)
Studying effective smoking cessation interventions	Clinical trials of smoking cessation	Studies of pharmacological and nonpharmacological interventions	Kaplan <i>et al.</i> , 2014 (16)
Assessing how to ameliorate working conditions for disease and injury prevention and health maintenance in migrant workers	Develop longitudinal studies of occupational disease in migrants	Studies of the impact of industrial hygiene on occupation respiratory diseases	Rabito <i>et al.</i> , 2011 (74)
Examining the impact of governmental regulations (or deregulations) on the environment, tobacco use, and occupational safety on respiratory health	Long-term studies following changes in key government regulations	Studies of the impact of changes in thresholds for air pollutants	European Environment Agency, 2017 (12)
Understanding how urban and rural migration impact the development of asthma	Long-term longitudinal studies of migration and asthma in children and adults	Prospective studies of migration from rural to urban areas and asthma	Holguin <i>et al.</i> , 2005 (29) Parsons <i>et al.</i> , 2017 (75)
Gaining knowledge about nonsmoking risk factors for COPD	Longitudinal studies of migrants and refugees exposed to biomass smoke in their home countries	Prospective studies of prior biomass smoke exposure and COPD	Regalado <i>et al.</i> , 2006 (76) Díaz <i>et al.</i> , 2018 (35)
Alleviating the impact of forced migration on sleep quality	Design and implement behavioral interventions to prevent and treat sleep disorders	Clinical trials of cognitive behavioral treatments for insomnia	Fazel <i>et al.</i> , 2005 (38)
Understanding the relation between unauthorized border crossings (UBCs) on critical illness at the U.S.–Mexico border	Conduct longitudinal studies of UBCs and critical illnesses along the U.S.–Mexico border	Expansion of studies conducted by the Binational Migration Institute of the University of Arizona Mexican American Studies and Research Center	Rubio-Goldsmith <i>et al.</i> , 2006 (42) Wong <i>et al.</i> , 2015 (43)
Evaluating the impact of telemedicine-based approaches on critical care in areas affected by conflict or war	Develop and test telemedicine-based strategies to provide critical care to displaced persons in war zones	Telemedicine guiding critical care in Aleppo, Syria	Holguin <i>et al.</i> , 2017 (1)
Gaining knowledge of the scope and impact of screening and treating communicable diseases across countries	Design and implement large multinational databases capturing screening and treatment of respiratory infectious diseases in migrants and refugees	<ul style="list-style-type: none"> • European survey stimulating European cross-border collaboration • E-DETECT project 	Dara <i>et al.</i> , 2016 (47) European Union Health Programme, 2016 (54)
Developing, evaluating, and standardizing best practices to improve surveillance, timely screening, stigma prevention, access to treatment, and adequate infection control regarding TB	<ul style="list-style-type: none"> • Identify culturally appropriate strategies, which consider the needs and interests of the target populations • Longitudinal studies comparing efficacy and cost-effectiveness of various approaches to screening and treatment of TB 	<ul style="list-style-type: none"> • European survey stimulating European cross-border collaboration • E-DETECT project 	Dara <i>et al.</i> , 2016 (47) European Union Health Programme, 2016 (54)

(Continued)

Table 1. (Continued)

Research Need	Recommendations	Examples	References
Assessing the impact of HIV/AIDS, and investigating the development and implementation of practices designed to diagnose and treat HIV/AIDS	<ul style="list-style-type: none"> • Epidemiological studies of HIV/AIDS in migrants and refugees • Clinical trials of pharmacological and nonpharmacological interventions to prevent and treat HIV/AIDS in migrants and refugees 	Clinical trials of antiretroviral medications among HIV-infected refugees	Spiegel, 2004 (56) Mendelsohn <i>et al.</i> , 2014 (58)
Evaluating the burden of nontuberculous mycobacterial infections and related disorders	Epidemiological studies of non-TB mycobacterial infections in migrants and refugees	Prospective studies of non-TB mycobacterial infections in migrant populations being screened for TB	Griffith and Aksamit, 2016 (64)
Assessing the impact of social media approaches and multimedia marketing campaigns to help in the prevention, diagnosis, and treatment of infectious and noninfectious respiratory diseases in migrants and refugees	Use social media in campaigns for TB screening	Study of social media as part of a multimarketing campaign for HIV testing in young Latino migrant men who have sex with men	Solorio <i>et al.</i> , 2016 (77)

Definition of abbreviations: AHIMSA = Acculturation, Habits, and Interests Multicultural Scale; BAS = Bidimensional Acculturation Scale for Hispanics; COPD = chronic obstructive pulmonary disease; HIV/AIDS = human immunodeficiency virus infection and acquired immune deficiency syndrome; TB = tuberculosis; UBCs = understanding the relation between unauthorized border crossings.

Community Health Study/Study of Latinos, in which approximately 85% of participants were migrants, current smoking was highest in Puerto Ricans (men, 35.0%; women, 32.6%) and Cubans, and lowest in Dominicans, with intermediate estimates for Mexican Americans (men, 23.4%; women, 10.4%) (16).

Other migrant groups to the United States bring tobacco use behaviors from their native countries. Middle Eastern and North African immigrants often use both water pipes and combustible tobacco, predominantly in men. For example, among adults in a mid-Western U.S. city, current use of both cigarettes and water pipes was 2.3 times higher in foreign-born Arab Americans than in whites (7.9% vs. 3.5%) (18).

Cigarette smoking is often managed as a nicotine addiction, but nearly one-half of immigrants who smoke report fewer than five cigarettes per day or nondaily use (16). There are no clinical trials of pharmacological treatment of very light or nondaily smokers, and few behavioral interventions have been adapted.

Occupational hazards. During the twentieth century and early in the twenty-first century, Western European countries received impoverished workers from Central and Southern Europe, Turkey, the Middle East, and Africa. In 2008, nearly 31 million foreign citizens (or ~6% of the population) lived in the 27 states of the EU (19). Although nonuniform registration of migrants from different

countries is a barrier to understanding migrants' health in Europe (20), such migrants are often employed in jobs that are below their educational level and carry high risk of injury or disease, such as domestic work and cleaning; agriculture, horticulture, and forestry; hotel work, catering, and tourism; building and infrastructure; and transport.

Like their counterparts in Europe, immigrant workers in the United States are overrepresented in hazardous industries: agriculture, construction, and transportation. Moreover, immigrant workers have higher occupational fatality and injury rates than native workers (21). Although the overall occupational fatality rate in the United States has declined over the past two decades, the proportion of occupational fatalities among immigrant workers has markedly increased, likely due to lack of safety training and equipment, linguistic barriers, and precarious employment. This situation is even worse for undocumented immigrants, who risk losing work or deportation.

Data from specific industries illustrate the occupational risks of immigrants in the United States (22). In this country, approximately 60% of agricultural workers are immigrants who are at risk for noninfectious diseases (asthma, COPD, hypersensitivity pneumonitis, and interstitial fibrosis) and infectious respiratory illnesses (e.g., tuberculosis, which is more easily transmitted in

crowded housing or work conditions). Moreover, immigrant women employed in household cleaning are at increased risk of asthma.

Research needs in migrants and refugees.

- Examining the consequences of indoor and outdoor air pollutants, as well as climate change, through epidemiological surveys
- Understanding the interactions among age, sex, race/ethnicity, acculturation, country of origin, and socioeconomic status on use of tobacco and nontobacco (e.g., e-cigarette) products
- Implementing studies of effective smoking cessation interventions
- Assessing how to ameliorate working conditions for disease/injury prevention and health maintenance
- Engaging in longitudinal studies to elucidate the threats to the respiratory health of newly deported migrants over time
- Examining the impact of governmental regulations (or deregulations) on the environment, tobacco use, and occupational safety on respiratory health

Chronic (Noninfectious) Diseases

Noninfectious respiratory disorders that are common in the general population also affect migrants and refugees. Asthma, COPD, sleep disorders, and critical care illnesses are of particular interest because of their high prevalence.

Asthma. Childhood asthma is more common in high-income nations than in

low–middle-income countries. After migrating to industrialized nations, however, children born in developing countries acquire a greater risk of asthma over time, likely due to environmental and lifestyle changes (i.e., reduced physical activity and a “Westernized” diet) (23, 24). For example, migrant children living in Italy for less than 5 years had 41% lower odds of lifetime asthma than native children (95% confidence interval for odds ratio, 0.23–0.66), but those living in Italy for at least 5 years had an asthma risk close to that of native children (25). Similar results were found in Australian adolescents (26) and in Swedish children or young adults (27). This migration-related asthma risk may be greatest for those migrating before age 5 years, as early life is critical to immune system development (28). Moreover, individuals born to migrant parents in high-income countries are at greater risk of asthma than their foreign-born parents: Mexican Americans born in the United States have twice the odds of asthma as those born in Mexico (29).

Adult migrants may not be as likely to develop asthma as migrating children, except for occupational asthma. In a 2001 study of adults living in 18 countries in the EU, there was no significant difference in bronchodilator responsiveness, atopy, or health care use for asthma between migrants and nonmigrants (30). In the United States, adult migrants are often employed as farm workers, which puts them at risk of chronic airflow obstruction and chronic bronchitis (31).

Little is known about respiratory diseases in refugee children. In a Palestinian study, children in refugee camps were at higher risk of asthma or asthma symptoms than those from neighboring villages or cities. Among refugee children, current wheeze (12.6%) and physician-diagnosed asthma (15.6%) were particularly common (32). Similar findings were obtained in a study of migrants crossing the Mediterranean Sea into Italy, in which young children (≤ 5 yr) and unaccompanied minors were particularly vulnerable to respiratory illnesses such as asthma and respiratory infections (33). Additional studies are needed to identify the relative contribution of risk factors for asthma among migrants and refugees.

COPD. Nearly 29 million people may have COPD in the United States (34). Latinos, whose ancestry can be traced to the

former Spanish empire, are the largest minority group in the United States, constituting 17.6% of the nation’s population (35). Latino migrants are diverse for racial ancestry, country of origin, birthplace, and area of residence.

Consistent with patterns for asthma prevalence (36) and smoking, there are marked differences in disease prevalence among Latino subgroups, with COPD more likely in Puerto Ricans and Cubans than in Mexicans; such differences may be partly explained by the asthma-COPD overlap syndrome in Puerto Ricans. In the United States, foreign-born Latino immigrants often lack health insurance ($\sim 55\%$), English proficiency, or high education, which affect health care access and quality (35).

Sleep disorders. Adequate sleep is vital to good health (37). Refugees commonly experience stress during and after relocation, along with traumas inducing them to migrate. Poor sleep after traumatic or stressful events is an independent risk factor for PTSD, impacting nearly 10% of refugees (a rate 10-fold higher than in the general population). PTSD itself further worsens sleep by causing insomnia and nightmares (the most refractory symptoms of this disorder) (38, 39). Inadequate resources have been invested in delivering effective behavioral treatments in languages spoken by refugees.

Immigrants in general also face stressors that adversely impact sleep, including discrimination, adverse neighborhoods, and high rates of shift work, underemployment, and unemployment. Nevertheless, immigrants often have better sleep than native-born residents of Western nations, perhaps due to lack of unhealthy sleep habits such as tobacco or caffeine use and screen time, or a belief system that values sleep. However, second-generation immigrants usually have worse sleep patterns than first-generation immigrants, possibly due to acculturation (40, 41).

Critical illness. Little is known about critical illness after unauthorized crossings along the U.S.–Mexico border. The Binational Migration Institute of the University of Arizona’s Mexican American Studies and Research Center comprehensively reports annual unauthorized border crosser (UBC) deaths (42). Although these reports have linked a “funnel effect” created by U.S. immigration control policies and a marked increment

in known UBC deaths, such deaths are a poor surrogate for a spectrum of critical illness. A retrospective case review conducted at the University of Arizona School of Medicine–Tucson from 2010 to 2012 identified 55 admissions of UBCs to adult intensive care units, with one fatality (43). Several critical illnesses were identified, related mostly to exposure to a hot and dry environment, strenuous exercise, or dehydration.

The conflict in Syria has led to a humanitarian crisis and negative effects on health care (3), including critical care (44). In response to this crisis, some groups have used innovative methods to overcome lack of physicians and critical care expertise in a war-torn country (1, 44). In October 2012, Syrian-American physicians volunteered to train Syrian nurses on basic critical care skills in Turkey, and two nurses were initially chosen to start a remotely managed intensive care unit (ICU) in the governance of Idlib (1). Within 6 months, the program expanded to cover the ICU of every trauma hospital in eastern Aleppo, serving initially 2.5 million civilians with 11 to 15 remotely monitored ICU beds. Approximately 20 Arabic-speaking intensivists and other specialists from North America have volunteered to provide remote supervision and training to the nurses and medical students in the field. With their help, the program expanded to serve up to 40 ICU beds, using inexpensive communications technology (e.g., Internet protocol [IP] cameras and satellite Internet, and applications such as Skype and WhatsApp). The applicability and sustainability of this promising telemedicine model to other conflict zones have yet to be tested.

Research needs in migrants and refugees.

- Engaging in longitudinal studies of the impact of urban and international migration or displacement on the development of asthma
- Implementing studies of nonsmoking risk factors for COPD (e.g., prior exposure to biomass- and traffic-related air pollution)
- Developing clinical trials of behavioral interventions to ameliorate sleep disorders
- Promoting longitudinal studies of the impact of unauthorized border crossings on critical illnesses along the U.S.–Mexico border

- Assessing the feasibility and effectiveness of telemedicine-based models to provide critical care in war or conflict zones

Respiratory Infectious Diseases

Respiratory infections that commonly affect migrants and refugees include tuberculosis, opportunistic respiratory infections associated with HIV infection, and infection with nontuberculous mycobacteria.

Tuberculosis. Communicable infectious diseases deserve attention when addressing migrant respiratory health; TB is perhaps the best studied, as it is most prevalent in low- and middle-income countries. TB incidence is increased by poverty, displacement, communal living, and malnutrition, circumstances commonly confronted by migrants and refugees. To address the worldwide impact of TB, the WHO developed a comprehensive strategy of TB control (the DOTS [directly observed treatment, short course] strategy) in 1995, focused on rapid diagnosis and treatment of infectious cases (45). Such approach then evolved toward the 2006 Stop TB strategy (including management of multidrug-resistant disease and TB in HIV-infected individuals), and the 2014 End TB strategy, which consists of three pillars: 1) technical interventions (prevention, diagnosis, and treatment), 2) policies and supporting systems (e.g., universal health coverage, social protection, and poverty alleviation), and 3) research activities (46). The End TB strategy, aligned with sustainable development goals, includes the concept of TB elimination (defined as <1 case per million population), which needs to be pursued by countries of low tuberculosis incidence (<10 cases per 100,000 population) through implementing eight core activities (44); of these, activity 3 focuses on the needs of migrants and transborder issues, while activity 4 deals with the diagnosis and treatment of latent infection (47).

An ERS/WHO survey in Europe, besides presenting important country-specific differences, revealed that much less programmatic information is available for latent infection than for TB disease (48). A 2016 statement called for proper implementation of the End TB strategy, improved surveillance, timely screening, stigma prevention, universal access, and adequate infection control (49). Research evaluating best practices to accomplish the above goals throughout the affected regions,

and the cost-effectiveness of such interventions, is needed while south–north and east–west migration movements continue.

Efforts to screen and treat TB in migrants and refugees are of the utmost importance. In 2015, TB notification in the EU and European Economic Area (EU/EEA) countries was 11.7 per 100,000 population (range, 2.1–76.5), with an average of 29.8% of cases in persons of foreign origin (range, 0.2–89.5%) (50). In countries with a high proportion of TB cases in migrants, screening for active TB and/or latent TB infection (LTBI) is key to TB elimination (51–53). However, the actual implementation of TB/LTBI screening of migrants differs substantially in the EU/EEA (53). Published studies on the yield of migrant screening are so heterogeneous that no valid conclusions can be drawn on the most effective approach. Moreover, few EU/EEA countries have health information systems that can capture results of migrant TB/LTBI screening and evaluate the screening systematically. This has led to the identification of several research needs and initiatives, of which one is the E-DETECT TB project, cofinanced by the European Commission, which aims to use country screening data and develop a standardized protocol to collect indicators, share data, and build better systems at the national and international levels, with a long-term goal to initiate future routine reporting into a European database (54).

Limited information and standardization are also available regarding the screening and management of TB/LTBI among U.S. migrants, which depends on personnel and other resources. Refugees resettled in the state of Kentucky, for example, arrived from more than 30 different countries. The overall rate of LTBI among migrants and refugees resettling in Kentucky is 9% versus 5% among native-born U.S. citizens (55). Of the 581 refugees arriving between January 2013 and December 2014, 45 were eligible for treatment of LTBI, but only 12 (27%) completed treatment. Primary reasons for nonadherence to treatment included language barriers, work schedule conflicts, the perception that treatment was unnecessary, and difficulties in accessing medication. Key interventions implemented included 1) stakeholder meetings with representation from the

Kentucky Office for Refugees, the local health department, and academic leaders; 2) opening of a clinic focusing on treatment of LTBI; and 3) use of global health navigators as key personnel in centering care around the needs of the individual refugee. However, the impact of those interventions remains unclear.

HIV infection. Another important infectious disease in migrants and refugees is HIV/acquired immune-deficiency syndrome (AIDS). Although it is commonly believed that mobility, conflict, and displacement are associated with HIV transmission, the evidence that this translates into more infections is not uniformly supported by published data (56). Risk factors for HIV infection in migrants and refugees include breakdowns in social structures, sexual violence and abuse, and inadequate access to health care (56). However, what is often not assessed are protective factors against HIV transmission, such as decreased mobility, and even improved circumstances in some of the refugee camps regarding health, education, and social conditions. Important also are the HIV prevalence rates in the affected and in the surrounding host communities, as well as their interaction (56). The Office of the United Nations High Commissioner for Refugees, together with its various partners such as the United Nations Program on HIV/AIDS, has published guidelines regarding the rights of refugees and best practices to provide HIV-related services to both refugees and the surrounding host country populations (57). Refugees and internally displaced persons can achieve high adherence to antiretroviral therapy with associated viral suppression (58).

HIV infection in deportees is an emerging area of interest. Since 2007, more than 319,000 migrants, predominantly Mexican, have been deported annually from the United States (59). Such statistics have motivated research on the socioeconomic and health implications of deportation, especially as families are separated and communities on both sides of the U.S.–Mexico border become destabilized. Migrants' forced displacement may result in the loss of social and economic resources (i.e., jobs), which may adversely affect the deportees' health (59–62). Studies conducted in a border metropolis (Tijuana, Mexico) have shown

that deportees are at high risk for HIV infection (63).

Nontuberculous mycobacteria.

Pulmonary disease due to nontuberculous mycobacteria (NTM) is another increasingly prevalent condition (64). Although our understanding of this disease has improved, published evidence on its impact in migrants and refugees is minimal and largely restricted to case reports (65–67). Insufficient research on NTM in migrants may be explained by heterogeneous data on NTM-pulmonary disease (PD) epidemiology, in light of the geographic diversity of the NTM species (68); the fact that NTM-PD remains a not-reportable disease in most countries; and lack of concern for human-to-human transmission of NTM-PD, with conflicting evidence for possible transmission of *Mycobacterium abscessus* among patients with cystic fibrosis (69, 70).

Research needs in migrants and refugees.

- Designing Health Insurance Portability and Accountability Act (HIPAA)–compliant and shareable national and international database systems to report the screening and treatment of communicable infectious diseases
- Developing, evaluating, and standardizing best practices to improve surveillance, timely screening, stigma prevention, access to treatment, and adequate infection control regarding tuberculosis, as well as the cost-effectiveness of these interventions
- Assessing the impact of HIV/AIDS, and investigating the development and implementation of practices designed to diagnose and treat HIV/AIDS
- Developing epidemiological studies of NTM-related pulmonary diseases and related infectious disorders

Conclusions and Future Directions

Reducing the burden of pulmonary, critical care, and sleep disorders in migrants

and refugees will require a concerted effort by all stakeholders, including involvement of nongovernmental (e.g., the Gates Foundation) and governmental organizations, as well as consideration of successful approaches to nonrespiratory diseases in migrants. Moreover, developing, expanding, and maintaining easy-to-access interactive maps describing migration patterns (e.g., <http://metrocosm.com/global-immigration-map>) could help prioritize areas of greatest need.

Using best research practices, considering how research impacts policies affecting migrant and refugee populations, and developing new approaches to engage and fund trainees, clinical investigators, and public health practitioners to conduct high-quality research on the respiratory health of migrants and refugees is essential. The participants at this ATS/ERS workshop created a forum to discuss these issues and proposed key recommendations. Addressing these recommendations, together with continued and expanded advocacy by the ATS and the ERS, should help develop sound public policies and improve the respiratory health of migrants and refugees, ultimately reducing the global burden of respiratory diseases. ■

This Workshop Report was prepared by an *ad hoc* subcommittee of the American Thoracic Society and the European Respiratory Society.

Members of the subcommittee are as follows:

JUAN C. CELEDÓN, M.D., DR.P.H. (*Chair*)¹
GIOVANNI VIEGI, M.D. (*Co-Chair*)²
JESSE ROMAN, M.D. (*Co-Chair*)³
STEFANO ALIBERTI, M.D.⁴
ISABELLA ANNESI-MAESANO, M.D., Ph.D., Sc.D.⁵
CHRISTIAN BIME, M.D., M.Sc.⁶
GERARD DE VRIES, M.D., Ph.D.⁷
CHARLES FELDMAN, M.D., Ph.D., D.Sc.⁸
FERNANDO HOLGUIN, M.D., M.P.H.⁹
STEFANIA LA GRUTTA, M.D., Ph.D.²
ANNE LINDBERG, M.D., Ph.D.¹⁰
GIOVANNI B. MIGLIORI, M.D.¹¹
ANAS MOUGHRABIEH, M.D., M.P.H.¹²
BENOIT NEMERY, M.D.¹³
VICTORIA D. OJEDA, Ph.D.¹⁴
SANJAY R. PATEL, M.D.¹

ELISEO J. PÉREZ-STABLE, M.D.¹⁵
JULIO RAMÍREZ, M.D.³
MARC SCHENKER, M.D., M.P.H.¹⁶

¹University of Pittsburgh, Pittsburgh, PA; ²National Research Council, IBIM-Palermo and IFC-Pisa, Italy; ³University of Louisville Health Sciences Center, Louisville, KY; ⁴Department of Pathophysiology and Transplantation, University of Milan; Internal Medicine Department, Respiratory Unit and Cystic Fibrosis Adult Center, Fondazione IRCCS Ca' Granda Ospedale Maggiore Policlinico, University of Milan, Milan, Italy; ⁵French Institute of Health and Medical Research (INSERM) and Sorbonne Université, Paris, France; ⁶University of Arizona, Tucson, AZ; ⁷KNCV Tuberculosis Foundation, The Hague, Netherlands; ⁸University of Witwatersrand, Johannesburg, South Africa; ⁹University of Colorado, Denver, CO; ¹⁰University of Umeå, Umeå, Sweden; ¹¹World Health Organization Collaborating Centre for TB and Lung Diseases, Maugeri Care and Research Institute, Tradate, Italy; ¹²Wayne State University, Detroit, MI; ¹³University of Leuven, Leuven, Belgium; ¹⁴University of California at San Diego, San Diego, CA; ¹⁵Office of the Director, National Institute on Minority Health and Health Disparities, Bethesda, MD; ¹⁶University of California at Davis, Davis, CA.

Author Disclosures: J. Roman received research support from Boehringer Ingelheim, Gilead, Fibrogen, and Promedior; served as a consultant for Boehringer Ingelheim. S.R.P. received research support from Bayer, Philips Respironics, and ResMed Foundation; served on a data and safety monitoring board for Philips Respironics; served as a consultant for Medtronic. J. Ramirez served on an advisory committee for Achaogen, Nabriva, Paratek, Pfizer, and The Medicines Company; served as a speaker for Amgen and The Medicines Company; served as a consultant for Curetis and Pfizer; received research support from Pfizer. S.A. received research support from Aradigm, Bayer, Chisei, Grifols, and Insmad; received personal fees (unspecified) from Actavis UK, Aradigm, AstraZeneca, Basilea, Bayer, Chiesi, Grifols, Horizon, Insmad, Novartis, Raptor, and Zambon. C.F. served on an advisory committee for Abbott and AstraZeneca; served as a speaker for Aspen, GlaxoSmithKline, and Sanofi; served on an advisory committee and as a speaker for Pfizer and Pharma Dynamics. J.C.C. received research support from GlaxoSmithKline, Merck, and Pharmavite. G.V., M.S., V.D.O., E.J.P.-S., B.N., I.A.-M., S.L.G., F.H., A.M., C.B., A.L., G.B.M., and G.D.V. reported no relationships with relevant commercial interests.

References

- Holguin F, Moughrabieh MA, Ojeda V, Patel SR, Peyrani P, Pinedo M, *et al.* Respiratory health in migrant populations: a crisis overlooked. *Ann Am Thorac Soc* 2017;14:153–159.
- World Health Organization. Refugee and migrant health 2017 [accessed 2018 Feb 5]. Available from: <http://www.who.int/migrants/en>.
- Nicolai T, Fuchs O, von Mutius E. Caring for the wave of refugees in Munich. *N Engl J Med* 2015;373:1593–1595.

- 4 Annesi-Maesano I. United Nations Climate Change Conferences: COP21 a lost opportunity for asthma and allergies and preparing for COP22. *J Allergy Clin Immunol* 2016;138:57–58.
- 5 McMichael C, Barnett J, McMichael AJ. An ill wind? Climate change, migration, and health. *Environ Health Perspect* 2012;120:646–654.
- 6 Carballo M. Climate change, migration and health. *World Hosp Health Serv* 2008;44:47–48.
- 7 D'Amato G, Holgate ST, Pawankar R, Ledford DK, Cecchi L, Al-Ahmad M, et al. Meteorological conditions, climate change, new emerging factors, and asthma and related allergic disorders: a statement of the World Allergy Organization. *World Allergy Organ J* 2015;8:25.
- 8 Thurston GD, Kipen H, Annesi-Maesano I, Balmes J, Brook RD, Cromar K, et al. A joint ERS/ATS policy statement: what constitutes an adverse health effect of air pollution? An analytical framework. *Eur Respir J* 2017;49:1600419.
- 9 World Health Organization. Ambient air pollution: a global assessment of exposure and burden disease [accessed 2018 Jan 15]. Geneva, Switzerland: World Health Organization; 2016. Available from: <http://apps.who.int/iris/bitstream/handle/10665/250141/9789241511353-eng.pdf?sequence=1>.
- 10 World Health Organization. Preventing disease through healthy environments: a global assessment of the burden of disease from environmental risks [accessed 2018 Feb 10]. Geneva, Switzerland: World Health Organization; 2016. Available from: http://apps.who.int/iris/bitstream/handle/10665/204585/9789241565196_eng.pdf?sequence=1.
- 11 Cohen AJ, Brauer M, Burnett R, Anderson HR, Frostad J, Estep K, et al. Estimates and 25-year trends of the global burden of disease attributable to ambient air pollution: an analysis of data from the Global Burden of Diseases Study 2015. *Lancet* 2017;389:1907–1918.
- 12 European Environment Agency. Air quality in Europe—2017 report. Copenhagen, Denmark: European Environment Agency; 2017 [accessed 2018 Mar 26]. Available from: <https://www.eea.europa.eu/publications/air-quality-in-europe-2017>.
- 13 Frieden TR; Centers for Disease Control and Prevention (CDC). CDC health disparities and inequalities report—United States, 2013 [foreword]. *MMWR Suppl* 2013;62:1–2.
- 14 Al-Khatib I, Ju'ba A, Kamal N, Hamed N, Hmeidan N, Massad S. Impact of housing conditions on the health of the people at al-Ama'ri refugee camp in the West Bank of Palestine. *Int J Environ Health Res* 2003;13:315–326.
- 15 Jamal A, King BA, Neff LJ, Whitmill J, Babb SD, Graffunder CM. Current cigarette smoking among adults—United States, 2005–2015. *MMWR Morb Mortal Wkly Rep* 2016;65:1205–1211.
- 16 Kaplan RC, Bangdiwala SI, Barnhart JM, Castañeda SF, Gellman MD, Lee DJ, et al. Smoking among U.S. Hispanic/Latino adults: the Hispanic Community Health Study/Study of Latinos. *Am J Prev Med* 2014;46:496–506.
- 17 Tong EK, Nguyen TT, Vittinghoff E, Pérez-Stable EJ. Smoking behaviors among immigrant Asian Americans: rules for smoke-free homes. *Am J Prev Med* 2008;35:64–67.
- 18 Jamil H, Templin T, Fakhouri M, Rice VH, Khouri R, Fakhouri H. Comparison of personal characteristics, tobacco use, and health states in Chaldean, Arab American, and non-Middle Eastern white adults. *J Immigr Minor Health* 2009;11:310–317. [Published erratum appears in *J Immigr Minor Health* 11:318.]
- 19 European Commission. Eurostat: your key to European statistics: Eurostat database [accessed 2018 Mar 1]. Available from: <http://ec.europa.eu/eurostat>.
- 20 Rehel BMP, Devillé W, Rijks W, Petrova-Benedict R, McKee M. Migration and health in the European Union. New York: McGraw Hill Open University Press; 2011.
- 21 Schenker M. Work-related injuries among immigrants: a growing global health disparity. *Occup Environ Med* 2008;65:717–718.
- 22 Schenker MB. A global perspective of migration and occupational health. *Am J Ind Med* 2010;53:329–337.
- 23 Gold DR, Adamkiewicz G, Arshad SH, Celedón JC, Chapman MD, Chew GL, et al. NIAID, NIEHS, NHLBI, and MCAN Workshop Report: the indoor environment and childhood asthma—implications for home environmental intervention in asthma prevention and management. *J Allergy Clin Immunol* 2017;140:933–949.
- 24 Gold DR, Wright R. Population disparities in asthma. *Annu Rev Public Health* 2005;26:89–113.
- 25 Migliore E, Pearce N, Bugiani M, Galletti G, Biggeri A, Bisanti L, et al.; SIDRIA-2 Collaborative Group. Prevalence of respiratory symptoms in migrant children to Italy: the results of SIDRIA-2 study. *Allergy* 2007;62:293–300.
- 26 Gibson PG, Henry RL, Shah S, Powell H, Wang H. Migration to a Western country increases asthma symptoms but not eosinophilic airway inflammation. *Pediatr Pulmonol* 2003;36:209–215.
- 27 Bråbäck L, Vogt H, Hjerm A. Migration and asthma medication in international adoptees and immigrant families in Sweden. *Clin Exp Allergy* 2011;41:1108–1115.
- 28 Barr RG, Avilés-Santa L, Davis SM, Aldrich TK, Gonzalez F II, Henderson AG, et al. Pulmonary disease and age at immigration among Hispanics: results from the Hispanic Community Health Study/Study of Latinos. *Am J Respir Crit Care Med* 2016;193:386–395.
- 29 Holguin F, Mannino DM, Antó J, Mott J, Ford ES, Teague WG, et al. Country of birth as a risk factor for asthma among Mexican Americans. *Am J Respir Crit Care Med* 2005;171:103–108.
- 30 Tobias A, Soriano JB, Chinn S, Anto JM, Sunyer J, Burney P; European Community Respiratory Health Survey. Symptoms of asthma, bronchial responsiveness and atopy in immigrants and emigrants in Europe. *Eur Respir J* 2001;18:459–465.
- 31 Garcia JG, Matheny Dresser KS, Zerr AD. Respiratory health of Hispanic migrant farm workers in Indiana. *Am J Ind Med* 1996;29:23–32.
- 32 El-Sharif N, Abdeen Z, Qasrawi R, Moens G, Nemery B. Asthma prevalence in children living in villages, cities and refugee camps in Palestine. *Eur Respir J* 2002;19:1026–1034.
- 33 Trovato A, Reid A, Takarinda KC, Montaldo C, Decroo T, Owiti P, et al. Dangerous crossing: demographic and clinical features of rescued sea migrants seen in 2014 at an outpatient clinic at Augusta Harbor, Italy. *Confl Health* 2016;10:14.
- 34 Ford ES, Croft JB, Mannino DM, Wheaton AG, Zhang X, Giles WH. COPD surveillance—United States, 1999–2011. *Chest* 2013;144:284–305.
- 35 Díaz AA, Celli B, Celedón JC. Chronic obstructive pulmonary disease in Hispanics: a 9-year update. *Am J Respir Crit Care Med* 2018;197:15–21.
- 36 Rosser FJ, Forno E, Cooper PJ, Celedón JC. Asthma in Hispanics: an 8-year update. *Am J Respir Crit Care Med* 2014;189:1316–1327.
- 37 Mukherjee S, Patel SR, Kales SN, Ayas NT, Strohl KP, Gozal D, et al.; American Thoracic Society Ad Hoc Committee on Healthy Sleep. American Thoracic Society Ad Hoc Committee on Healthy Sleep. An Official American Thoracic Society Statement: the importance of healthy sleep: recommendations and future priorities. *Am J Respir Crit Care Med* 2015;191:1450–1458.
- 38 Fazel M, Wheeler J, Danesh J. Prevalence of serious mental disorder in 7000 refugees resettled in Western countries: a systematic review. *Lancet* 2005;365:1309–1314.
- 39 Germain A, Buysse DJ, Nofzinger E. Sleep-specific mechanisms underlying posttraumatic stress disorder: integrative review and neurobiological hypotheses. *Sleep Med Rev* 2008;12:185–195.
- 40 Patel SR, Sotres-Alvarez D, Castañeda SF, Dudley KA, Gallo LC, Hernandez R, et al. Social and health correlates of sleep duration in a US Hispanic population: results from the Hispanic Community Health Study/Study of Latinos. *Sleep (Basel)* 2015;38:1515–1522.
- 41 Seicean S, Neuhauser D, Strohl K, Redline S. An exploration of differences in sleep characteristics between Mexico-born US immigrants and other Americans to address the Hispanic Paradox. *Sleep (Basel)* 2011;34:1021–1031.
- 42 Rubio-Goldsmith R, McCormick M, Martinez D, Duarte I. The “funnel effect” and recovered bodies of unauthorized migrants processed by the Pima County Office of the Medical Examiner, 1990–2005. Tucson, AZ: Binational Migration Institute, University of Arizona; 2006. Available from: <https://bmi.arizona.edu/sites/default/files/publication-files/The%20Funnel%20Effect%20and%20Recovered%20Bodies.pdf>.

- 43 Wong C, Hsu W, Carr GE. Spectrum of critical illness in undocumented border crossers: the Arizona–Mexico border experience. *Ann Am Thorac Soc* 2015;12:410–414.
- 44 Sahloul MZ, Monla-Hassan J, Sankari A, Kherallah M, Atassi B, Badr S, et al. War is the enemy of health: pulmonary, critical care, and sleep medicine in war-torn Syria. *Ann Am Thorac Soc* 2016;13:147–155.
- 45 Sotgiu G, Spanevello A, Migliori GB. History of tuberculosis and drug resistance. *N Engl J Med* 2013;368:88–89.
- 46 Lönnroth K, Migliori GB, Abubakar I, D’Ambrosio L, de Vries G, Diel R, et al. Towards tuberculosis elimination: an action framework for low-incidence countries. *Eur Respir J* 2015;45:928–952.
- 47 Dara M, Solovic I, Sotgiu G, D’Ambrosio L, Centis R, Goletti D, et al. Call for urgent actions to ensure access to early diagnosis and care of tuberculosis among refugees: Statement of the European Respiratory Society and the European Region of the International Union against Tuberculosis and Lung Disease. *Eur Respir J* 2016;47:1345–1347.
- 48 Dara M, Solovic I, Sotgiu G, D’Ambrosio L, Centis R, Tran R, et al. Tuberculosis care among refugees arriving in Europe: an ERS/WHO Europe region survey of current practices. *Eur Respir J* 2016;48:808–817.
- 49 European Centre for Disease Prevention and Control. Tuberculosis surveillance and monitoring in Europe 2016 [accessed 2017 Dec 20]. Available from: <https://ecdc.europa.eu/en/publications-data/tuberculosis-surveillance-and-monitoring-europe-2016>.
- 50 Ködmön C, Zucs P, van der Werf MJ. Migration-related tuberculosis: epidemiology and characteristics of tuberculosis cases originating outside the European Union and European Economic Area, 2007–2013. 2016 [accessed 2017 Dec 5]. Available from: <http://www.eurosurveillance.org/ViewArticle.aspx?ArticleId=21418>.
- 51 World Health Organization. Systematic screening for active tuberculosis: principles and recommendations. 2013 [accessed 2017 Dec 5]. Available from: <http://www.who.int/tb/screening/en>.
- 52 World Health Organization. Guidelines on the management of latent tuberculosis infection. 2014 [accessed 2017 Dec 5]. Available from: http://www.who.int/tb/publications/tbi_document_page/en.
- 53 Kunst H, Burman M, Arnesen TM, Fiebig L, Hergens MP, Kalkouni O, et al. Tuberculosis and latent tuberculosis infection screening of migrants in Europe: comparative analysis of policies, surveillance systems and results. *Int J Tuberc Lung Dis* 2017;21:840–851.
- 54 European Union Health Programme. E-DETECT TB: a research consortium for the early detection and integrated management of tuberculosis in Europe 2016 [accessed 2017 Dec 5]. Available from: <https://e-detecttb.eu>.
- 55 Carrico RM, Goss L, Wiemken TL, Bosson RS, Peyrani P, Mattingly WA, et al. Infection prevention and control and the refugee population: experiences from the University of Louisville Global Health Center. *Am J Infect Control* 2017;45:673–676.
- 56 Spiegel PB. HIV/AIDS among conflict-affected and displaced populations: dispelling myths and taking action. *Disasters* 2004;28:322–339.
- 57 UN Refugee Agency (UNHCR). Refugees, HIV and AIDS: UNHCR’s strategic plan 2005–2007: fighting HIV and AIDS together with refugees [accessed 2018 Jan 17]. Available from: http://data.unaids.org/pub/report/2005/unhcr_strategic_plan2005_2007.pdf.
- 58 Mendelsohn JB, Spiegel P, Schilperoord M, Cornier N, Ross DA. Antiretroviral therapy for refugees and internally displaced persons: a call for equity. *PLoS Med* 2014;11:e1001643.
- 59 Gonzalez-Barrera A, Lopez MH. U.S. immigrant deportations fall to lowest level since 2007. Washington, DC: Pew Research Center; 2016.
- 60 Pinedo M, Burgos JL, Ojeda VD. A critical review of social and structural conditions that influence HIV risk among Mexican deportees. *Microbes Infect* 2014;16:379–390.
- 61 Robertson AM, Lozada R, Pollini RA, Rangel G, Ojeda VD. Correlates and contexts of US injection drug initiation among undocumented Mexican migrant men who were deported from the United States. *AIDS Behav* 2012;16:1670–1680.
- 62 Ojeda VD, Robertson AM, Hiller SP, Lozada R, Cornelius W, Palinkas LA, et al. A qualitative view of drug use behaviors of Mexican male injection drug users deported from the United States. *J Urban Health* 2011;88:104–117.
- 63 Pinedo M, Burgos JL, Robertson AM, Vera A, Lozada R, Ojeda VD. Perceived risk of HIV infection among deported male injection drug users in Tijuana, Mexico. *Glob Public Health* 2014;9:436–454.
- 64 Griffith DE, Aksamit TR. Understanding nontuberculous mycobacterial lung disease: it’s been a long time coming. *F1000 Res* 2016;5:2797.
- 65 Kelly PM, Scott L, Krause VL. Tuberculosis in East Timorese refugees: implications for health care needs in East Timor. *Int J Tuberc Lung Dis* 2002;6:980–987.
- 66 Varghese B, Shajan SE, Al MO, Al-Hajoj SA. First case report of chronic pulmonary lung disease caused by *Mycobacterium abscessus* in two immunocompetent patients in Saudi Arabia. *Ann Saudi Med* 2012;32:312–314.
- 67 Gerogianni I, Papala M, Kostikas K, Petinaki E, Gourgoulis K. Epidemiology and clinical significance of mycobacterial respiratory infections in central Greece. *Int J Tuberc Lung Dis* 2008;12:807–812.
- 68 Hoefsloot W, van Ingen J, Andrejak C, Angeby K, Bauriaud R, Bemer P, et al.; Nontuberculous Mycobacteria Network European Trials Group. The geographic diversity of nontuberculous mycobacteria isolated from pulmonary samples: an NTM-NET collaborative study. *Eur Respir J* 2013;42:1604–1613.
- 69 Bryant JM, Grogono DM, Greaves D, Foweraker J, Roddick I, Inns T, et al. Whole-genome sequencing to identify transmission of *Mycobacterium abscessus* between patients with cystic fibrosis: a retrospective cohort study. *Lancet* 2013;381:1551–1560.
- 70 Tortoli E, Kohli TA, Trovato A, Baldan R, Campana S, Cariani L, et al. *Mycobacterium abscessus* in patients with cystic fibrosis: low impact of inter-human transmission in Italy. *Eur Respir J* 2017;50:1602525.
- 71 Adler N, Stewart J; Psychosocial Working Group; John D. and Catherine T. MacArthur Foundation. Research Network on SES & Health: the MacArthur Scale of Subjective Social Status. San Francisco, CA: University of California at San Francisco; 2007. Available from: <https://maces.ucsf.edu/research/psychosocial/subjective.php>.
- 72 Marín G, Gamba R. A new measurement of acculturation for Hispanics: the Bidimensional Acculturation Scale for Hispanics (BAS). *Hispanic J Behav Sci* 1996;18:297–316.
- 73 Unger JB, Gallaher P, Shakib S, Ritt-Olson A, Palmer PH, Anderson Johnson C. The AHIMSA Acculturation Scale: a new measure of acculturation for adolescents in a multicultural society. *J Early Adolesc* 2002;22:225–251.
- 74 Rabito FA, Perry S, Salinas O, Hembling J, Schmidt N, Parsons PJ, et al. A longitudinal assessment of occupation, respiratory symptoms, and blood lead levels among Latino day laborers in a non-agricultural setting. *Am J Ind Med* 2011;54:366–374.
- 75 Parsons MA, Beach J, Senthilvelan A. Association of living in a farming environment with asthma incidence in Canadian children. *J Asthma* 2017;54:239–249.
- 76 Regalado J, Pérez-Padilla R, Sansores R, Páramo Ramírez JI, Brauer M, Paré P, et al. The effect of biomass burning on respiratory symptoms and lung function in rural Mexican women. *Am J Respir Crit Care Med* 2006;174:901–905.
- 77 Solorio R, Norton-Shelpuk P, Forehand M, Montaña D, Stern J, Aguirre J, et al. *Tu Amigo Pepe*: evaluation of a multi-media marketing campaign that targets young Latino immigrant MSM with HIV testing messages. *AIDS Behav* 2016;20:1973–1988.