Perspective on HIV in this country as well as a better understanding of the health status, length of time in the United States makes persons born outside the United States different epidemiologic characteristics. Among persons born outside the United States, 14.5% (n=3656) were from Africa, 41.0% (n=10 343) were from Central America (including Mexico), and 21.5% (n=5418) were from the Caribbean. The 4 states (California, Florida, New York, and Texas) reporting the highest numbers of persons born outside the United States and diagnosed with HIV were also the top 4 reporters of HIV cases overall. Among persons born outside the United States with HIV, 73.5% (n=22 773) were male. Among whites, 1841 of 55 574 (3.3%) of HIV diagnoses were in Hispanics, 17 913 of 42 431 diagnoses (42.2%); and in Asians, 1987 of 3088 diagnoses (64.3%). The percentage infected through heterosexual contact was 39.4% among persons born outside the United States vs 27.2% for US-born persons.

Conclusions Among persons in 46 US states and 5 US territories who received a diagnosis of HIV from 2007 through 2010, 16.2% were born outside the United States. Of the 25,255 persons with a specified country or region of birth outside the United States, 14.5% (n=3656) were from Africa, 41.0% (n=10 343) were from Central America (including Mexico), and 21.5% (n=5418) were from the Caribbean. The 4 states (California, Florida, New York, and Texas) reporting the highest numbers of persons born outside the United States and diagnosed with HIV were also the top 4 reporters of HIV cases overall. Among persons born outside the United States with HIV, 73.5% (n=22 773) were male. Among whites, 1841 of 55 574 (3.3%) of HIV diagnoses were in Hispanics, 17 913 of 42 431 diagnoses (42.2%); and in Asians, 1987 of 3088 diagnoses (64.3%). The percentage infected through heterosexual contact was 39.4% among persons born outside the United States vs 27.2% for US-born persons.
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US-born counterparts because of self-selection (ie, healthier people are able to migrate), which may ameliorate some of the above-mentioned factors affecting health. The objective of this study was to describe the epidemiology of HIV infection among persons born outside the United States.

**METHODS**

This analysis describes the demographic, geographic, and risk factor characteristics of persons born outside the United States who received a diagnosis of HIV while living in the United States and its territories between 2007 and 2010. Data were reported to the US Centers for Disease Control and Prevention (CDC) through June 2011 for people in whom HIV infection was diagnosed from 2007 through 2010, regardless of stage of disease at diagnosis.

Through the National HIV Surveillance System, the CDC collects data in collaboration with state and local partners. Laboratories, physicians, hospitals, and other health care providers report persons diagnosed with HIV infection to local and state health departments, which transmit data to the CDC without names or other personally identifying information.

The CDC requires the following variables to be included on the case report form to be counted as an HIV case: alphanumeric (soundex) code of the patient’s name; state-assigned patient identifier number (stateno); HIV and AIDS diagnosis information, including test type and date or dates of diagnosis; vital status, and (if relevant) date of death; date of birth; race/ethnicity; and sex. The completeness of data collection for these variables was 100%.

Risk factor information is not required to create a case, and completeness of that variable was 72%; multiple imputation was conducted for that variable. The imputed total number of cases born outside the United States was 30,995; however, we could not impute for world region within the persons born outside the United States because that would involve small numbers, so the denominator for world region remained 25,255. Of the 25,255 HIV cases born outside the United States, 24,704 (97.8%) had a specific country or region of origin assigned; the remaining 2.2% were identified as born outside the United States without a specific country or region of origin.

As mandated by state, local, or US laws or regulations, all data were collected as part of routine HIV surveillance and ethical review or approval for this study was waived. Information is collected on demographic and clinical characteristics, including country of birth and HIV risk factors. Country of birth was determined by health department personnel conducting active surveillance and accessing medical records. If the country of birth was not identified or was not clear when reviewing medical records of persons being treated for HIV infection, health department personnel would ask the clinician for more information.

Data on race/ethnicity were identified by health department personnel conducting active surveillance and reviewing medical records. Race/ethnicity is also sometimes obtained during regular record linkage with sexually transmitted disease surveillance, tuberculosis surveillance, and other related programs.

Information on immigration status, date of entry to the United States, or country where HIV infection was transmitted is not collected. An HIV diagnosis is based on the report of a positive confirmatory HIV test; if a person infected with HIV arrives in the United States with laboratory documentation of HIV infection and provides those results to his or her physician, then the date of the original test is used as the diagnosis date. However, if the person only has a verbal report of diagnosis, then the date of the HIV testing performed in the United States is the HIV diagnosis date.

For this study, we used data from 46 US states and 5 US territories (Puerto Rico, the US Virgin Islands, Guam, Commonwealth of the Northern Mariana Islands, and American Samoa) that have been reporting HIV diagnoses to the CDC for a minimum of 4 years, which is a period sufficient to calculate reporting delays to estimate trends reliably. We did not have data from Hawaii, Massachusetts, Maryland, and Vermont. Results were adjusted for reporting delays and missing risk factor information. More information on the methods used is available on the CDC website.

Human immunodeficiency virus was categorized into 2 types, HIV-1 and HIV-2. A recent analysis of HIV-2 infections in the United States found that HIV-2 is rare (166 cases from 1987-2009, constituting 0.01% of >1.4 million US cases of HIV infection diagnosed during that period), concentrated in the Northeast, and limited mainly to persons born in West Africa.

**Statistical Methods**

The number and percentage distributions of HIV diagnoses from 2007 to 2010 for persons born outside the United States were examined by selected demographic and HIV-transmission risk factors and country of birth. Because the system is population-based, US Census data were used as the denominator. For geographic analyses, world regions as defined by the US Census were used (Africa, Asia, Europe, the Middle East, North America, Central America, South America, the Caribbean, and Oceania).

Using multiple imputation, records missing information on country of birth (n = 35,806; 18.7%) were reassigned as either born in the United States or outside the United States and were included in the analysis presented in Table 1. Multiple imputation is based on the assumption that information is missing at random, but it does not require data to be missing completely at random (ie, not depending on any variable). If missing only depends on variables that are available in the data, and they are included in the imputation model, then the missing-at-random assumption is satisfied. The variables included in our data and used for imputation of missing
Persons Born Outside the United States

these methods are reported.21
estimated data. Detailed information on
ation, it is more appropriate to use the
that have not yet been reported to the
adjusted case counts because they take
ction of the burden of disease than un-
are considered a more accurate reflec-
 adjusted case counts because they take
for delays in reporting (of
diagnoses and deaths) and for missing
adjustments do not account for incom-
mer data have been controlled for with
above variables, any potential bias
should be small because the assump-
tion becomes more plausible as more
variables are included in the imputa-
tion model. We estimated the vari-
ces of the proportion estimates
based on binomial distribution. We
then used the standard statistical pro-
cedure for multiple imputation18 to
combine the binomial variances with
the variation from multiple imputation
to calculate the 95% confidence
intervals.

Adjusted (estimated) data were cal-
culated by applying statistical adjust-
ments to the unadjusted data to ac-
count for delays in reporting (of
diagnoses and deaths) and for missing
risk factor information. The statistical
adjustments do not account for incom-
plete reporting. These methods are de-
scribed in detail in the HIV Surveil-
ance Report.20 Estimated case counts
are considered a more accurate reflec-
tion of the burden of disease than un-
adjusted case counts because they take
into consideration diagnoses or deaths
that have not yet been reported to the
CDC. Therefore, for planning, re-
source allocation, and program evalua-
tion, it is more appropriate to use the
estimated data. Detailed information on
these methods are reported.21

The significance threshold was a P
value of less than .05 and testing was
2-sided. The $\chi^2$ test was used for the
comparisons of US-born persons and
those born outside the United States.
Data were analyzed using SAS soft-
ware version 9.2 (SAS Institute Inc).

RESULTS

From 2007 through 2010 in 46 US
states and 5 US territories, a total of
191 697 persons received a diagnosis of
HIV and were reported to the CDC. Of
these, 30 995 (16.2%; 95% CI, 16.0%-16.3%) were born outside the United
States; during this same period, a total of
4 332 984 legal immigrants entered

<table>
<thead>
<tr>
<th>Table 1. Estimated Diagnoses of Human Immunodeficiency Virus (HIV) Infection by Selected Characteristics of US-Born Persons and Persons Born Outside the United States for 46 US States and 5 US Territories, 2007-2010</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>US-Born Persons</strong></td>
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<tr>
<td><strong>Characteristics</strong></td>
</tr>
<tr>
<td>Sex</td>
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<td>Age at diagnosis, y</td>
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<tr>
<td>Female</td>
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<td></td>
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<tr>
<td>Diagnosis of AIDS after diagnosis of HIV infection</td>
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<td></td>
</tr>
</tbody>
</table>

Abstractions: IDU, injection drug use; MSM, male-to-male sexual contact.

*Estimated numbers resulted from statistical adjustment that accounted for reporting delays and missing risk factor infor-
mation, but not for incomplete reporting.

**Estimated numbers resulted from statistical adjustment that accounted for missing country of birth, reporting delays, and
missing risk factor information, but not for incomplete reporting. The variances of the proportion estimates were calcu-
lated based on binomial distribution and then the standard statistical procedure for multiple imputation was used to
combine the binomial variances with the variation from multiple imputation to calculate the 95% CIs.

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Table 2. Estimated Diagnoses of Human Immunodeficiency Virus (HIV) Infection Among Persons Born Outside the United States by World Region of Birth, Transmission Category, and Sex for 46 US States and 5 US Territories, 2007-2010

<table>
<thead>
<tr>
<th>Transmission Category</th>
<th>Africa (n = 3656)</th>
<th>Asia (n = 1995)</th>
<th>Europe (n = 995)</th>
<th>Middle East (n = 208)</th>
<th>North America (n = 126)</th>
<th>Central America (n = 10,343)</th>
<th>South America (n = 1929)</th>
<th>Caribbean (n = 5418)</th>
<th>Oceania (n = 69)</th>
<th>Missing or Unknown (n = 551)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heterosexual contact</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>801 (21.9)</td>
<td>199 (10.0)</td>
<td>80 (8.3)</td>
<td>18 (8.6)</td>
<td>9 (7.4)</td>
<td>1300 (12.6)</td>
<td>201 (10.4)</td>
<td>1374 (25.4)</td>
<td>5 (7.9)</td>
<td>107 (19.3)</td>
</tr>
<tr>
<td>Female</td>
<td>1895 (51.8)</td>
<td>379 (19.0)</td>
<td>134 (14.0)</td>
<td>21 (9.9)</td>
<td>13 (10.2)</td>
<td>1560 (15.1)</td>
<td>276 (14.3)</td>
<td>1853 (34.2)</td>
<td>10 (14.0)</td>
<td>167 (30.4)</td>
</tr>
<tr>
<td>IDU</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>90 (2.4)</td>
<td>65 (3.3)</td>
<td>49 (5.1)</td>
<td>14 (6.5)</td>
<td>0 (0.3)</td>
<td>503 (4.9)</td>
<td>50 (2.6)</td>
<td>221 (4.1)</td>
<td>1 (0.2)</td>
<td>30 (5.4)</td>
</tr>
<tr>
<td>Female</td>
<td>82 (2.2)</td>
<td>20 (1.0)</td>
<td>19 (2.0)</td>
<td>2 (0.9)</td>
<td>6 (4.9)</td>
<td>94 (0.9)</td>
<td>23 (1.2)</td>
<td>101 (1.9)</td>
<td>1 (2.0)</td>
<td>15 (2.5)</td>
</tr>
<tr>
<td>MSM and IDU</td>
<td>31 (0.8)</td>
<td>41 (2.1)</td>
<td>33 (3.5)</td>
<td>4 (1.9)</td>
<td>5 (3.6)</td>
<td>282 (2.7)</td>
<td>32 (1.6)</td>
<td>51 (0.9)</td>
<td>3 (4.7)</td>
<td>12 (2.1)</td>
</tr>
<tr>
<td>Pediatric or perinatal</td>
<td>183 (5.0)</td>
<td>14 (0.7)</td>
<td>14 (1.5)</td>
<td>NA</td>
<td>NA</td>
<td>13 (0.1)</td>
<td>2 (0.1)</td>
<td>21 (0.4)</td>
<td>NA</td>
<td>3 (0.6)</td>
</tr>
<tr>
<td>Unknown or other</td>
<td>4 (0.1)</td>
<td>10 (0.5)</td>
<td>4 (0.4)</td>
<td>1 (0.3)</td>
<td>0 (0.1)</td>
<td>18 (0.2)</td>
<td>2 (0.1)</td>
<td>8 (0.1)</td>
<td>2 (2.3)</td>
<td>1 (0.2)</td>
</tr>
</tbody>
</table>

Abbreviations: IDU, injection drug use; MSM, male-to-male sexual contact; NA, not applicable.

Overall, 39.4% of HIV diagnoses in persons born outside the United States (men and women combined) were attributed to heterosexual contact; for US-born persons, 27.2% was due to heterosexual contact. Among males born outside the United States, the majority (70.5%) of HIV diagnoses were in men who have male-to-male sexual contact; for US-born men, 75.1% were in men who have male-to-male sexual contact. For women born outside the United States, 5.8% of HIV diagnoses were due to injection drug use. For women born in the United States, 17.7% of HIV diagnoses were due to injection drug use.

Country of Origin

In descending order by total number of HIV diagnoses, the 10 countries of birth with the highest numbers were from Mexico (n = 7 311), Haiti (n = 2140), Cuba (n = 988), El Salvador (n = 908), Dominican Republic (n = 898), Guatemala (n = 895), Honduras (n = 841), Jamaica (n = 841), Ethiopia (n = 584), and Colombia (n = 509). A total of 186 countries were represented in the data.

During this same period, the number of legal permanent residents entering the United States from these countries (in descending order) as reported by the Department of Homeland Security was 642 669 from Mexico, 103 274 from Haiti, 151 131 from Cuba, 79 501 from El Salvador, 163 187 from the Dominican Republic, 56 744 from Guatemala, 27 038 from Honduras, 79 460 from Jamaica, 55 431 from Ethiopia, and 113 655 from Colombia.

The National HIV Surveillance System collects information on all persons diagnosed with HIV in the United States but does not collect data on immigration status. The Department of Homeland Security only reports on people who obtained legal permanent resident status. Rates should be calculated with great caution, particularly for countries with undocumented migrant populations in the United States.

Risk Factors

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World Region

Among persons diagnosed with HIV who were born outside the United States, the most common world region of birth origin was Central America (including Mexico; n = 10 343 [41.0%]), followed by the Caribbean (n = 5418; 21.5%), Africa (n = 3656; 14.5%), Asia (n = 1995; 7.9%), and South America (n = 1929; 7.6%) (TABLE 2). Among all persons diagnosed with HIV who were born outside the United States, 30.4% (n = 2078) of women were from Africa compared with 8.6% (n = 1578) of men.

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The US Census organizes the world region of origin (40 million persons in 2010) into the following categories: Africa (3.9%), Asia (27.7%), Europe (12.7%), Latin America (53.1%), and other (North America and Oceania; 2.7%). Using these same categories, among persons born outside the United States who were diagnosed with HIV while living in the United States from 2007-2010, 14.5% were from Africa, 7.9% from Asia, 3.8% from Europe, 70.0% from Latin America, and 0.8% from other (North America and Oceania).

There were differences in transmission category by region of origin: the predominant mode of exposure for persons with a diagnosis of HIV born in Africa and the Caribbean was heterosexual contact, while the predominant mode of exposure for persons born in other world regions was male-to-male sexual contact. Although 13.9% of adults and adolescents from outside the United States and diagnosed with HIV in the United States from 2007-2010 were born in Africa, 183 of 250 (73.2%) of all perinatal or pediatric HIV cases born outside the United States were from Africa.

The US regional variations in world region of origin for persons diagnosed with HIV are presented in more detail in the eTable at http://www.jama.com. Of persons born outside the United States, those born in Africa ranged from 9.7% (737 of 7620) of HIV cases living in the West to 36.7% (770 of 2098) of HIV cases living in the Midwest. The percentage of HIV diagnoses in persons born in Central America ranged from 19.4% (1238 of 6385) of cases living in the Northeast to 65.8% (5014 of 7620) of cases living in the Midwest. The percentage of HIV diagnoses in persons born in Asia ranged from 4.2% (374 of 8870) of HIV cases living in the South to 12.4% (944 of 7620) of HIV cases living in the West.

**COMMENT**

Persons born outside the United States and diagnosed with HIV while living in the United States had different demographic and risk factor profiles compared with US-born persons. Compared with persons born in the 46 US and 5 territories diagnosed with HIV, persons born outside the United States diagnosed with HIV were more likely to be Hispanic or Asian, and they more often acquired HIV through heterosexual transmission.

The US population of persons born outside the United States consists of multiple groups with different demographic characteristics, community networks, resources, and patterns of risk behaviors. Persons born in Africa, for example, had a higher proportion of women and children diagnosed with HIV than people born in other regions. In Africa and the Caribbean, the largest proportion of HIV transmissions are through heterosexual sex, and this pattern was seen in our analysis, in which heterosexual contact accounted for 73.7% of HIV diagnoses in persons from Africa and 59.6% of people from the Caribbean. In Western Europe, Central America, South America, North America, Asia, the Middle East, and Oceania, sex between men (male-to-male sexual contact) is the main HIV transmission route, and it was also the main mode of transmission for people born in these regions diagnosed with HIV in the United States (Table 2).

Asians were the only racial group in which HIV diagnoses in persons born outside the United States (n=1987) outnumbered those in the US-born population (n=1101). Limited data exist regarding HIV testing levels and risk behaviors in Asian Americans compared with other racial/ethnic groups. The top 5 Asian countries for HIV diagnosis in persons born outside the United States were the Philippines (n=449), India (n=287), Vietnam (n=256), Thailand (n=190), and China (n=137).

Variations existed in the size and composition of populations born outside the United States at the state and regional levels, and local patterns of infection may be different from the national average. In states with relatively large African-born populations, sub-Saharan Africans make up a disproportionately large number of HIV diagnoses in blacks. In 1 multistate study, African-born persons accounted for a wide range of percentages of the HIV-diagnosed black population, varying from 2.5% in Georgia to 49.8% in Minnesota.

Date of first entry into the United States is not collected on the HIV case report form, so it is not possible to know whether HIV infection preceded or followed immigration. Structural factors inherent in immigration, such as loss of stable social and sexual networks, may contribute to behavioral changes associated with increased risk of HIV infection. A study of HIV prevalence at Los Angeles County, California, health centers found that persons born outside the United States who tested positive for HIV had a mean age of 32.7 years, and that 60% of patients were primarily Hispanic and it may not be possible to generalize the results. A small-scale study of persons born in Central America and diagnosed with HIV in Texas found that approximately half may have acquired HIV in their home countries, and half in the United States. These findings suggest that much acquisition of HIV may have occurred after migration, but the small size and regional focus limit the applicability of the research. However, it is known that immigrants travel back to their home countries (sometimes for extended lengths of time) so infection with HIV could have occurred in a person’s birth country even after he or she migrated to the United States.

Depending on their region of origin and their manner of entry into the United States, immigrants face differing challenges. Two groups of immigrants who encounter special risks related to HIV are refugees and undocumented immigrants. Displaced persons in the process of getting to refugee camps or persons living in the...
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camps themselves are at higher risk of being raped. Recent estimates at 4.1 million, may
determined that 32% of HIV-positive refugees had posttraumatic stress disorder and that 35% named torture, including rape, as their HIV exposure. Other studies have found an association between premigration trauma and HIV risk behaviors as well as trauma and poor adherence to medication regimens.

Undocumented immigrants face additional potential risk factors beyond those experienced by documented immigrants. Traveling as an undocumented immigrant to the United States is dangerous, and women are vulnerable to sexual assault during this period because perpetrators know that women are unlikely to report these crimes to the authorities. Health care providers should be aware that undocumented female migrants, a population recently estimated at 4.1 million, may have been sexually assaulted during their journey to the United States and may be reluctant to disclose this risk.

Another vulnerable group is pregnant women born outside the United States. One study found that pregnant women born outside the United States attending prenatal clinics had a refusal rate for HIV screening of 9.7% compared with 5.2% for US-born pregnant women; the most frequently given reason for refusal was lack of a perception of risk. However, because spouses are sometimes separated for years before being reunited in the host country, these women may be facing HIV infection risks of which they are unaware.

The HIV immigration exclusion, which prevented persons who had been diagnosed with HIV from entering the country, was first instituted in 1987; the exclusion was lifted in January 2010. This change in policy may alter patterns of immigration and thus the future epidemiology of persons diagnosed with HIV who were born outside the United States. The 2010 HIV surveillance data set shows no increase in HIV diagnoses in persons born outside the United States by risk factor, country of origin, or sex.

Because HIV was also removed from the list of recommended screening tests, it may take years for persons born outside the United States to be diagnosed with HIV and reported to public health officials. It is not known what proportion of persons born outside the United States and diagnosed with HIV were infected after their arrival to the United States; a person born outside the United States may live in the United States for years before they become infected. An additional challenge in diagnosing HIV in the recently arrived is the restriction on legal immigrants from accessing federal benefits, including Medicaid, for 5 years after their arrival. A modeling analysis conducted by the CDC projected that approximately 4275 HIV-infected persons (95% CI, 966-5768 persons) could migrate each year to the United States; however, because people who are healthier to begin with are the ones who are able to migrate, the lower end of the confidence interval may be a more accurate prediction.

This analysis was subject to several limitations. Data were available from only 46 states and 5 US territories with long-standing HIV surveillance. The estimated percentage of persons diagnosed with AIDS between 2007 through 2010 is approximately 92% of the entire United States and its territories. Some states with high morbidity and large populations of persons born outside the United States, including Maryland and Massachusetts, were not included in the analysis. The data presented are on HIV diagnoses, with the time from infection to HIV diagnosis unknown. In addition, the time since entry into the United States is not known. The lifting of the HIV immigration exclusion may result in changes in HIV diagnoses in persons born outside the United States entering the United States, but due to the lack of HIV testing in the immigration examination and the disease’s long asymptomatic period, it may take years for these changes to become apparent.

In conclusion, among persons in 46 US states and 5 US territories diagnosed with HIV from 2007 through 2010, 16.2% were born outside the United States. Compared with US-born persons diagnosed with HIV, persons born outside the United States were more likely to attribute HIV transmission to heterosexual contact and were more likely to be Hispanic or Asian. These findings demonstrate the diversity of the HIV-infected population born outside the United States, presenting many clinical and public health challenges.

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Study concept and design: Proser, Hall.

Acquisition of data: Proser, Hall.

Analysis and interpretation of data: Proser, Tang, Hall.

Drafting of the manuscript: Proser, Hall.

Critical revision of the manuscript for important intellectual content: Proser, Tang, Hall.

Statistical analysis: Proser, Tang, Hall.

Obtained funding: Hall.

Administrative, technical, or material support: Proser, Hall.

Study supervision: Hall.

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Disclaimer: The findings and conclusions in this report are those of the authors and do not necessarily represent the views of the Centers for Disease Control and Prevention.

Online-Only Material: The eTable and Author Video Interview are available at http://www.jama.com.

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