Factors Associated with Health Inequalities in Infectious Disease Pandemics Predating COVID-19 in the United States: A Systematic Review

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Abstract

Objective: Previous pandemics may offer evidence on mediating factors that contributed to disparities in infection and poor outcomes, which could inform the effort to mitigate potential unequal outcomes during the current COVID-19 pandemic. This systematic review sought to examine those factors.

Methods: We searched MEDLINE, PsycINFO, and Cochrane to May 2020. We included studies examining health disparities in adult U.S. populations during infectious disease epidemics or pandemics. Two investigators screened abstracts and full text. We assessed study quality using the Newcastle/Ottawa Scale or the Critical Appraisal Skills Programme Checklist for Qualitative Studies.

Results: Sixteen articles were included, of which 14 focused on health disparities during the 2009 H1N1 influenza pandemic. Studies showed that disparities during the H1N1 pandemic were more related to differential exposure to the virus than to susceptibility or access to care. Overall, pandemic-related disparities emanate primarily from inequalities in social conditions that place racial and ethnic minorities and low socioeconomic status populations at greater risk of exposure and infection, rather than individual-level factors such as health behaviors and comorbidities.

Conclusions: Policy- and systems-level interventions should acknowledge and address these social determinants of heightened risk, and future research should evaluate the effects of such interventions to avoid further exacerbation of health inequities during the current and future pandemics.

Keywords: racial minorities; minority health; health disparities; COVID; low income; pandemic

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Introduction
Infectious disease outbreaks such as the coronavirus disease 2019 (COVID-19) that necessitate drastic public health measures (e.g., social distancing, school, business, and facility closures) have the potential to differentially impact disadvantaged populations and contribute to higher burdens of morbidity and mortality among certain groups. In the United States, the ongoing effects of COVID-19 have varied by region and community over time, and while the full extent of its effect on disadvantaged communities remains uncertain, health disparities are already apparent.

A recent systematic review found that African American (AA)/black and Latino adults experienced disproportionately higher rates of both severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infections and COVID-19-related mortality. The authors suggest that differences in exposure and access to care might be driving the higher infection and mortality rates.1

Similar disparities in health outcomes have been observed in past infectious disease outbreaks. In the 2009 H1N1 pandemic, AA/blacks and Latinos had higher rates of hospitalizations and mortality in Illinois.2 Patients of low socioeconomic status (SES) were also found to have higher odds of hospitalization in New York City.3 While it remains too early to know the true impact of SARS-CoV-2 on vulnerable populations, it is likely the United States will feel the ripple effects of these unequal health outcomes for years. For this reason, research on the root causes of these disparities is crucial.

Methods
This is part of a larger systematic review commissioned by the Veterans Health Administration (VHA) that examined the mediating factors contributing to health-related inequalities during the U.S. epidemics and pandemics predating COVID-19, and the interventions developed to address them.

The protocol, which follows PRISMA guidelines,4 was registered to PROSPERO (CRD42020187078) before study initiation.

Data sources and searches
We searched MEDLINE ALL, PsycINFO, Cochrane Database of Systematic Reviews, and Cochrane Central Register of Controlled Trials from database inception through May 20, 2020. Searches included MeSH terms and free-text words related to previous epidemics, pandemics, disasters, and health disparities. We reviewed the bibliographies of relevant articles and contacted experts to identify additional studies. Search strategies were developed in consultation with a research librarian (Supplementary Appendix SA1).

We further refined search results by performing keyword searches in EndNote (X9.3.3) to exclude articles that were not studies (i.e., errata, comments, replies, and proposals), and studies that were basic science, of animals, not of infectious disease pandemics or epidemics relevant to the United States, and of non-U.S. state or territory populations. Titles and abstracts excluded via keyword search were confirmed by an investigator.

Study selection
Eligible studies examined mediators of health inequalities by race/ethnicity, SES, disability, or geographic location in primarily adult U.S. populations during the infectious disease epidemics/pandemics predating COVID-19 (Supplementary Appendix SA2 and SA3). Studies were independently reviewed for inclusion by at least two reviewers. Discordant results were resolved through consensus or a third reviewer.

Data abstraction and quality assessment
From each article, we abstracted details that related to sample size, setting, population characteristics, and inclusion and exclusion criteria; and findings on factors that may contribute to health inequalities. Data were abstracted by one investigator and confirmed by a second. Two reviewers independently assessed study risk-of-bias using modified versions of the Newcastle/Ottawa Scale for observational studies and the Critical Appraisal Skills Programme (CASP) Qualitative Checklist for qualitative studies5,6 (Supplementary Appendix SA4). Disagreements were resolved by consensus or a third reviewer.

Data synthesis
We qualitatively synthesized the evidence and present it in tables. Our approach was guided by a framework that was developed in 2008 by Blumenshine et al.7 to describe the mechanisms through which inequalities in influenza health outcomes occur. It was later adapted by Quinn et al. to describe evidence from the H1N1 pandemic.8,9

Factors contributing to inequalities are categorized into those related to the following: (1) exposure (factors that affect exposure to infectious agents, including structural factors such as working and living
conditions; work-related factors such as the inability to work from home or fear of job loss; and other factors related to childcare or public transportation), (2) susceptibility (factors that increase susceptibility to being infected or having poor outcomes once infected, including existing chronic conditions), (3) access to care (e.g., lack of a regular health care provider, insurance, or the ability to pay coinsurance or copays), and (4) experiencing health care-related discrimination (e.g., self-reported perceived discrimination by a provider).

We expanded exposure-related factors to also include (1) hygiene and health-related behaviors, and (2) information and knowledge. In addition, we broadened factors related to health care discrimination from the experiences of interpersonal mistreatment to also include community discrimination and trust in health care systems and government.

**Results**

We reviewed 9096 titles and abstracts and 163 full-text articles, and 14 studies (16 articles) met the inclusion criteria (Fig. 1). All but two studies focused on factors that potentially contributed to health disparities during the 2009 H1N1 influenza pandemic. Other studies examined the 2012 Middle East respiratory syndrome (MERS) outbreak and or planning for future infectious disease epidemics.

Six studies examined both the AA/black and Latino populations. Two studies examined the Asian populations and two focused on American Indian/Alaska Natives (AI/AN). Five studies examined participants with limited English proficiency (LEP), four of Latino populations and one of Chinese immigrants. Five studies (six articles) examined persons of low SES, and one study was of Veterans with spinal cord disorders (Table 1).
| Study Author, year and N participants | Setting and Dates | Study design | Study timing | Focus | Demographics % female | Age (SD) | Race/ethnicity | Education Unemployed | Other | Limited English proficient | Low socioeconomic status | Rural | Disability | Applicability | Study quality ratings and concerns |
|-------------------------------------|------------------|-------------|--------------|-------|-----------------------|----------|-----------------|----------------------|-------|-------------------------|-----------------------|-------|-----------|-------------|-----------------------------|
| Etingen 2012¹² | 3384 | Hines, Illinois | August 2010 | Cross-sectional Survey | H1N1 | 3% Female | 61.82 (11.70) | AA/black: 14.71% | Latino: 8.42% | White: 73.05% | < HS: 6.39% | | | | Good | Veteran sample, low response rate |
| Freimuth, 2014¹⁵ | 1543 | Nationally Represented | June–July 2009 | Cross-sectional Survey | H1N1 | 51.8% Female | 46.3 (0.54) | AA/black: 11.4% | Latino: 13.7% | White: 68.8% | < HS: 31.7% | | | | Good | — |
| Hennessy, 2015¹⁷ | 381 | AI/AN N=72 | 2009 | Case Control | H1N1 Mortality | Cases/controls | Female: 50% vs. 54% | ≤20: 19% vs. 50%; 21–60: 59% vs. 47%; ≥61: 22% vs. 3% | AA/black: 17% vs. 11% | Latino: 13.7% | White: 68.8% | < HS: 31.7% | | | | Fair | Issues with method of ascertainment and comparability of cases and controls. |
| Levy, 2013³ | 374 | New York City | October 2009–February 2010 | Case Control | H1N1 Hospitalization | Cases/controls | Women: 51.7% | Age: 44.9 (SE = 0.4) | AA/black: 4% vs. 1% | Latino: 29.48% | White: 41.58% | | | | Fair | Expected uneven response rate, so controls were oversampled. Matched 2:1 as planned. |

(continued)
| Study Author, year | N participants | Setting | Dates | Study design | Study timing | Focus | Demographics | % female | Age (SD) | Race/ethnicity | Education | Unemployed | Rural | Disability | Applicability | Study quality ratings and concerns |
|--------------------|----------------|---------|-------|--------------|--------------|-------|--------------|----------|----------|---------------|------------|------------|------|-----------|--------------|---------------------------------|
| Lin, 2014<sup>21</sup> | N = 1569 | Nationally Representative | February–March 2010 | Cross-sectional Survey | H1N1 | 51% Female | 49% were ≤ 44 | AA/black: 11% | Latino: 14% | White: 68% | < HS: 14% | Unemployed: 21% | 18–29: 19%; 30–39: 15%; 40–49: 20%; 50–59: 20%; 60+ 26% | Low socioeconomic status | Good | — |
| Lin, 2018<sup>22</sup> | N = 627 | Nationally Representative | December 2013 | Cross-sectional Survey | H1N1 | 51% Female | 18–29: 19%; 30–39: 15%; 40–49: 20%; 50–59: 20%; 60+ 26% | AA/black: 13% | Latino: 17% | White: 69% | < HS: 12% | Fair | Unclear whether confounding factors were controlled. |
| McCauley, 2013<sup>19</sup> | N = 46 | City A Only: | | | | 57.7% Female | | AA/black: 81.2% | Latino: 12.5% | White: 6.25% | < HS: 43.75%; HS: 43.75% | < Poverty: 50% | Poor | Qualitative synthesis not very more robust. |
| Mesch, 2015<sup>24</sup> | N = 968 | National | October 2009 | Cross-sectional Survey | H1N1 | 51% Female | 45.80 (17.84) | AA/black: 11% | Latino: 7.6% | White: 6% | < HS: 14.2% | H5: 30.9% | Good | Unclear if respondents similar to nonrespondents. |
| Quinn, 2009<sup>13</sup> | N = 1479 | Nationally Representative | June 2009 | Cross-sectional Study | H1N1 | 51.8% Female | 46.3 | AA/black: 11.4% | Latino: 13.7% | < HS: 13.6%; HS: 31.7% | | Good | — | (continued) |
| Study Author, year | Demographics | % female | Age (SD) | Race/ethnicity | Education | Unemployed | Other | Asian and/or Pacific Islander | American Indian or Alaska Native | Limited English proficient | Low socioeconomic status | Rural | Disability | Applicability | Study quality ratings and concerns |
|--------------------|--------------|----------|----------|---------------|-----------|------------|-------|--------------------------------|---------------------------------|-------------------------------|--------------------------|-------|-----------|-------------|--------------------------------|
| Schoch-Spana, 2010 | 18 Community clinic executives | ✓        |          |                |            |            |       |                                |                                 |                               |                          |       |           | Good        | Stakeholder interviews, qualitative methods not adequately described. |
| N=33               |              |          |          |                |            |            |       |                                |                                 |                               |                          |       |           |             |                                  |
| Multiple sites nationally | 6 Government agencies |            |          |                |            |            |       |                                |                                 |                               |                          |       |           |             |                                  |
| July–October 2009  | 7 MSFW advocacy groups |            |          |                |            |            |       |                                |                                 |                               |                          |       |           |             |                                  |
| Qualitative stakeholder interviews | 2 Industry and academic contacts |            |          |                |            |            |       |                                |                                 |                               |                          |       |           |             |                                  |
| H1N1               |              |          |          |                |            |            |       |                                |                                 |                               |                          |       |           |             |                                  |
| SteelFisher, 2015  | Female: NR  | ✓        | ✓        | ✓             | ✓          |            |       |                                |                                 |                               |                          |       |           | Good        |                                  |
| N=2355             | AA/black: 14.3% | ✓        | ✓        | ✓             | ✓          |            |       |                                |                                 |                               |                          |       |           |             |                                  |
| Nationally Representative | Asian: 11.7% | ✓        | ✓        | ✓             | ✓          |            |       |                                |                                 |                               |                          |       |           |             |                                  |
| March–April 2010   | Latino: 13.8% | ✓        | ✓        | ✓             | ✓          |            |       |                                |                                 |                               |                          |       |           |             |                                  |
| Cross-sectional Survey | White: 48.8% | ✓        | ✓        | ✓             | ✓          |            |       |                                |                                 |                               |                          |       |           |             |                                  |
| H1N1               |              |          |          |                |            |            |       |                                |                                 |                               |                          |       |           |             |                                  |
| Witrago, 2011      | 71% Female  | ✓        | ✓        | ✓             | ✓          |            |       |                                |                                 |                               |                          |       |           | Fair        | No control for confounders, methods poorly reported. |
| N=209              | 18–34: 35%; 35–54: 57%; 55–64: 5%; 65 older: 1% | ✓        | ✓        | ✓             | ✓          |            |       |                                |                                 |                               |                          |       |           |             |                                  |
| Fresno County, CA  | Born in Mexico: 89% | ✓        | ✓        | ✓             | ✓          |            |       |                                |                                 |                               |                          |       |           |             |                                  |
| Cross-sectional Survey |              |          |          |                |            |            |       |                                |                                 |                               |                          |       |           |             |                                  |
| Influenza Pandemic | < HS: 53%   | ✓        | ✓        | ✓             | ✓          |            |       |                                |                                 |                               |                          |       |           |             |                                  |
| Preparedness: Rural Latinos |              |          |          |                |            |            |       |                                |                                 |                               |                          |       |           |             |                                  |
| Yip, 2009          | 73% Female  | ✓        | ✓        | ✓             | ✓          |            |       |                                |                                 |                               |                          |       |           | Fair        | Pilot study, no control for confounders, methods poorly reported. |
| N=100              | Age: Median 47.5 | ✓        | ✓        | ✓             | ✓          |            |       |                                |                                 |                               |                          |       |           |             |                                  |
| Seattle, WA        | Years in the U.S.: 0–5: 39%; 6–10: 27%; >10: 35% | ✓        | ✓        | ✓             | ✓          |            |       |                                |                                 |                               |                          |       |           |             |                                  |
| April–June, 2009   | Cross-sectional Survey |              |          |                |            |            |       |                                |                                 |                               |                          |       |           |             |                                  |
| H1N1               |              |          |          |                |            |            |       |                                |                                 |                               |                          |       |           |             |                                  |

AA, African American; AI/AN, American Indian/Alaska Native; HS, high school; I, intervention; LEP, limited English proficiency; MSFW, migrant and seasonal farmworkers; SD, standard deviation; SES, socioeconomic status; U.S., United States.
Within each subsection, we organized findings in the following order: (1) associations between demographic characteristics (e.g., race/ethnicity and SES) and hypothesized mediating risk factors (e.g., exposure and susceptibility), (2) associations between risk factors and outcomes (e.g., influenza-like illness and hospitalization), (3) evidence of mediation of associations between demographic characteristics and outcomes by hypothesized risk factors, and (4) findings from qualitative studies. Supplementary Appendix SA5 provides the study detail.

Exposure

Five studies (six articles) examined the factors that related to exposure.8,13,14,18,21,22 Table 1 provides study population detail. Table 2 highlights study findings by population by exposure subcategory.

Structural. Three studies examined structural factors of exposure.8,13,18 Two nationally representative cross-sectional studies examined measures of residential density by race and ethnicity. After controlling for sociodemographics, the studies by Kumar et al. (N=2042)13 and Quinn et al. (N=1479)8 both found that, compared with whites, AA/black and Latino (both English-speaking and with LEP) participants were more likely to live in apartments and metropolitan areas.

Both studies also found that AA/black participants had a similar number of or fewer children per household than whites, and Kumar et al. found that Latino families reported significantly more children per household than whites.13 Quinn et al. disaggregated Latinos by language and found that while English-speaking Latino participants reported fewer children per household, Latino participants with LEP reported more.8

Kumar et al. also examined the relationship between structural factors and the likelihood of a self-reported influenza-like illness (ILI) in both the participants and their household. They found that the number of children in a household was positively related to the likelihood of ILI in the household (odds ratio [OR] = 1.10, confidence interval [95% CI] NR). Neither apartment nor metropolitan living was related.13

No studies directly addressed the role of structural factors of exposure in mediating disparities in epidemic-related outcomes.

Social distancing. Four studies (five articles) examined measures of social distancing by race, ethnicity, and SES.8,13,14,21,22 Across studies, findings comparing AA/black and Latino with white participants were inconsistent. Two studies found that AA/black participants were similar to whites or were more likely to social distance (e.g., avoid public transportation, air travel, social gatherings, and people with flu-like symptoms).13,14 However, Quinn et al. found that AA/blacks reported being more dependent on public transportation.8 One study found that Latinos were better able to social distance.14 However, both Quinn et al.8 and Kumar et al.13 found that both English-speaking Latinos and those with LEP reported more barriers to social distancing than whites.
| Study timing            | N   | Exposure                                                                 |
|------------------------|-----|---------------------------------------------------------------------------|
| **AA/Black compared with non-Hispanic white** |     |                                                                           |
| Kumar 2012\(^{13}\)   | 2042| More likely to live in an apartment\(^{a}\)                                |
|                        |     | More likely to live in a metropolitan area\(^{a}\)                        |
|                        |     | No difference in ability to social distance due to work\(^{a}\)           |
|                        |     | No difference in ability to social distance\(^{a}\)                       |
| SteelFisher 2015\(^{14}\) | 2355| —                                                                         |
|                        |     | No difference in avoiding people with flu-like symptoms\(^{b}\)           |
|                        |     | No difference in handwashing, sneezing, or coughing into elbow\(^{b}\)    |
|                        |     | More likely to have cleaned more frequently\(^{b}\)                      |
| Quinn 2011\(^{8}\)    | 1479| Fewer adults per household\(^{a}\)                                        |
|                        |     | More likely to live in an apartment\(^{a}\)                              |
|                        |     | More likely to live in a metropolitan area\(^{a}\)                        |
|                        |     | Better able to social distance at work\(^{a}\)                          |
|                        |     | More dependent on public transportation\(^{a}\)                         |
|                        |     | More likely to have used stronger cleaners or disinfectants than usual\(^{b}\) |
| **Hispanic/Latino compared with non-Hispanic white (general)** |     |                                                                           |
| Kumar 2012\(^{13}\)   | 2042| More children per household\(^{a}\)                                      |
|                        |     | More likely to live in an apartment\(^{a}\)                              |
|                        |     | More likely to live in a metropolitan area\(^{a}\)                        |
|                        |     | Less able to social distance due to work\(^{a}\)                         |
|                        |     | Less able to social distance (including public transportation)\(^{a}\)   |
| SteelFisher 2015\(^{14}\) | 2355| —                                                                         |
|                        |     | No difference in avoiding people with flu-like symptoms\(^{b}\)           |
|                        |     | No difference in other personal hygiene-behaviors\(^{b}\)                |
|                        |     | More likely to have cleaned more frequently\(^{b}\)                      |
| Quinn 2011\(^{8}\)    | 1479| No difference in adults or children per household\(^{a}\)                |
|                        |     | More likely to live in an apartment\(^{a}\)                              |
|                        |     | More likely to live in a metropolitan area\(^{a}\)                        |
|                        |     | No difference in ability to social distance due to work\(^{a}\)           |
|                        |     | No difference in ability to obtain childcare that was not with a group of children\(^{a}\) |
|                        |     | More dependent on public transportation\(^{a}\)                         |
|                        |     | More likely to have used stronger cleaners or disinfectants than usual\(^{b}\) |
| **AI/AN compared with non-Hispanic white** |     |                                                                           |
| SteelFisher 2015\(^{14}\) | 2355| —                                                                         |
|                        |     | No difference in avoiding people with flu-like symptoms\(^{b}\)           |
|                        |     | No difference in other personal hygiene-behaviors\(^{b}\)                |
|                        |     | More likely to have cleaned more frequently\(^{b}\)                      |
|                        |     | More likely to avoid air travel and public transportation\(^{a}\)         |
|                        |     | More likely to have used stronger cleaners or disinfectants than usual\(^{b}\) |
Table 2. (Continued)

| Asian compared with non-Hispanic white | SteelFisher 2015 | 2355 | — | — | No difference in avoiding people with flu-like symptoms\(b\) | More likely to cover nose and mouth with a tissue\(b\) |
|---------------------------------------|------------------|------|----|-----|---------------------|---------------------|
|                                       |                   |      |    |    | More likely to avoid social gatherings\(b\) | No difference in other personal hygiene-behaviors\(b\) |
|                                       |                   |      |    |    | More likely to avoid social gatherings\(b\) | No difference in cleaning more frequently\(b\) |
|                                       |                   |      |    |    | More likely to have used stronger cleaners or disinfectants than usual\(b\) | |
| LEP                                   | Quinn 2011        | 1479 | — | — | More likely to live in an apartment\(a\) | Less able to social distance due to work\(a\) |
|                                       |                   |      |    |    | More likely to live in a metropolitan area\(a\) | More dependent on public transportation\(a\) |
|                                       |                   |      |    |    | More adults and children per household\(a\) | Less able to obtain childcare that was not with a group of children\(a\) |
|                                       | Schoch-Spana, 2010 | 33   | — | — | 10–12 people or 2–3 families in a small cabin | Unable to stay home when schools close or children are sick |
|                                       |                   |      |    |    | | Limited work benefits and low wages but dependence on job – may not stay home when sick |
|                                       |                   |      |    |    | | Lack of consistent childcare. Children may accompany parents to work |
| Lower SES compared with higher SES    | Levy 2013         | 374  | — | — | Residents of high-poverty neighborhoods were more likely to have been hospitalized for H1N1\(a,b\) | No difference in social distancing (including public transportation) (education)\(a,b\) |
|                                       |                   |      |    |    | | No difference in wearing a face mask (education)\(a,b\) |
|                                       | Lin 2014          | 1569 | — | — | | No difference in "staying home" (education)\(a,b\) |
|                                       |                   |      |    |    | | No difference in the frequency of handwashing or hand sanitizer use (education)\(a,b\) |
|                                       |                   |      |    |    | | No difference in the reduction of human contact with people outside of household (education)\(a,b\) |
|                                       | SteelFisher 2015  | 2355 | — | — | ≤ HS were more likely to avoid people with flu-like symptoms\(a\) | ≤ HS were more likely to cover nose and mouth with a tissue\(b\) |
|                                       |                   |      |    |    | | No difference in other personal hygiene-behaviors by education\(b\) |
|                                       |                   |      |    |    | | ≤ HS were more likely to avoid social gatherings\(b\) |
|                                       |                   |      |    |    | | ≤ HS were more likely to avoid air travel and public transportation\(b\) |

\(a\)Controlled for demographics and SES.  
\(b\)Controlled for demographics and additional confounders.

| Higher risk | No difference in risk | Lower risk |
|-------------|-----------------------|------------|
Quinn et al. found that AA/black, and Latino participants with LEP, reported more difficulty than whites in securing childcare that was not with a group of children. However, English-speaking Latinos and whites were similar.8

Only one study (N=2355) examined the Asian and AI/AN populations, and it found that both groups were as or more likely than whites to avoid social gatherings, air travel, and public transportation, and to avoid people with flu-like symptoms during the H1N1 pandemic.14

Two studies (three articles) examining the relationship between SES and social distancing also reported conflicting findings.14,21,22 One was a cross-sectional study (reported in two articles) of the H1N1 pandemic (N=1569) that found no association between educational attainment and “staying home,” social distancing (including using public transportation), or the reduction of contact with nonhousehold members.21,22 The other found that participants with less than a high school education were more likely to avoid social gatherings, air travel, and public transportation, but were less likely to avoid people with flu-like symptoms.14

Kumar et al. examined the relationship between dependence on public transportation and self-reported ILI in the self and household. No differences were reported (Tables 1 and 2).13 No studies directly addressed the role of social distancing in mediating disparities in epidemic-related outcomes.

Hygiene-related behaviors. Two cross-sectional studies (three articles) examined hygiene-related behaviors during the 2009 H1N1 pandemic.14,21,22 Findings were consistent that participants with lower education attainment were as or more likely than those with some college or college graduates to report adhering to recommended cleaning and hygiene practices during H1N1 (e.g., frequent handwashing, hand sanitizer, coughing with mouth covered, and cleaning more frequently). One study compared white with AA/black, Latino, Asian, and AI/AN participants. Racial and ethnic minority participants were no less likely to report following recommended cleaning and personal hygiene practices (Tables 1 and 2).14

No studies examined the associations of hygiene-related behaviors with epidemic-related outcomes, or the role of hygiene-related behaviors as mediators of racial or socioeconomic disparities in outcomes.

Susceptibility
One cross-sectional study examined comorbid conditions associated with susceptibility to H1N1 complications and found that AA/black, English-speaking Latino participants, and Latino participants with LEP all had similar or fewer comorbid conditions than whites.8

Two case/control studies examined the relationship between comorbid conditions associated with susceptibility to H1N1 complications, and patient outcomes. One study (N=374) was conducted in New York City, and looked at the impact of both education and neighborhood poverty on hospitalization for H1N1. It found that overall, adults with one or more comorbid conditions associated with susceptibility to H1N1 complications were significantly more likely to be hospitalized (OR=12.83, 95% CI [4.99–32.97]).

In a model adjusted for education and access to care, adults with one or more comorbid conditions remained more likely to be hospitalized (adjusted odds ratio [AOR]=7.61, 95% CI [2.68–21.65]). Comorbid conditions (and access to care) only partially mediated the relationship between education and hospitalization. After adjustment, compared with adults with some college or more, both adults with less than or equal to a high school education (AOR=21.21, 95% CI [5.32–84.53]) and high school graduates (AOR=3.82, 95% CI [1.64–8.90]) were still more likely to be hospitalized.3

The findings were similar for the relationship between neighborhood poverty and hospitalization. After controlling for access to care and the percentage of residents below the federal poverty level (FPL) in a neighborhood, adults with one or more comorbid conditions had 10 times higher odds of hospitalization (AOR=10.05, 95% CI [3.65–27.64]). After adjusting for comorbid conditions (and access to care), adults from neighborhoods with 30% or more residents under the FPL remained at five times greater odds of hospitalization (AOR=5.02, 95% CI [1.83–13.89]).3

The second case/control study (N=381) found that although AI/AN were nearly twice as likely to die from H1N1 (OR=1.95, 95% CI [1.03–3.68]), comorbid conditions and age mediated the relationship, and AI/AN race was not an independent risk factor for H1N1 mortality.17

Access to care
Three cross-sectional studies8,11,14 and a qualitative study18 examined factors that related to access to care
during H1N1. Findings indicated that AA/black and English-speaking Latino participants were no different from whites on an access to care index measure (Table 3). However, Latinos with LEP had significantly lower access.8

In addition, when controlling for demographics, access to health care, and H1N1-related attitudes, AA/black, Latino, and AI/AN participants were more likely than whites to have spoken to a doctor or other health care professional about how to protect themselves or their families from H1N1. There was no difference for Asians or low SES participants.14 Other studies found that among LEP Latinos, the primary reason for not having medication on hand in case of an influenza pandemic was the lack of health insurance (Tables 1 and 3).11

One additional study3 examined the relationship between measures of access to care and hospitalization for H1N1 in New York City. There was no difference in hospitalization when comparing adults with and without health insurance (OR=0.42, 95% CI [0.12–1.49]). However, people with private (vs. public) insurance were less likely to be hospitalized (OR=0.15, 95% CI [0.07–0.32]). There was no significant relationship between having a primary care provider and hospitalization for H1N1 (OR=0.88, 95% CI [0.35–2.18]).

In a model adjusted for participant education and comorbid conditions, the relationships between having a primary care provider (AOR=1.88, 95% CI [0.50–7.05]) and having health insurance (AOR=0.73, 95% CI [0.14–3.70]) and hospitalization for H1N1 remained nonsignificant. As previously noted, when adjusting for access to care (and comorbid conditions), compared with adults with some college or more, both adults with less than or equal to a high school education (AOR =21.21, 95% CI [5.32–84.53]) and high school graduates (AOR =3.82, 95% CI [1.64–8.90]) were more likely to be hospitalized.

The findings were similar for the relationship between neighborhood poverty and hospitalization. After controlling for comorbid conditions and the percentage of residents below the FPL in a neighborhood, neither having a primary care provider (AOR=1.50, 95% CI [0.42–5.30]) nor health insurance (AOR=0.42, 95% CI [0.09–2.04]) was significantly associated with hospitalization. As previously noted, after adjusting for access to care (and comorbid conditions), adults from neighborhoods with 30% or more residents under the FPL had 5 times greater odds of hospitalization (AOR =5.02, 95% CI [1.83–13.89]).3

A qualitative study of migrant and seasonal farmworkers found that ingrained barriers for low health care utilization such as lack of money for care, lack of insurance or ability to access public assistance, lack of knowledge of migrant health clinics, lack of Spanish- and indigenous language materials and support at health centers, lack of transportation, and fear of deportation would likely impede treatment for H1N1.18

Discrimination and trust

One cross-sectional study8 and one qualitative study18 of H1N1 pandemic-related disparities examined experiences of discrimination in health care settings. Findings indicated that compared with whites, AA/black and Latino participants (both English-speaking and LEP) were more likely to have ever experienced discrimination when seeking health care.8

Three cross-sectional studies15,23,24 and one qualitative study19 examined trust in the government and government agencies regarding the handling of H1N1. Findings indicated similar or higher government trust scores among AA/black and Latino participants.23,24 AA/black and Latino participants were more likely than whites to trust the federal government, including President Obama specifically, with no difference for the Centers for Disease Control (CDC), or state or local governments.15 There was no difference in trust by SES (Tables 1 and 3).15

No studies examined associations of discrimination or trust with epidemic-related outcomes, or the role of discrimination and trust as mediators of racial or socioeconomic disparities in outcomes.

Findings from a qualitative study suggest that AA/black participants were unsure whom to trust with regard to H1N1 due to mixed messages from the media and government officials.19 In another, health care providers reported knowledge of stigmatization directed toward Latino migrant and seasonal farmworkers by other providers. For example, one participant reported overhearing a colleague say, “People [are] coming from Mexico and they’re bringing in the swine flu” (Table 1 and 3).18

Information and knowledge

Five cross-sectional studies examined factors related to information and knowledge of pandemics predating COVID-19. A study of Veterans with spinal cord injuries (N=3384) found that, compared to whites, fewer AA/black and Latino Veterans, and fewer low SES participants reported receiving “adequate” information about H1N1.12
Table 3. Health Inequity Risk Factors by Group: Susceptibility, Access to Care, Discrimination and Trust, Information and Knowledge

| Study | N | Susceptibility | Access to care | Discrimination and trust | Information and knowledge |
|-------|---|----------------|----------------|--------------------------|---------------------------|
| **AA/Black compared with non-Hispanic white** |   |                |                |                          |                           |
| Etingen 2012<sup>12</sup> H1N1 | 3384 | —             | —             | —                        | Less likely to report receiving adequate H1N1 information (patients with a disability)? |
| Freimuth, 2014<sup>11</sup> H1N1 | 1543 | —             | —             | —                        |                           |
| Lin 2017<sup>10</sup> MERS | 627  | —             | —             | —                        |                           |
| McCauley, 2013<sup>17</sup> H1N1 | 46   | —             | —             | —                        |                           |
| **Hispanic/Latino compared with non-Hispanic white** |   |                |                |                          |                           |
| Etingen 2012<sup>12</sup> H1N1 | 3384 | —             | —             | —                        | Less likely to report receiving adequate H1N1 information (patients with a disability)? |
| Freimuth, 2014<sup>11</sup> H1N1 | 1543 | —             | —             | —                        |                           |
| Lin 2017<sup>10</sup> MERS | 627  | —             | —             | —                        |                           |
| **AI/AN compared with non-Hispanic white** |   |                |                |                          |                           |
| Hennessy 2015<sup>17</sup> H1N1 | 381  | Preexisting conditions mediated the relationship between AI/AN and H1N1 mortality.<sup>2</sup> | —             | —                        |                           |
| **Asian compared with non-Hispanic white** |   |                |                |                          |                           |
| SteelFisher 2015<sup>34</sup> H1N1 | 2355 | —             | —             | —                        |                           |

(continued)
### Table 3. (Continued)

| Study                          | Year    | Language          | H1N1   | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-------------------------------|---------|-------------------|--------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Quinn, 2011                   |         | Hispanic/Latino   |        | Fewer co morbid conditions. c Poorer access to care (composite). c More likely to have experienced discrimination when seeking health care. c                                                                                                                                                                                                                                                                                                                                                           |
| Schoch-Spana, 2010            |         | Hispanic/Latino   | 33     | Not aware of migrant health centers Lack of transportation from rural locations Lack of Spanish and indigenous language materials and support Low utilization of care for prevention and early stages of illnesses Do not seek care due to fear of deportation Lack of money for health care costs No insurance, cannot access public assistance Stigmatization by providers, “they are coming from Mexico and they’re bringing in the swine flu.” |
| Witrago, 2011                 |         | Hispanic/Latino   | 209    | The primary reason reported for not having medication at home was lack of health insurance and money Less prepared for an influenza pandemic (scale)                                                                                                                                                                                                                                                                                                                                                         |
| Chinese ethnicity regardless of language compared with Chinese ethnicity English speakers |         | Chinese ethnicity |        | Less likely than English proficient to feel well informed about H1N1  Less than a college degree are less likely to report receiving adequate H1N1 information (participants with a disability). a Lower knowledge about H1N1 transmission (education). b No difference in knowledge about H1N1 transmission (education). b No difference in misconceptions about H1N1 transmission (education). b More likely to avoid eating pork products. b  Less likely than English proficient to have heard of MERS. c No difference in accurate knowledge about MERS. c |
| Low SES compared with higher SES |         | Hispanic/Latino   |        | Adults with 1+ comorbidities were more likely to be hospitalized for H1N1. Comorbidities did not explain all of the association between hospitalization and low SES (education) or neighborhood SES (FPL). a No relationship associated with having a primary care provider and hospitalization for H1N1. a No difference in trust in the federal government (i.e., President Obama, HHS). b No difference in trust of the CDC and state and local governments b No difference in overall government trust by previous experience of discrimination in health care. b |
| Freimuth, 2014                |         | Hispanic/Latino   | 1543   |  No difference in trust in the federal government (i.e., President Obama, HHS). b No difference in trust of the CDC and state and local governments b No difference in overall government trust by previous experience of discrimination in health care. b |
| Mesch, 2015                   |         | Hispanic/Latino   | 1000   | No difference in trust in the government to handle H1N1                                                                                                                                                                                                                                                                                                                                                                                                                        |
| SteelFisher, 2015             |         | Hispanic/Latino   | 2355   | No difference in having spoken to a provider about H1N1 protection by SES (level of education). c No difference in trust in the government to handle H1N1                                                                                                                                                                                                                                                                                                                                       |

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*aControlled for demographics and additional variables.  
*bWeighted by demographics, SES, and additional variables.  
*cControlled for demographics and SES.  

CDC, Centers for Disease Control; FPL, federal poverty level; HHS, Health and Human Services; MERS, Middle East respiratory syndrome.
Another study asked respondents about the MERS outbreak and previous pandemics. AA/black and Latino participants were similar to whites in their awareness of previous pandemics; however, participants with lower SES (education) had less awareness. Both AA/blacks and Latino participants were less likely than whites to have heard of MERS, and AA/black participants were less likely to have accurate knowledge about MERS. There was no difference by SES for having heard of, or having accurate knowledge of, MERS (Tables 1 and 3).\(^\text{10}\)

Two studies examined information and knowledge by English proficiency. A small cross-sectional survey of Latinos in a rural setting in California (\(N=209\)) compared English-speaking Latinos with LEP Latinos and found that those with LEP scored lower on an influenza pandemic preparedness scale.\(^\text{11}\) The second was a study of Chinese residents in Seattle. It found that compared with those with better English skills, LEP participants were less likely to feel well-informed about H1N1. Commonly used channels for information among LEP participants were the television (including Chinese-language channels; 81%), Chinese-language newspapers (69%), and community-based organizations (30%; Tables 1 and 3). The study did not control for confounding variables.\(^\text{20}\)

A study (\(N=1569\)) examined H1N1 knowledge and misconceptions by SES (education) and found that after controlling for sociodemographics and communication behaviors, there were no differences on an H1N1 transmission knowledge and misconception index. However, even after controlling for confounders, participants with less than a high school education were more likely than those with a college degree to avoid eating pork products during the swine flu pandemic.\(^\text{21,22}\)

No studies examined associations of information and knowledge with epidemic-related outcomes, or the role of information and knowledge as mediators of racial or socioeconomic disparities in outcomes.

**Discussion**

To our knowledge, this is the first review of studies aimed at identifying the factors that mediate health disparities in infectious disease epidemics. Our conceptual framework was guided by the work of Quinn and Kumar, who considered the potential causes of epidemic influenza based on measures of exposure, susceptibility, and access to care as they applied to data collected in 2009–2010 during the H1N1 pandemic. The framework points to proximal and distal determinants of disease burden with the goal of identifying potential points of policy and programmatic intervention.

Our review revealed that disparities during the H1N1 pandemic were more related to differential exposure to the virus than to susceptibility or access to care. Disparities in exposure were, in turn, related to societal structural and work-related factors, rather than individual factors such as hygiene and cleaning. These findings were consistent across studies. We identified few significant differences in social distancing attitudes and intentions between groups. Instead, it was clear that the meaningful differences lay in the ability or inability to social distance.

Only one study examining variables related to exposure to illness disaggregated the Latino population by language proficiency, and one additional study provided qualitative input in the form of stakeholder interviews. In contrast with other populations we examined, compared with either English-proficient Latinos or whites, limited English-proficient Latinos (and/or migrant and seasonal farmworkers) were at higher risk across both structural and work-related variables measured (Table 2).

Susceptibility to illness played a major role in H1N1 severity and mortality, although disparities in H1N1 outcomes did not appear to be attributable to differential comorbidity burden across socioeconomic groups. Access to care (i.e., having a primary care provider or health insurance) also did not appear to play a major role in explaining disparities in H1N1 outcomes.

Significantly greater proportions of every racial and ethnic minority group reported having experienced discrimination while seeking health care, and many reported being less informed or were less prepared. Much of the literature guiding communication is dated due to advances in technology, and findings of proportionally higher rates of trust in the federal government, particularly in AA/black and Latino adults, may be out of date (Table 3).

Many of the studies are a decade old, most examined the H1N1 pandemic, and findings may no longer be applicable. Much has changed over the last decade, including advances in technology that affect the ways that we communicate, access information, and interact with health care providers. In recent years, our country has shifted sociopolitically, affecting factors related to discrimination and government trust among different population subgroups. In addition, the COVID-19 pandemic is very different than H1N1. Not only is
SARS-CoV-2 more infectious and more widely spread in the United States, but it has affected the way that we live, work, and even socialize in more pervasive ways that the H1N1 pandemic did.

However, despite a decade of change, some things have remained constant. The societal factors that placed vulnerable populations at higher risk for health disparities are largely unchanged. Groups that were vulnerable a decade ago are similarly or more vulnerable today. Social and institutional barriers remain.

As the COVID-19 pandemic enters its third year, it is clear that racial and ethnic minorities are at higher risk than whites.1 Policy- and systems-level interventions are urgently needed and should address the social determinants of health and mitigate exposure risk. Potential mitigating strategies include extending eviction moratoriums, financial support for basic needs and health care, and prioritizing those at higher risk due to housing and work-related conditions for both testing and vaccine distribution.

There are a number of limitations of this evidence base. The operationalization of potential mediating factors was heterogeneous, and we identified very few studies that examined whether risk factors mediated the associations between population characteristics and outcomes. Several included studies did not control for confounding variables or ambiguously reported their methods,10,11,20 although many studies were well conducted and adequately reported. In addition, qualitative studies did not clearly report their methodology and/or findings.18,19

Many of the studies are a decade old, and in light of advances in technology and sociopolitical shifts over the past decade, their findings may be less applicable now than they were then. The categorization of racial and ethnic groups was not consistent across studies (e.g., Latinos as a group or stratified by nativity or language), and very few studies examined disparities among the Asian, Pacific Islander, and AI/AN populations, or among rural residents and adults with disabilities.

**Conclusion**
The literature examining health disparities associated with previous infectious disease epidemics may provide some guidance for the current COVID-19 response. Our findings indicate that pandemic-related disparities emanate primarily from inequalities in social conditions that place racial and ethnic minorities and low SES populations at greater risk of exposure and infection, rather than individual-level factors such as health behaviors and comorbidities. Policy- and systems-level interventions should acknowledge and address these social determinants of heightened risk, and future research should evaluate the effects of such interventions to avoid further exacerbation of health inequities during the current and future pandemics.

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**Disclaimer**
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**Supplementary Material**
Supplementary Appendix SA1
Supplementary Appendix SA2
Supplementary Appendix SA3
Supplementary Appendix SA4
Supplementary Appendix SA5

**References**
1. Mackey K, Ayers CK, Kondo KK, et al. Racial and ethnic disparities in COVID-19-related infections, hospitalizations, and deaths: a systematic review. Ann Intern Med. 2020. [Epub ahead of print]; DOI: 10.7326/m20-6306.
2. Soyemi K, Medina-Marino A, Sinkowitz-Cochran R, et al. Disparities among 2009 pandemic influenza A (H1N1) hospital admissions: a mixed methods analysis—Illinois, April–December 2009. PLoS One [Electronic Resource]. 2014;9:e84380.
3. Levy NS, Nguyen TQ, Westheimer E, et al. Disparities in the severity of influenza illness: a descriptive study of non-Hispanic white and African American patients. Am J Infect Control. 2015;43:1161–1165.

4. Person B, Sy F, Holton K, et al. Fear and stigma: the epidemic within the outbreak. Emerg Infect Dis. 2008;14:709–715.

5. Blumenshine P, Reingold A, Egerter S, et al. Pandemic influenza planning in the United States: a health disparities perspective. Emerg Infect Dis. 2008;14:709–715.

6. Critical Appraisal Skills Programme. CASP Qualitative Checklist 2018 [27 May 2020]. Available at https://casp-uk.net/wp-content/uploads/2018/01/CASP-Qualitative-Checklist-2018.pdf (last accessed May 16, 2020).

7. Blumenshine P, Reingold A, Egerter S, et al. Pandemic influenza planning in the United States from a health disparities perspective. Emerg Infect Dis. 2008;14:709–715.

8. Quinn SC, Kumar S, Freimuth VS, et al. Public willingness to take a vaccine or drug under Emergency Use Authorization during the 2009 H1N1 pandemic. Biosecur Bioterror. 2009;7:275–290.

9. Quinn SC, Kumar S, Reingold A, et al. Racial disparities in exposure, susceptibility, and access to health care in the US H1N1 influenza pandemic. Am J Public Health. 2011;101:285–293.

10. Lin L, McCloud RF, Bigman CA, et al. Tuning in and catching on? Examining the relationship between pandemic communication and awareness and knowledge of MERS in the USA. J Public Health. 2017;39:282–289.

11. Witrago E, Perez MA. Preparing for an influenza pandemic: policy implications for rural Latino populations. J Health Care Poor Underserved. 2011;22(3 Suppl):58–71.

12. Etingen B, LaVela SL, Miskevics S, et al. Health information during the H1N1 influenza pandemic: did the amount received influence infection prevention behaviors? J Commun Health. 2013;38:443–450.

13. Kumar S, Quinn SC, Kim KH, et al. The impact of workplace policies and other social factors on self-reported influenza-like illness incidence during the 2009 H1N1 pandemic. Am J Public Health. 2012;102:134–140.

14. Steelfisher GK, Blenden RJ, Kang M, et al. Adoption of preventive behaviors in response to the 2009 H1N1 influenza pandemic: a multiethnic perspective. Influenza Other Respir Viruses. 2015;9:131–142.

15. Freimuth VS, Musa D, Hilyard K, et al. Trust during the early stages of the 2009 H1N1 pandemic. J Health Commun. 2014;19:321–339.

16. Person B, Sy F, Holton K, et al. Fear and stigma: the epidemic within the SARS outbreak. Emerg Infect Dis. 2004;10:358–363.

17. Hennessy TW, Bruden D, Castrodale L, et al. A case-control study of risk factors for death from 2009 pandemic influenza A (H1N1): is American Indian racial status an independent risk factor? Epidemiol Infect. 2016;144:315–324.

18. Schoch-Spana M, Bauri N, Rambhia KJ, et al. Stigma, health disparities, and the 2009 H1N1 influenza pandemic: how to protect Latino farmworkers in future health emergencies. Biosecur Bioterror. 2010;8:243–254.

19. McCauley M, Minsky S, Viswanath K. The H1N1 pandemic: media frames, stigmatization and coping. BMC Public Health. 2013;13:1116.

20. Yip MP, Ong B, Painter I, et al. Information-seeking behaviors and response to the H1N1 outbreak in Chinese limited-English proficient individuals living in King County, Washington. Am J Disast Med. 2009:4:353–360.

21. Lin L, Jung M, McCloud RF, et al. Media use and communication inequalities in a public health emergency: a case study of 2009–2010 pandemic influenza A virus subtype H1N1. Public Health Rep. 2014;129 Suppl 4:49–60.

22. Lin L, McCloud RF, Jung M, et al. Facing a health threat in a complex information environment: a National Representative Survey Examining American Adults’ Behavioral Responses to the 2009/2010 A/H1N1 Pandemic. Health Educ Behav. 2018;45:77–89.

23. Quinn SC, Kumar S, Freimuth VS, et al. Public willingness to take a vaccine or drug under Emergency Use Authorization during the 2009 H1N1 pandemic. Biosecur Bioterror. 2009;7:275–290.

24. Mesch GS, Schwirian KP. Social and political determinants of vaccine hesitancy: lessons learned from the H1N1 pandemic of 2009–2010. Am J Infect Control. 2015;43:1161–1165.

25. Kumar S, Quinn SC, Kim KH, et al. The social ecological model as a framework for determinants of 2009 H1N1 influenza vaccine uptake in the United States. Health Educ Behav. 2012;39:229–243.

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Abbreviations Used

AA = African American
AI/AN = American Indian/Alaska Native
CASP = Critical Appraisal Skills Programme
CDC = Centers for Disease Control
FPL = federal poverty level
ILI = influenza-like illness
LEP = limited English proficiency
MERS = Middle East respiratory syndrome
SARS-CoV-2 = severe acute respiratory syndrome coronavirus 2
SES = socioeconomic status
VHA = Veterans Health Administration

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