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The state of infection prevention and control at home health agencies in the United States prior to COVID-19: A cross-sectional study

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ABSTRACT

Background: Home health care is a rapidly growing healthcare sector worldwide. Home health professionals face unique challenges related to preventing and controlling infections, which are likely to amplify during an infectious disease outbreak (e.g. SARS-CoV-2). Little is known about the current state of infection prevention and control-related policies and outbreak preparedness at U.S. home health agencies.
Objectives: In this study, we conducted a national survey to assess infection prevention and control-related policies, infrastructure, and procedures prior to the SARS-CoV-2 pandemic.
Design: Cross-sectional study.
Setting/Participants: Using a stratified random sample of 1506 U.S. home health agencies, we conducted a 61-item survey (paper and online) from November 9, 2018 to December 31, 2019.
Methods: Survey data were linked to publicly-available data on the quality of patient care, patient satisfaction, and other agency characteristics. Probability weights were developed to account for sample design and nonresponse; Pearson's $\chi 2$, Fisher's exact, t-tests or linear regression were used to compare the universe of agencies/respondents and urban/rural agencies.
Results: 35.6% of agencies responded ($n = 536$). Most home health personnel in charge of infection prevention and control have other responsibilities; one-third have no formal infection prevention and control training. Rural agencies are more likely to not have anyone in charge of infection prevention and control compared to those in urban areas. About 22% of agencies implement recommended guidelines when administering antibiotics. Less than a third (26.4%) report that their staff vaccination rates were higher than 95% during the last flu season. Only 48.1% of agencies accept patients requiring ventilation, and of those, 40.9% located in rural areas do not have specific infection prevention and control policies for ventilated patients, compared to 20.8% in urban areas ($p < 0.001$). Only 39.7% of agencies provide N95 respirators to their clinical staff; rural agencies are significantly more likely to provide those supplies than urban agencies (50.7% vs. 37.7%, $p = 0.004$). Lastly, agencies report their greatest challenges with infection prevention and control are collecting/reporting infection data and adherence to/monitoring of nursing bag technique.
Conclusions: Prior to the SARS-CoV-2 pandemic, we found that infection prevention and control was suboptimal among U.S. home health care agencies. Consequently, most agencies have limited capacity to respond to infectious disease outbreaks. Staff and personal protective equipment shortages remain major concerns, and agencies will need to quickly adjust their existing infection prevention and control policies and potentially create new ones. In the long-term, agencies also need to improve influenza vaccination coverage among their staff.

Tweetable abstract: Infection prevention and control infrastructure, policies and procedures and outbreak preparedness at U.S. home health agencies was found to be suboptimal in nationally-representative survey conducted just prior to the COVID-19 pandemic.

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What is already known about the topic?

- We searched PubMed from database inception until March 23, 2020, without language restrictions for longitudinal or cross-sectional research studies using the search string: ((“home” AND “health”) AND (“infection” AND “prevention” OR “control”) OR (“preparedness”)), in addition to searching (via Google) up to April 28, 2020 for current news stories about home health care and the SARS-CoV-2 pandemic.
- Prior to the SARS-CoV-2 pandemic, infections were cited as one of the top reasons for unplanned hospitalization among home health care patients, significant variations were found in infection prevention and control procedures across U.S. home health agencies, and most U.S. agencies did not have a full-time infection preventionist on staff.
- With respect to preparedness, a study conducted after the 2009 H1N1 pandemic suggested that planning for surge capacity and supply shortages also varies widely among U.S. home health agencies, and at the beginning of the SARS-CoV-2 pandemic, significant shortages of trained staff and personal protective equipment were being reported in the U.S.

What this paper adds

- We conducted a nationally-representative survey of infection prevention and control at U.S. home health agencies prior to the SARS-CoV-2 pandemic.
- To our knowledge, this is the first study to examine the overall state of infection prevention and control infrastructure, policies and procedures in U.S. home health agencies, and our results provide the most current data about U.S. agency preparedness for outbreaks, epidemics and pandemics.
- Our findings suggest that the state of infection prevention and control-related policies and outbreak preparedness at U.S. home health agencies is suboptimal, particularly when faced with a global pandemic, which has implications for clinicians, policy-makers and future home health care guidelines.

1. Introduction

Home health care, referring to care delivered in a patient’s home by healthcare professionals, is a vital service for those who prefer to age in place, as well as those who are convalescing. As the worldwide population continues aging (World Health Organization 2011), this rapidly growing healthcare sector is faced with unique challenges, specifically around infection prevention and control. Unlike hospital or long-term care settings, home health care is delivered in a less controlled environment with potential sanitation hazards and fewer resources (Gershon et al., 2008).

During the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) pandemic (World Health Organization 2020), the home environment poses difficulties for home health professionals implementing infection prevention and control policies and procedures. In the United States (U.S.), the Emergency Preparedness Rule, prompted by the 2014 Ebola and other emerging infectious disease outbreaks (Centers for Medicare, and Medicaid Services 2016), requires home health agencies to prepare readiness plans in the event of epidemics and pandemics. Implemented in late 2016 by the Centers for Medicare and Medicaid Services (CMS), the rule established requirements for home health agencies that are similar to those of hospitals, and required home health clinicians to complete individual patient emergency preparedness plans during their comprehensive assessments. Furthermore, the Pandemic and All-Hazards Preparedness and Advancing Innovation Act of 2019 requires the U.S. government to provide specific instructions, as well as improve communication and coordination, so that healthcare systems and providers can appropriately respond to infectious disease outbreaks (Pandemic and All-Hazards Preparedness and Advancing Innovation Act of 2019 2019).

In line with those requirements, CMS published specific SARS-CoV-2 infection control recommendations for home health agencies on March 10, 2020 (Center for Clinical Standards and Quality/Quality, Safety and Oversight Group Services 2020). Subsequently, certain Medicare and Medicaid regulations, such as telemedicine and paperwork requirements, were changed in order to assist home health clinicians with providing care to vulnerable patients (Centers for Medicare, and Medicaid Services 2020). However, it is unknown how prepared U.S. home health agencies are to care for patients who may have COVID-19 (the disease arising from SARS-CoV-2 infection) (World Health Organization 2020). In non-pandemic conditions, the location of the agency can determine what resources the agency may have access to (Skillman et al., 2016). Previous investigators have cited numerous challenges for agencies located in rural settings (e.g. workforce recruitment, availability of community resources, internet access/bandwidth for telehealth), compared to those in urban locales, which contributes to differences in access to care and home health utilization (Hartman et al., 2007). Furthermore, prior research conducted after the 2009 H1N1 pandemic indicates that planning for surge capacity and supply shortages may vary widely among agencies (Kassmeier et al., 2013; Rebmann et al., 2011). Early on in the SARS-CoV-2 pandemic, there were reports of significant shortages of trained staff and personal protective equipment (e.g., N95 respirators, gowns, face shields) in the U.S., which are critical for preventing viral transmission (Jamison, 2020; The United States Conference of Mayors 2020). Even without an ongoing pandemic, inadequate implementation of recommended infection prevention and control practices can significantly affect the quality of care and safety of home health patients (Rhinehart and McGoldrick, 2006), who are predominantly older adults with multiple chronic conditions (Avalere Health 2019).

Prior to the SARS-CoV-2 outbreak, infections were cited as one of the top reasons for unplanned hospitalization among home health patients (Shang et al., 2015). Infection prevention and control in home health care has been identified as a national patient safety goal by the Joint Commission (The Joint Commission Accreditation of Healthcare Organizations 2016). Yet, the effort expended on infection prevention and control in the U.S. home health industry is not keeping pace with the industry’s growth rate and risks that home health patients face. To our knowledge, only one study has previously examined infection prevention and control policies and procedures in home health care, and the researcher found that most agencies did not have a full-time infection preventionist (Kenneley, 2012). The investigator also found significant variation in infection prevention and control procedures across agencies. However, the researcher surveyed home health nurses and only focused on policies related to multiple drug-resistant organisms (MDROs) and did not analyze by agency location, which does not reflect the overall state of infection prevention and control-related policies and preparedness for outbreaks, epidemics and pandemics in U.S. home health agencies.

To address this knowledge gap and provide evidence to guide future decision-making related to infection prevention and control in home health care, we conducted a national survey of infection prevention and control-related policies and procedures in U.S. home health agencies, and analyzed our results by urban/rural location of the agency. This study was conducted in the months prior to the SARS-CoV-2 pandemic, with data collection ending in late December 2019, thereby giving insight into the level of pre-

paredness among home health agencies to care for patients with COVID-19.

2. Methods

2.1. Sample

A cross-sectional agency-level survey (available upon request) of a stratified, random sample of U.S. home health agencies was conducted. Agencies were identified from the June 2018 Provider of Services file (Centers for Medicare, and Medicaid Services 2020) and were included if: 1) they were located in the 50 U.S. states, the District of Columbia, or Puerto Rico, 2) were eligible to participate in Medicare, and 3) had an active provider status. The universe of home health agencies totaled 11,549 agencies in 2018. We stratified the universe by Census region (e.g., Northeast, South, Midwest, West), agency ownership (i.e., nonprofit, for-profit, and government), and rural/urban location. Proportional sampling was used for each strata, with the exception of urban and rural location; rural agencies were oversampled at a 2:1 ratio. The survey was fielded to a stratified, random sample of 1506 agencies, and 536 complete responses were returned (35.6% response rate).

2.2. Data collection

Data collection occurred from November 9, 2018 through December 31, 2019. Using previously successful methods (Stone et al., 2019), recruitment occurred in six waves (of approximately 250 agencies each). The Administrator or Director of Nursing (DON)/Clinical Manager at each agency was mailed an invitation letter with instructions for survey completion and a paper copy of the survey. Respondents were given the option to respond via paper or online. Incentives included $25 gift cards for all completed surveys, as well as inclusion in iPad or $100 lotteries for those who completed the survey within two to three weeks. Online surveys were administered via Qualtrics CoreXM^{TM} (Provo, UT), and once received, paper-based surveys were entered into the Qualtrics survey software. Accuracy of data entry was checked through double data entry of a random sample of 8% of the paper-based surveys. Online and paper-based survey data were then combined into a single analytical dataset.

2.3. Measures

The survey was adapted from previous work in nursing homes (Stone et al., 2019), recommendations for infection prevention and control in home health agencies (Healthcare Infection Control Practices Advisory Committee 2017), a review of published home health as well as federal surveys examining staffing and resources in home health agencies (Kenneley, 2012; Gershon et al., 2009; Gershon et al., 2007; National Center for Health Statistics 2015). Content validity was examined by our research team and experts on infection prevention and control in home healthcare. We also refined the survey after conducting qualitative interviews with home health staff (Chastain et al., 2019; Pogorzelska-Maziarz et al., 2020). We piloted the paper version of the survey with home health agencies (n = 7) and respondents were asked to "think aloud" when completing and make notations. The survey was further refined after feedback from pilot study respondents to reduce both respondent burden and response error.

The final survey included sections on infection prevention and control infrastructure (staffing, three items; resources, four items; staff training/monitoring, seven items), general infection prevention and control policies and procedures (nine items), specific infection prevention and control policies (ventilator-related, urinary catheter-related, intravenous catheter-related, deep tissue infection, respiratory infection, each one item), and staff vaccination policies (three items). The survey also collected characteristics of personnel in charge of infection prevention and control at responding agencies, including education, clinical licensure and infection prevention and control training.

Using the CMS Certification Number (CCN), our survey data was linked to the publicly-available 2018 Provider of Services file, Home Health Compare, and the Home Health Care Consumer Assessment of Healthcare Providers and Systems (HHCAHPS) survey data (Centers for Medicare and Medicaid Services). The Provider of Services data contain staffing, organizational characteristics, and geographical information for Medicare-approved home health agencies. Home Health Compare data include the measures of quality of patient care from Outcome and Assessment Information Set (OASIS) and Medicare claims. The HHCAHPS data include measures of patient experience. Both Home Health Compare and HHCAHPS are used to generate Home Health Star Ratings for Medicare-certified home health agencies (Centers for Medicare, and Medicaid Services 2020).

2.4. Statistical analyses

Surveys with 50% or more of the questions completed are included in these analyses (n = 536). We constructed probability weights to account for sample design and nonresponse by calculating the inverse of the probability an agency was sampled and returned the survey. We calculated weighted frequencies, means and standard deviations (SD) to compare strata measures and other agency characteristics (from Provider of Services, Home Health Compare and HHCAHPS) from survey respondents (n = 536) and the universe of home health agencies (n = 11,549) to identify potential sampling and nonresponse bias. We used Pearson's $\chi 2$, Fisher's exact, t-tests or linear regression to compare means, as appropriate. To identify any differences by urban/rural location, we also compared measures of infection prevention and control infrastructure, policies and procedures between rural and urban agencies with Pearson's $\chi 2$, Fisher's exact or t-tests, using weighted estimates. All statistical analyses were conducted using survey data analysis procedures in Stata 13 (StataCorp LLC, College Station, TX).

2.5. Ethics approval

The agency-level survey procedures were reviewed by our Institutional Review Boards and were deemed to be exempt.

3. Results

Table 1 provides a comparison between the sample universe (n = 11,549) and the respondents (n = 536). A comparison of the unweighted respondent estimates to the universe of U.S. agencies shows the influence of our sample design, in particular the substantial oversampling of rural agencies. The weighted survey estimates of strata characteristics match the those of the universe by construction, and the weighted survey estimates for the remaining agency characteristics are not statistically significantly different from the national figures. A majority of responding home health agencies were located in urban areas and in the South Census region, similar to the nationwide distribution of U.S. agencies. Most agencies had for-profit ownership; few had either hospital or Visiting Nurse Association oversight. The majority of nurse staffing was comprised of registered nurses (RNs). Quality of Patient Care Star Ratings and HHCAHPS Summary Star Ratings averaged 3.34 and 3.74, respectively.

The weighted nationally-representative data on infection prevention and control program staffing are presented in Table 2. Personnel in charge of infection prevention and control at home

Table 1
Comparison of strata and agency characteristics for U.S. home health agencies and survey respondents, 2018.

	Universe of U.S. Agencies (n = 11,549)	Survey Respondents (n = 536)		
	Unweighted %	Weighted %	*p-value*[†]	Unweighted %
Strata Characteristics				
Rural	14.8	14.8	*	39.7
Urban	85.2	85.2	*	60.3
Census region				
Northeast (including Puerto Rico)	9.4	9.4	*	11.6
Midwest	26.8	26.8	*	28.7
South	43.9	43.9	*	40.9
West	19.9	19.9	*	18.7
Ownership				
For-profit	81.4	81.4	*	64.4
Nonprofit	14.8	14.8	*	27.3
Government	3.8	3.8	*	8.4
Agency Characteristics				
Agency Oversight				
Hospital	6.8	8.6	0.08	17.0
Visiting Nurse Association	4.9	7.0	0.08	8.0
Medicare Only	21.6	18.0	0.06	14.7
Operates Medicare Hospice	5.6	5.3	0.72	8.8
Part of a System of Branches	13.7	15.1	0.40	17.4
Services Provided In-House				
Nursing Services	92.2	91.3	0.54	92.4
Home Health Aide Services	85.7	86.7	0.58	88.4
	Mean (SD)	**Mean (SD)**	***p-value***[†]	**Mean (SD)**
Nurse Staffing				
% RN	58.7 (23.9)	57.6 (25.6)	0.40	59.4 (24.1)
% LPN/LVN	20.4 (19.8)	19.7 (19.6)	0.50	17.1 (18.4)
% Home Health Aides	20.9 (20.6)	22.7 (23.3)	0.14	23.5 (21.9)
QoPC Star Rating[‡]	3.27 (0.93)	3.34 (0.92)	0.20	3.27 (0.88)
HHCAHPS Summary Star Rating[‡]	3.70 (0.97)	3.74 (0.93)	0.54	3.93 (0.87)

LPN/LVN = Licensed Practical Nurse/Licensed Vocational Nurse; RN = Registered Nurse; QoPC = Quality of Patient Care; HHCAHPS = Home Health Care Consumer Assessment of Healthcare Providers and Systems. Strata characteristics are measures used to define sampling strata.
* $p = 1.00$; weighted estimates for variables used for probability weights are equal to universe of U.S. agencies.
† *p-values*, generated using regression, are a test of equivalence of the U.S. agencies and weighted survey respondents and are significant at $\alpha < 0.05$.
‡ 20.4% and 46.4% of agencies had missing values for QoPC Star Rating and HHCAHPS Summary Star Rating, respectively.

health agencies are mostly employed full-time (83.0%), licensed as an RN or nurse practitioner (NP) (93.6%), and likely to have a bachelor's degree (55.3%). Infection control personnel from 63.9% of agencies have specific training in infection prevention and control. Nationwide, only 6.8% (data not shown) of personnel in charge of infection prevention and control are Certified in Infection Control (CIC) by the Certification Board of Infection Control and Epidemiology, Inc. Compared to those at urban agencies, rural agencies have a higher proportion of infection control personnel that are licensed practical or vocational nurses (LPN/LVNs) (6.8% vs. 2.4%, $p = 0.023$); personnel in rural areas are also more likely to have an associate degree (40.8% vs. 19.4%, $p < 0.001$), and to have no specific infection prevention and control training (46.8% vs, 34.3%, $p = 0.009$). Typically, infection prevention and control personnel have other responsibilities at their agencies such as supervision of clinical services/patient coordination (63%), quality improvement (59.5%), education/training (55.5%), or clinical administration (54.5%). Very few home health agencies (0.5%, data not shown) have a person in charge of infection prevention and control with no additional responsibilities. Regarding infection prevention and control-related activities at agencies, staff education (85.7%), collecting/reporting infection data (81.7%), and monitoring staff adherence to infection prevention and control policies (72.1%) were reported as taking up the most time. Rural agencies appear to spend more time on vaccination of patients than urban agencies (21.2% vs. 13.7%, $p = 0.028$).

Table 3 displays the weighted infection prevention and control-related infrastructure and policies. About 71% home health agencies have a committee that reviews infection prevention and control-related activities or issues, and those committees typically meet on a monthly or quarterly basis. Only 26.6% of the agencies require staff flu vaccinations to work, and over half offer flu vaccination to their staff for free. Fewer than 30% of agencies report that their staff vaccination rates were higher than 95% during the last flu season. Rural agencies have higher vaccination rates and are significantly more likely to provide vaccinations on-site or for free than urban agencies. Almost half of agencies have a policy prohibiting staff from wearing artificial nails. The vast majority of agencies (97.6%) have specific policies related to wound care, and most (78.6%) have policies related patient education on pneumonia prevention. Nearly all agencies admit patients with urinary catheters (98.6%) or IVs/central lines (87.5%), and the vast majority have relevant policies in place for those medical devices. However, less than half of U.S. agencies accept patients requiring ventilation; of the agencies that care for ventilated patients, one-quarter do not have specific infection prevention and control policies related to ventilators, and this differs significantly by urban and rural location (20.8% vs. 40.9%, $p < 0.001$).

Most agencies collect data on antibiotic use (65.8%) and notify primary care providers and agency clinical staff about prescribed antibiotics (54.4–60.7%). About 41% provide antibiotic stewardship training, however, only 21.7% of agencies use guidelines for clinicians to prescribe antibiotics.

Infection prevention and control-related processes and resources are described in Table 4. The vast majority of home health agencies collect and review infection data on a quarterly basis or more frequently. Agencies use a combination of methods to

Table 2
Infection prevention and control staffing and personnel characteristics by urban/rural location, weighted estimates.

	%			
	Total	Urban	Rural	*p-value*
Type of Employment[†]				
Full-time	83.0	81.9	89.5	**0.024**
Part-Time	14.1	15.3	6.7	**0.005**
Clinical Licensure[†]				
RN/NP	93.6	93.9	92.3	0.52
LPN/LVN	3.0	2.4	6.8	**0.023**
Level of Education[†]				
Associates	22.5	19.4	40.8	**<0.001**
Bachelors	55.3	57.0	45.4	**0.014**
Masters and above	16.4	18.1	6.4	**<0.001**
IPC Training or Certification				
Specific IPC training/certification received	63.9	65.7	53.2	**0.009**
No specific IPC training	36.1	34.3	46.8	**0.009**
Responsibilities in Addition to IPC[*]				
Supervision of Clinical Services/Patient Coordination	63.0	65.1	51.0	**0.002**
Quality Improvement	59.5	60.3	54.8	0.22
Education/Training	55.5	56.7	48.2	0.06
Clinical Administration/Management	54.5	55.3	49.9	0.24
No one in charge of IPC at the agency	5.5	5.0	8.3	0.14
	Mean (SD)			*p-value*
Time Devoted to IPC, Hours	8.4 (30.25)	8.7 (27.46)	6.7 (14.52)	0.34
	%			*p-value*
Most Time-Consuming IPC Activities[*]				
Staff Education	85.7	86.6	80.7	0.07
Collecting/reporting infection data	81.7	81.2	84.5	0.33
Monitoring staff adherence to policy	72.1	73.1	66.4	0.13
IPC policy development	26.7	26.0	31.0	0.22
Monitoring staff vaccinations	16.1	16.5	13.7	0.39
Vaccination of patients	14.8	13.7	21.2	**0.028**

IPC, infection prevention and control; LPN, licensed professional nurse; LVN, licensed vocational nurse; RN, registered nurse; NP, nurse practitioner. All data shown are weighted. % are column percentages. *p-values* are significant at $\alpha < 0.05$. Totals varied due to missing data or skip patterns.

[*] Column totals may not add to 100% since response choices were select all that apply.

[†] Column totals may not add to 100% since responses were mutually exclusive but Other and Don't Know categories are not shown.

determine infections; however, most agencies assess patients' risk factors for infection (90.7%). Several agencies report that urinary tract infections pose the greatest infection control challenge (67.3%), and the greatest infection prevention and control practice challenges facing most agencies are collecting and reporting infection data, poor infection prevention and control policy and procedure adherence (e.g., bag technique), and inadequate field staffing coverage. Almost all agencies provide clinicians with basic infection prevention and control supplies. However, only 39.7% of home health agencies provide their staff with N95 respirators; rural agencies are significantly more likely to provide these supplies compared to urban agencies (50.7% vs. 37.7%, $p = 0.004$). While more than half of agencies provide access to a clinical procedures manual and have financially supported their staff to attend conferences (during the past 2 years), less than 20% of agencies have supported attendance to specific infection prevention and control-related conferences.

Table 5 summarizes infection prevention and control training and monitoring. Most agencies provide face-to-face training on infection prevention and control policies and procedures (91.1%), supplemented by computer-based tools (65.3%), knowledge assessments (56.8%) and field shadowing (56.6%). The training is usually provided at new employee orientations and is reinforced annually or biannually. Only 37.4% of agencies provide infection prevention and control training for their staff quarterly or more frequently. Almost half of agencies provide additional training when an infection prevention and control issue or outbreak arises. Trainings cover a variety of topics from hand hygiene (89.7%) to environmental cleaning (51.4%). When measuring staff adherence to general infection prevention and control policies, agencies primarily use competency testing (30.9%) and supervisory visits (26.8%). Similarly, shadowing agency staff in the field (83.7%) and knowledge assessments (75%) are common methods of monitoring adherence to hand hygiene policies.

4. Discussion

Our paper provides an overview of infection prevention and control in U.S. home health agencies prior to the SARS-CoV-2 pandemic. Since we finished survey data collection just as the novel coronavirus was emerging, our findings are particularly relevant regarding U.S. home health agency readiness for infectious disease outbreaks, infection prevention and control policies related to ventilators, personal protective equipment, and influenza vaccination (for both patients and staff). Consistent with a previous study (Kenneley, 2012), we found that the overwhelming majority of agencies do not have a full-time staff member dedicated to infection prevention and control. Personnel in charge of infection prevention and control usually have many other responsibilities and over one-third of infection prevention and control personnel have no formal training in infection prevention. These findings demonstrate a potential weakness in the ability of a home health agency to respond appropriately to infection outbreaks, and educate staff, patients, their families and/or caregivers about infection prevention and control.

With respect to infection prevention and control infrastructure, almost all agencies provide gowns, gloves, eye protection, and surgical masks to their clinical staff. However, under non-pandemic conditions, less than half of U.S. agencies provide their employees with N95 respirators. Urban agencies are significantly less likely to provide respirators to their staff compared to those in rural locations. During the SARS-CoV-2 pandemic, urban home health clinicians may be at increased risk of exposure and transmitting virus with fewer protections and increased reliance on public

Table 3
Infection prevention and control-related organizational structures, policies and procedures by urban/rural location, weighted estimates.

	%			
	Total	Urban	Rural	*p-value*
Agency Committee for IC-Related Activities or Issues[†]				
Yes	70.5	71.7	63.8	0.06
Not currently, but plans to develop one in the next year	9.6	9.6	10.1	0.85
Not currently, and no plans to develop one	15.5	14.8	19.5	0.17
Frequency of IC Committee Meetings[†]				
Annually or biannually	6.4	6.7	4.7	0.44
Quarterly	66.0	65.4	69.9	0.39
Monthly or more	22.0	22.6	18.5	0.42
Agency Policies for Staff Flu Vaccination[*]				
Declination statement required if vaccine refused	56.4	56.3	56.9	0.90
Vaccinations offered for free	51.3	46.9	76.4	**<0.001**
Vaccinations offered on site	46.5	42.3	70.6	**<0.001**
Staff must wear mask during flu season if refused vaccine	31.0	30.1	36.2	0.15
Requiring vaccinations to work	26.6	26.1	29.4	0.41
No policies to encourage staff flu vaccinations	13.8	15.3	4.9	**<0.001**
Percentage of Staff Vaccinated During Last Flu Season				
≥95%	26.4	24.0	40.4	**<0.001**
75–94%	31.7	32.3	28.2	0.33
25–74%	20.2	20.4	18.7	0.63
<25%	4.1	4.1	4.1	1.00
Track, but do not know percentage	5.0	5.2	3.8	0.47
Agency does not track	12.6	14.0	4.8	**<0.001**
Agency Prohibits Staff from Wearing Artificial Nails	*49.1*	*47.8*	*56.9*	*0.044*
Condition- and Device-Specific Policies In-Place at Agency				
Written policies for care of patients with wounds	97.6	97.5	97.8	0.85
Written policies for patient education on prevention of pneumonia	78.6	79.2	75.1	0.61
Agency admits patients with urinary catheters	98.6	98.5	99.2	0.48
Written policies for care of patients with urinary catheters	97.4	97.1	99.0	0.18
Agency admits patients with IVs/central lines	87.5	85.9	96.3	**<0.001**
Written policies for care of patients with IVs/central lines	98.9	98.6	100.0	**<0.001**
Agency admits ventilated patients	48.1	47.5	51.5	0.40
Written policies for care of ventilated patients	75.9	79.2	59.1	**<0.001**
Antibiotic Stewardship Procedure or Program[*]				
Collect data on antibiotic use among agency patients	65.8	65.6	67.1	0.73
Notify clinical staff about antibiotics prescribed to agency patients	60.7	61.4	56.6	0.29
Notify primary MD/NP about antibiotics prescribed to agency patients	54.4	54.1	56.0	0.67
Training and/or education to improve antibiotic stewardship	40.9	40.7	42.0	0.78
Case review to assess appropriateness of antibiotic administration and/or indication	37.6	38.8	30.8	0.07
Use of guidelines for clinicians to prescribe antibiotics	21.7	22.8	15.5	**0.045**

IC, infection control; MD, doctor of medicine; NP, nurse practitioner; IV, intravenous therapy. All data shown are weighted.% are column percentages. *p-values* are significant at $\alpha < 0.05$. Totals varied due to missing data or skip patterns. Column totals may not add to 100% due to:.

[*] Column totals may not add to 100% since response choices were select all that apply.

[†] Column totals may not add to 100% since responses were mutually exclusive but Other and Don't Know categories are not shown.

transportation to visit patients. This is very concerning, especially on top of the personal protective equipment shortages that the U.S. healthcare organizations have reported throughout the pandemic, including home health agencies (National Association for Home Care and Hospice 2020). Home health clinicians are on the front lines of delivering healthcare to the most vulnerable; some may be vulnerable themselves due to preexisting health conditions and most appear to have been at a disadvantage even at the onset of the outbreak (Jamison, 2020).

We found that agencies have challenges with adherence to and monitoring of nursing bag technique, which is a unique dilemma in the home health care setting. Nursing bags, which are used by home health clinicians to carry supplies into homes, may contribute to infection transmission between patient homes by serving as a fomite for multidrug-resistant and emerging organisms (e.g., SARS-CoV-2) (Bakunas-Kenneley and Madigan, 2009). A previous study found that 84% of the outside and 48.4% of the inside of nursing bags contain human pathogens, including 15.9% and 6.3% multi-drug resistant organisms, respectively (Bakunas-Kenneley and Madigan, 2009), suggesting that bag technique adherence is crucial to infection prevention and control in home health care.

Agencies also report challenges in collecting and reporting infection data. Unlike in the hospital setting, laboratory technology and medical examination services are not readily available for home health clinicians, making infection diagnoses more difficult. Accurately diagnosing and reporting infections is a critical step in establishing an infection surveillance system, which has shown to help reduce healthcare-associated infections in hospital settings (Storr et al., 2017). However, this challenge, raised by experts decades ago, remains unsolved. A majority of home health personnel must rely on physician or nurse practitioner diagnoses and antibiotic prescriptions to determine infection cases. In a survey conducted with a convenience sample in mid-April 2020 (Shang et al., 2020), researchers found that only 12.4% of U.S. agencies have capacity to test patients for COVID-19. While access to testing has increased since that survey was fielded, differences still remain across states and types of healthcare providers (Goodnough et al., 2020). Future research should investigate how to improve diagnostics and reporting of infections in home health care, particularly during outbreaks of novel infectious organisms.

Reduced access to testing and test results also contributes to inadequate antibiotic stewardship in home health care. Only about 22% of U.S. home health agencies implement recommended guidelines when administering antibiotics. In home health care, antibiotics are often prescribed based on signs and symptoms without culture data due to the health care setting and limited resources (McGoldrick, 2014). These can lead to antimicrobial re-

Table 4
Infection control and prevention-related processes and resources by urban/rural location, weighted estimates.

	%			
	Total	Urban	Rural	*p-value*
Agency Collects and Reviews Infection Data	88.1	87.9	89.2	0.64
Frequency of Infection Data Review†				
Annually	3.3	3.5	2.2	0.41
Quarterly	57.1	58.7	47.8	**0.024**
Monthly or more	38.7	37.0	48.2	**0.019**
*Information Used to Determine Patient Infections**				
Provider diagnosis	83.7	82.9	88.1	0.13
New antibiotic prescription	82.4	82.0	84.8	0.44
Standard definitions or criteria	65.6	65.2	68.1	0.53
Clinical cultures	65.6	63.8	75.6	**0.009**
*Assessments Performed to Evaluate–**				
Infection risk factors	90.7	90.9	89.1	0.48
Non-compliance with IPC	74.3	75.2	68.8	0.11
Health status of others in home	51.9	52.7	47.6	0.26
Home environmental factors	5.2	5.2	5.4	0.92
No assessments performed	3.4	3.0	5.9	0.09
Infection/Organism Posing Greatest IPC Challenge†				
Urinary tract infections	67.3	67.4	66.9	0.90
Catheter-associated urinary tract infections	11.2	11.2	11.2	0.99
C. difficile	6.0	6.2	4.8	0.50
Upper respiratory infections	3.0	3.1	2.2	0.54
Wound infections	2.3	2.5	1.6	0.52
Other (MRSA, CLABSI, etc.)	1.0	0.7	3.1	**0.022**
No current challenges	1.5	1.4	2.0	0.57
Aspects of IPC Posing Greatest Challenge†				
Collecting/reporting infection data	32.6	32.0	36.3	0.32
Adherence to and monitoring bag technique	16.8	16.0	21.6	0.11
Adequate field staffing coverage	16.5	16.8	14.4	0.46
Adherence to and monitoring hand hygiene/standard precautions	16.2	16.8	13.0	0.25
Managing MDROs and *C. difficile*	10.4	10.7	8.6	0.41
*IPC Supplies Routinely Provided to Clinical Staff**				
Gloves/gowns/aprons/masks/eye protection	99.1	98.9	100.0	0.46
Sharps containers	93.4	92.9	96.6	0.08
Safety syringes/needles	82.0	79.4	96.7	**<0.001**
Blood spill kit	55.1	53.3	65.4	**0.007**
N95 respirators	39.7	37.7	50.7	**0.004**
MRSA kit	25.4	25.6	24.5	0.77
*Financial Resources Used in Last 2 Years For—**				
Access to clinical procedures manual	58.7	58.3	60.8	0.58
Staff attendance at conferences	56.1	55.8	57.8	0.66
On-site IPC training by external entity	31.3	32.4	25.0	0.07
Access to expert IPC consultation	19.5	19.7	18.0	0.62
Staff attendance at IPC conferences	18.6	19.1	15.6	0.31
Webinars/online training	3.6	3.8	2.9	0.56
No financial resources provided	14.3	14.5	13.0	0.62

IPC, infection prevention and control; MRSA, methicillin-resistant *S. aureus*; CLABSI, central line-associated bloodstream infection; MDRO, multidrug resistant organism. All data shown are weighted.% are column percentages. *p-values* are significant at $\alpha < 0.05$. Totals varied due to missing data or skip patterns.

* Column totals may not add to 100% since response choices were select all that apply.

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sistance, which is a serious threat to global health and contributes yearly to 500,000 suspected bacterial infections in 22 countries (World Health Organization 2018). While improving home health care capacity of point-of-care testing is critical, home health infection prevention and control experts also suggest that frequent and quality patient and caregiver education on antibiotics, as well as medication reconciliation and monitoring using antibiotic logs can help reduce risks of developing antibiotic-resistant infections (Rhinehart and McGoldrick, 2006; McGoldrick, 2014).

Encouragingly, a majority of U.S. home health agencies have committees to create new and review existing infection prevention and control policies and procedures, and those committees appear to meet frequently. Agencies have various infection-specific policies and procedures in place, and there are some significant differences by urban/rural location. Some of this variation can be due to the lack of standardized infection prevention and control guidelines for the home health care setting (Castellucci, 2018), causing agencies to craft their own policies and procedures. With respect to home health care capacity to care for patients diagnosed with COVID-19, only half of U.S. agencies accept patients requiring ventilation, and of those, a quarter do not have specific infection prevention and control policies for ventilated patients. Among rural agencies, 41% do not have written infection prevention and control policies in place for ventilator care. Additionally, we found about 20% of U.S. agencies do not have a written policy for patient education regarding prevention of pneumonia. This is of great concern especially during the SARS-CoV-2 pandemic since effective self-management of symptoms is critical for the recovery of self-isolating patients.

Lastly, we found that flu vaccination rates among home health personnel are alarmingly low. Since influenza can lead to respiratory infections and is one of the main causes of mortality in older adults (Simonsen et al., 1998), Healthy People 2020 set a target for flu vaccinations among healthcare workers at 90% (Office of Disease Prevention and Health Promotion 2010). Professional organizations, including the American Nursing Association,

Table 5
Infection prevention and control staff training and monitoring by urban/rural location, weighted estimates.

	%			
	Total	Urban	Rural	*p-value*
Training Modality[*]				
Face-to-face training (in-services, skills fairs)	91.1	91.4	89.8	0.56
Computer-based training tools (e.g. online education, DVDs, videos)	65.3	62.8	79.8	**<0.001**
Knowledge assessment	56.8	58.1	49.1	**0.045**
Shadowing in the field	56.6	57.4	52.3	0.26
Training Frequency[*]				
At new employee orientation	61.0	60.3	64.9	0.30
Annually or biannually	64.1	62.9	70.9	0.06
Quarterly	23.8	24.4	20.4	0.29
Monthly or more frequently	13.6	13.9	12.3	0.62
When an infection control issues/outbreak arises	47.4	46.9	50.2	0.46
Training Topics[*]				
Hand hygiene	89.7	90.1	87.7	0.41
Practices appropriate to the patient	77.1	76.2	82.2	0.11
Signs and symptoms of infections	73.4	74.2	69.3	0.22
Transmission precautions	67.5	66.5	72.7	0.14
Environmental cleaning	51.4	50.5	57.0	0.15
No IPC topics covered	1.2	1.1	1.8	0.53
Method of Measuring Adherence to IPC Policies[*]				
General competency testing/assessment/demonstration	30.9	31.2	28.7	0.57
Supervisory visits (un/announced) & evaluations	26.8	28.0	19.6	**0.045**
Shadowing/observation/tracer	25.1	23.4	35.4	**0.006**
Monitoring of infections through data via chart audits/logs/forms	17.0	17.2	15.6	0.66
Skills fairs	4.6	4.9	2.4	0.18
Hand hygiene monitoring tool/audits	4.1	3.7	6.1	0.22
Patient surveys/calls	3.3	2.7	6.9	**0.041**
Training/observation upon hire	2.3	2.7	0.0	**<0.001**
Bag technique audits	1.9	1.5	4.0	0.09
Other procedure	35.8	35.3	39.0	0.43
Agency Measures Adherence to Hand Hygiene Policies	81.7	81.3	83.8	0.48
Method of Monitoring Adherence to Hand Hygiene Policies[*]				
Shadowing in the field	83.7	83.2	86.4	0.39
Knowledge assessment	75.0	76.2	68.7	0.09
Other procedure	10.1	10.1	10.0	1.00

IPC, infection prevention and control. All data shown are weighted.% are column percentages. *p-values* are significant at $\alpha < 0.05$. Totals varied due to missing data or skip patterns.

[*] Column totals may not add to 100% since response choices were select all that apply.

strongly support influenza vaccination requirements for registered nurses and other healthcare workers (Nursing Practice, and Work Environment Department 2015). Despite this support, vaccination rates among healthcare workers remain suboptimal, especially in non-hospital settings (Centers for Disease Control and Prevention 2018). Mandatory vaccination requirements may offer the ultimate solution. However, these have not been implemented among healthcare workers due to multiple barriers (Field, 2009). The Centers for Disease Control and Prevention (CDC) suggests that offering incentives such as free vaccinations and providing vaccinations on site can promote higher vaccination rates among healthcare workers (Centers for Disease Control and Prevention). However, in our survey, we found that approximately half of U.S. agencies offer vaccinations onsite or for free for their employees. Future research should explore more effective ways to improve home healthcare personnel vaccination rates.

We compared infection prevention and control policies and processes between rural and urban agencies and found that, while location did not affect an agency's capacity to care for ventilated patients, there were significant differences regarding whether rural agencies had policies in place to care for those patients. In the context of the SARS-CoV-2 pandemic, this finding is concerning since rural populations in the U.S. are typically older and suffer from multiple chronic conditions (Centers for Disease Control and Prevention 2017). However, we did find that rural agencies outperform urban agencies in terms of staff vaccination rates. These findings are opposite to the usual rural-urban vaccination gaps among the general population (Talbert et al., 2018). Individuals living in rural areas still heavily depend on traditional clinical settings for vaccination (Bennett et al., 2011). The limited resources in rural areas may trigger home health agencies to provide more vaccination opportunities for their staff, as there are fewer vaccination sites.

While this study contributes to our understanding of infection prevention and control in U.S. home health agencies, there are limitations due to the use of self-reported data, which is susceptible to recall and social desirability biases (Fielding, 2006). However, the confidential nature in which our survey data were collected helped mitigate those threats to validity. Nevertheless, our respondents may differ from the non-respondents in various ways. To minimize this potential bias, we created weights to account for sample design and non-response such that the sample would generate nationally-representative estimates of our variables of interest. Additionally, the response rate in our survey (35.6%) was lower than typically found in other healthcare settings (Stone et al., 2019; Stone et al., 2009; Herzig et al., 2016). Home health care agencies are especially hard to reach population; despite our persistent recruiting efforts (multiple calls and emails following the initial recruitment email or letter), we encountered some recruitment challenges (e.g., agency closures, turnover of staff, fewer agencies use email) with this survey. Prior surveys in the home health care setting had much lower response rates (ranging from 7.1%–9.2%) (Kenneley, 2012; National Center for Health Statistics 2015). A few home health care studies reached slightly higher response rates (up to 44%) (Gershon et al., 2009; Gershon et al., 2007) than our survey. However, they target individual home health care clinicians and are based on convenient samples; our survey was

agency-level and a random sample was used. Despite these challenges, it is unlikely that the non-respondents are fundamentally different from our respondents in their practices. As demonstrated in Table 1, there are no statistically significant differences between our unweighted survey respondents and the universe of agencies, particularly regarding the Quality of Patient Care Star Ratings and HHCAHPS Summary Star Rating, which are designed to measure agencies' practice and outcomes. The moderate ratings (3.27 and 3.70 on a 5-star rating scale) from both rating systems correspond to the suboptimal infection prevention and control practices found in our survey. Nevertheless, we acknowledge that our results should be interpreted within the context of the low response rate.

5. Conclusions

This is the first national survey of infection prevention and control-related policies and procedures in the home healthcare setting, which included U.S. agencies in all 50 states, the District of Columbia, and Puerto Rico. We found that infection prevention and control in home healthcare is suboptimal (based on existing guidance primarily derived from hospital settings (Rhinehart and McGoldrick, 2006)) and infection prevention and control policies and procedures vary between agencies, especially among those in urban and rural locations. Personnel in charge of infection prevention and control at agencies have multiple responsibilities and lack adequate training. U.S. home health agencies will need to strengthen their capacity and quickly adjust their existing policies to respond to the SARS-CoV-2 pandemic. In addition to staffing, personal protective equipment shortages remain a major concern, especially since many agencies appear to have entered the current pandemic situation without adequate supplies. Home health agencies also need to improve influenza vaccination coverage among their staff, which can reduce workplace absences, as well as protect their patients and improve patient outcomes.

CRediT authorship contribution statement

Jingjing Shang: Funding acquisition, Conceptualization, Project administration, Supervision, Methodology, Writing - original draft. **Ashley M. Chastain:** Supervision, Project administration, Investigation, Resources, Data curation, Formal analysis, Visualization, Writing - original draft. **Uduwanage Gayani E. Perera:** Software, Formal analysis, Visualization. **Andrew W. Dick:** Funding acquisition, Conceptualization, Project administration, Supervision, Methodology, Writing - review & editing. **Caroline J. Fu:** Software, Data curation, Formal analysis, Visualization. **Elizabeth A. Madigan:** Methodology, Writing - review & editing. **Monika Pogorzelska-Maziarz:** Funding acquisition, Conceptualization, Methodology, Writing - review & editing. **Patricia W. Stone:** Funding acquisition, Conceptualization, Project administration, Supervision, Methodology, Writing - review & editing.

Conflict of interest

None.

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Ethical Approval

None.

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Data Sharing Statement

Survey instrument, deidentified survey dataset and data dictionary is available upon request, after approval of proposal and with a signed data access agreement, at the end of the study period (July 1, 2021) from js4032@cumc.columbia.edu or http://nursing.columbia.edu/research/InHome.

Supplementary materials

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