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Health System Contact and Awareness of Zoonotic Diseases: Can it Serve as One Health Entry Point in the Urban Community of Ahmedabad, India?

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One Health (OH) is emphasized globally to tackle the (re)emerging issues at the human-animal-ecosystem interface. However, the low awareness about zoonoses remain a challenge in global south, thus this study documented the health system contact and its effect on the awareness level of zoonoses in the urban community of Ahmedabad, India. A community-based household survey was conducted between October 2018 and July 2019. A total of 460 households (HHs) were surveyed from two zones and 23 wards of the city through cluster sampling. A structured, pilot-tested, and researcher-administered questionnaire in the vernacular language was used to collect the information on demographic details, socio-economic details, health-seeking behavior for both the humans and their animals, human and animal health system contact details and the participants' awareness on selected zoonotic diseases based on the prioritization (rabies, brucellosis, swine flu, and bird flu). Out of 460 surveyed households, 69% of HHs and 59% of HHs had a health system contact to the human and animal health system respectively at the community level. There are multiple health workers active on the community level that could potentially serve as One Health liaisons. The investigation of the knowledge and awareness level of selected zoonotic diseases revealed that 58.5%, 47.6%, and 4.6% know about rabies, swine and/or bird flu, and brucellosis, respectively. The mixed-effect linear regression model indicates that there is no significant effect on the zoonotic disease awareness score with the human health system contact; however, a minimal positive effect with the animal health system contact was evident.

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Abbreviations: HH, Household; HSC, Health system contact; OH, One Health.

Keywords: Health system contact, zoonotic diseases, community awareness, One Health, India

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INTRODUCTION

The identification and management of simple illnesses at the household level (HH) and/or referral to the appropriate health centers by the community health workers is one of the greatest health system revolutions in low- and middle-income countries so far [1,2]. For decades, these workers have been part of the health care delivery system in countries around the world [3-5]. In India, these workers are the backbone of primary health care, not only in the human health system [6,7] , but also in the animal health system [8,9]. Most often, these workers are considered as the first point of health system contact for the respective health system in India [10,11].

In the recent past, India has witnessed various outbreaks of emerging infections and the majority of them were of zoonotic origin [12,13]; which leads to a more complex infectious disease burden in the country and poses increased challenges for the health care system [13]. Available evidence suggests an increasing burden of zoonoses and also poor community awareness and preventive practices in regard to zoonoses [14,15]. The global movement for more zoonotic disease prevention ie, One Health (OH) (at the interface of human-animal-ecosystem) approach [16,17] provides an opportunity to tackle this burden [18].

In absence of any OH focused national program for the zoonoses prevention [19,20], the health system functionality is yet to be explored in an Indian context. It is very important to understand the potential actors and/or entry points for operationalizing OH in the Indian health system. Poor awareness of zoonotic diseases [15,21] and non-specific roles of the health system actors [22], demand an investigation into health system actors, their outreach in the zoonoses prevention, and operationalization of OH at the community level. Therefore, this study aims to document the reach and roles of the community health worker and to identify those that may be suitable to serve as OH entry point. Further, it is assessed whether contact to a health worker affects the relevant awareness of the community.

Hypothesis: Regular contact with the health system and its actors increases the awareness of zoonotic diseases.

MATERIALS AND METHODS

Study Design

This cross-sectional study is part of a larger health system study ie, RICOHA (Research to explore Intersectoral Collaborations for the One Health Approach), protocol published elsewhere [23]. This specific study was conducted from October 2018 to July 2019.

Setting

General setting: The study was conducted in one of the most populous cities of the Western state Gujarat: Ahmedabad. It is the seventh most populous city in India and is the largest city of the Western state Gujarat [24]. It is located on the banks of the Sabarmati River with a population of 7,650,000 [25]. Ahmedabad is one among the cities selected for the smart city model in 2016 [26] and India's first UNESCO World Heritage City [27].

Community setting: For administrative purposes, the city is at present divided into six zones ie, Central, East, West, North, South, and New West zone. Each zone is further split into wards. Presently, there is a total of 64 wards. About 1,191,843 HHs are spread across the city. About 2,000,000 dogs live in the city [28], about 7,000,000 livestock and 2,000,000 poultry spread over both the urban and rural areas of Ahmedabad [29].

Study Site

This study was conducted in the two most densely populated zones of the city ie, East and South zone, where the human-animal population density is highest.

Study Population

All wards (ie, 23 wards) from the East and South zone of Ahmedabad city were incorporated into the study. Further, each ward was sub-divided into multiple clusters based on the population (average of 1,000) and/or presence of an Anganwadi Centre (a community center, which delivers the child care and nutrition related activities under the public health system of India [30]). From each ward two clusters with a high human-animal population density were selected randomly, thus the study collected data from 46 clusters. Further, from each cluster 10 HHs were sampled. HHs of each cluster were further stratified into two categories, ie, five HHs with any animal(s) (livestock, dog, and poultry) and five HHs without any animal. As there was no line listing of HHs with or without animals, this study adapted systematic sampling, ie, each 10^{th} HH was sampled until the number of five HHs for each category in the respective cluster was achieved. In case of non-response, the particular HH was skipped and the next 10^{th} HH was sampled. As the HHs with animals were limited in number and no line listing of such HHs was available, the snowball sampling (only to seek the information) was adopted to identify five HHs with animals per cluster as fast as possible. The overall non-response rate was 20%. The total sample size of the study was 460 HHs.

Operational Definition: "Health System Contact"

Health System Contact (HSC) in this study is defined

as a person from the health system that is contacted when a new health or medical need arises, or a person providing preventive health care services at the community level. The HSC at the community level either provides care directly or serves as a facilitator, directing patients to more appropriate sources of care at the appropriate time. In order to be considered as providing HSC care, the services must be accessible (a structural characteristic) and used by the population each time a new need or problem arises (a behavioral characteristic).

Study Data Collection

A structured, pilot-tested questionnaire in the vernacular language was used to collect the information on the basic demographic and socio-economic characteristics, health seeking behavior (for both the humans and their animals) and contacts to the human and animal health system as well as details on awareness for rabies, brucellosis, swine flu, and bird flu. Based on the prioritization of zoonotic diseases in the local context, these four zoonotic diseases were selected against others [31]. A trained researcher administered the 10-15-minute questionnaire to the available adult of the sampled HH. When missing data (<5%) were encountered during the data cleaning phase, the researcher re-visited those HHs and/or called their mobile phones to capture the missing information.

Measurement

Two measures were calculated for further analysis, ie, HSC score and the awareness score for the selected zoonotic diseases. The HSC score was based on the dimensions: *comprehensiveness of service delivery* (refers to the availability of clinical and preventive services of the provider), *first contact* (is defined as the accessibility to and use of primary care services when a new health or medical problem arises), *community orientation* (refers to the provider's knowledge of community health needs), *coordination* (refers to the interpersonal linkage of care between different levels of providers or informational linkage of care), *family centeredness* (is defined as the inclusion of family health concerns in decision-making), *cultural competence* (is defined as patients' willingness to recommend their primary care provider to others/satisfaction level) [32,33]. A 4-point Likert-type scale was applied to measure each of these dimensions of the HSC, coded as "1" ("never"), "2" (rarely), "3" (sometimes), "4" ("always"). Thus, each dimension score ranged from minimum of 1 to maximum of 4, the total HSC score thus ranged from 6 to 24.

The awareness score, as the prime measure of outcome, was calculated in two ways: a) as "1" (correct response), "0" (no response) and "-1" (wrong response) and b) as "1" (correct response), "0" (no/wrong response), where the wrong responses were not accounted for each zoonotic disease. In option a, if a person has complete awareness, he/she will receive the highest score, whereas a person having wrong response will receive a lower score as compared to the person indicating not having any knowledge. A normalized score was derived for each disease. The total zoonotic awareness score was calculated as the simple sum of all disease scores and normalized for the analysis.

Analysis and Statistics

The quantitative data collected was entered, validated, and analyzed using EpiData version 3.1 (EpiData Association, Odense, Denmark) for entry and version 2.2.2.182 for descriptive analysis [34]. The descriptive statistics were segregated between HHs with animals and HHs without animals. Categorical variables were expressed as frequencies, percentages, whereas the scores and continuous variable were expressed as means with standard deviation. To assess differences between these groups, chi-square tests were used for categorical variables and t-tests were applied for continuous variables. The linear mixed regression model was conducted to understand the interaction of the zoonoses awareness score with the other independent variables such as socio-demographic factors, health seeking behavior, and the health system contact. The analysis was conducted in R version 3.4.1 (R Foundation for Statistical Computing, Vienna, Austria; 2017) [35].

RESULTS

Socio-demographic Characteristics

Table 1 presents the socio-demographic characteristics of the surveyed HHs stratified by the ownership of animals. The majority (72.2%) of respondents were female with a mean (SD) age of 39.3 ± 13.3 years. About 26% of the respondents were illiterate, whereas nearly half of them completed secondary education. The majority (82.4%) belong to the Hindu religion. About one-fourth (26.1%) belong to the scheduled caste/tribes, and another 5.4% belong to the lowest/privileged caste. Less than one-fourth were living below the poverty line. Most of the interviewees were permanent residents with a mean (SD) of 37 ± 29 years of residency. The average income per HH per month was found to be 204 ±168 USD. The descriptive findings indicated that, the two groups are rather homogenous with only significant difference in gender, occupation, total HH members, and duration of residency.

Health System Contact (HSC)

The majority of the surveyed HH members preferred

Table 1. Demographic and socio-economic characteristics of the participants of the surveyed households with or without animals in Ahmedabad, India from October 2018 to July 2019.

Variables	Total N=460 (%)	HHs with animal(s) n=230 (%)	HHs without animal(s) n=230 (%)	*p*-value
Age	39.3 ± 13.3	39.7 ± 13.5	39 ± 13.1	0.551
Female gender	332 (72.2)	148 (64.4)	184 (80)	0.000*
Education				
Illiterate	119 (25.9)	67 (29.1)	52 (22.6)	0.327
Primary level	77 (16.7)	42 (18.3)	35 (15.2)	
Secondary level	201 (43.7)	93 (40.4)	108 (47)	
Higher secondary	40 (8.7)	17 (7.4)	23 (10)	
Graduate or above	23 (5)	11 (4.8)	12 (5.2)	
Occupation				
Farmer/Agriculture	16 (3.5)	14 (6.1)	2 (0.9)	0.000*
Livestock dependent	98 (21.3)	98 (42.6)	NA	
Daily laborer	13 (2.8)	3 (1.3)	10 (4.4)	
Public/Private employed	13 (2.8)	5 (2.2)	8 (3.5)	
Homemaker	231 (50.2)	69 (30)	162 (70.4)	
Others	89 (19.4)	41 (17.8)	48 (20.9)	
Marital status				
Married	422 (91.7)	210 (91.3)	212 (92.2)	0.235
Single	28 (6.1)	17 (7.4)	11 (4.8)	
Widowed	10 (2.2)	3 (1.3)	7 (3)	
Religion				
Hindu	379 (82.4)	193 (83.9)	186 (80.9)	0.392
Muslim	81 (17.6)	37 (16.1)	44 (19.1)	
Caste				
Scheduled Caste/Tribe	120 (26.1)	72 (31.3)	48 (20.9)	0.058
Other privileged Castes	25 (5.4)	13 (5.7)	12 (5.2)	
General	259 (56.3)	122 (53)	137 (59.6)	
Not expressed	56 (12.2)	23 (10)	33 (14.4)	
Living below poverty line	107 (23.3)	60 (26.1)	47 (20.4)	0.207
Total HH member	6 ± 3	7 ± 3	6 ± 3	0.002#
HH monthly income (US$)	204 ± 168	203 ± 164	206 ± 173	0.852
Duration of residency (in years)	37 ± 29	44 ± 31	32 ± 29	0.000#

*p<0.05 is considered as significant, derived from the Chi-squared test for the HHs with or without animals
#p<0.05 is considered as significant, derived from the t-test for the HHs with or without animals
HH: Household; US$: Data collected in INR and converted to US$ @ 1US$=70INR

to seek primary health care services from private health care providers. On enquiring about the reasons for this, the ease of geographic access (nearer to the place of residence) was most commonly indicated. Similarly, the preferred mode of animal health services was also from the private sector; however, for these no public options are available. On enquiring about the HSC at the community level, it was found that human health workers only visited 69.3% of HHs during the last year. Among them, the most frequent healthcare workers are female health workers (Accredited Social Health Activist (ASHA) and/or Aanganwadi Worker (AWW)) followed by the male health workers (Multi-Purpose Health Worker (MPHW) and/or Malaria Sanitary Inspector (MSI)). Similarly, from the animal health system, any of the animal healthcare workers visited 58.7% HHs during the last year. Among them, private veterinarian doctors (87.4%) visited most often to provide healthcare services during the last year at at study subject residences as shown in Table 2.

On calculating the HSC score, it was found that for the human health system, the mean (SD) score was 15.11 ± 6.01 and for the animal health system, it was 12.09 ± 3.43. The details are shown in Table 3. Overall, the score for both systems are significantly different in the form of first contact, coordination, family centeredness. This indicates that the healthcare workers of the human health system are perceived well by the community. These three dimensions are in the same line, as when there are any

Table 2. Health system contact and primary care among the surveyed households in Ahmedabad, India from October 2018 to July 2019.

Variables	Total N=460 (%)	HHs with animal(s) n=230 (%)	HHs without animal(s) n=230 (%)	*p*-value
Preferred place to seek health services				
Public sector	179 (38.9)	76 (33)	103 (44.8)	
Private sector	260 (56.5)	145 (63)	115 (50)	0.081
Others (Pharmacy/Traditional)	21 (4.6)	9 (4)	12 (5.2)	
Preferred mode of getting health awareness and/or education				
Mass media	227 (49.3)	108 (47)	119 (51.7)	0.305
Health worker	250 (54.3)	132 (57.4)	118 (51.3)	0.190
Relatives/Friends	56 (12.2)	19 (8.3)	37 (16.1)	0.010*
Visit of any human health provider at doorstep (in last one year)	319 (69.3)	168 (73)	151 (65.7)	0.175
Type of human health provider at the doorstep (n=319)#				
Female HW (ASHA/AWW)	307 (66.7)	163 (70.9)	144 (62.6)	0.060
Male HW (MPHW/MSI)	159 (34.6)	81 (35.2)	78 (33.9)	0.539
Doctor	3 (0.7)	3 (1.3)	--	--
Visit of any animal health provider at doorstep (in last one year)	--	135 (58.7)	--	--
Type of animal health provider at the doorstep (n=135)#				
Animal Health worker		8 (5.9)		
Public Veterinarian	--	25 (18.5)	--	--
Private Veterinarian		118 (87.4)		
Prefer place for animal health services				
Public sector		58 (25.2)		
Private sector	--	150 (65.2)	--	--
Others (Pharmacy/Traditional)		22 (9.6)		

*p<0.05 is considered as significant and derived through chi-squared test
#Data are n (%) or n unless otherwise stated
HW: Health worker; ASHA: Accredited Social Health Activist; AWW: Aanganwadi Worker; MPHW: Multi-purpose Health Worker; MSI: Malaria Sanitary Inspector

problems, community members first prefer to contact these health care workers (first contact) and then the health care worker coordinates the care between different levels of providers (coordination). In addition, healthcare workers were also valued in family health concerns in decision-making (family centeredness). Whereas for the animal health system, this was not the case, as there were no community animal health workers among the surveyed population and veterinarians are the only source of contact. In both cases, these groups are culturally competent and are able to provide comprehensive services.

Awareness of Zoonoses and Preventive Practices

The investigation of the knowledge and awareness level of selected zoonotic diseases revealed that 58.5%, 47.6%, and 4.6% know about rabies, swine and/or bird flu, and brucellosis, respectively. Further, enquiring about the preventive practices for the above mentioned zoonoses, awareness was found to be poor with a mean (SD) zoonoses score of 0.32 ± 0.26 and for the respective diseases: 0.34 ± 0.31 for rabies, 0.21 ± 0.26 for flu, 0.02 ± 0.1 for brucellosis as shown in Table 4. About 30% of HHs reported that they had at least one case of dog bite during their lifetime and nearly all of those surveyed (96.7%) knew that the mode of transmission for rabies was through dogs. About half (47.2%) were unaware of the general symptoms of rabies and 16.4% preferred traditional remedies such as applying turmeric/snuff powders to the wound as treatment. However, most of those surveyed (86.2%) reported that the anti-rabies vaccine was available in either public or private health care facilities. Sixty-three percent of respondents indicated that they report dog bite cases to the municipality health office. On enquiring about the flu, the mode of transmission was not known to 42.5% of the HHs. In addition, general preventive practices for any flu, such as wearing

Table 3. Perception on different dimensions of health system contact among the surveyed households in Ahmedabad, India from October 2018 to July 2019.

Dimensions of HSC	HSC for the human health system (n=319)	HSC for the animal health system (n=135)	*p*-value
Comprehensiveness of service delivery	2.55 ± 1.39	2.33 ± 1.34	0.051
First contact	2.16 ± 1.39	1.11 ± 0.48	0.000*
Community orientation	2.53 ± 1.38	2.69 ± 1.35	0.123
Coordination	2.15 ± 1.39	1.16 ± 0.61	0.000*
Family centeredness	2.31 ± 1.41	1.39 ± 0.89	0.000*
Cultural competence	3.41 ± 0.94	3.41 ± 0.79	0.451
Total HSC score	15.11 ± 6.01	12.09 ± 3.43	0.000*

**p<0.05 is considered as significant and derived from two-sample T-test using variables with unequal variance
Min-Max for the individual dimension is liker scale of 1-4 (least to highest satisfaction)
Min-max for the total score is 6-24 (least to highest satisfaction)

Table 4. Awareness of selected zoonotic diseases among the surveyed households in Ahmedabad, India from October 2018 to July 2019.

Variables	Total	HHs with animals(s)	HHs without animals(s)	*p*-value
	N (%)	***n (%)***	***n (%)***	
Heard of Rabies	269 (58.5)	140 (60.9)	129 (56.1)	0.372
Heard of Brucellosis	21 (4.6)	18 (7.8)	3 (1.3)	0.004*
Heard of Flu	219 (47.6)	105 (45.7)	114 (49.6)	0.570
Heard of zoonoses	345 (75)	176 (76.5)	169 (73.5)	0.568
	Mean ± SD	***Mean ± SD***	***Mean ± SD***	***p*-value**
Awareness score for Rabies	0.34 ± 0.31	0.35 ± 0.31	0.33 ± 0.32	0.284
Awareness score for Brucellosis	0.02 ± 0.1	0.03 ± 0.01	0.01 ± 0.01	0.004#
Awareness score for Flu	0.21 ± 0.26	0.19 ± 0.26	0.21 ± 0.27	0.189
Awareness score for zoonoses	0.32 ± 0.26	0.32 ± 0.26	0.32 ± 0.27	0.443

*p<0.05 is considered as significant and derived from the Chi-squared test
#p<0.05 is considered as significant and derived from the two-sample T-test

a mask (36.1%), covering the face while sneezing (16%), and reducing contact with crowded places (14.2%) were found to be low among the surveyed population. Only 2.3% of the population had ever received the flu vaccine and 76.7% were not aware of its availability. Overall, the brucellosis awareness level was found to be very low (4.6%). About one-third of the population still prefer to drink raw milk in their daily life.

Health System Contact and Zoonoses Awareness

With the zoonoses awareness score as the dependent variable and other factors as independent variables, the regression model indicated that zoonoses knowledge is significantly influenced by age, education, and contact with the animal health system. An increase of 1 year of age was associated with a mean increase of the zoonoses awareness score of 0.3% (Coef. 0.003; 95% CI: 0.001 to 0.005). Having formal education leads to a 16% (Coef. 0.168; 95% CI: 0.109 to 0.228) increase of the zoonoses awareness score. Among the other socio-demographic factors, gender, living above the poverty line, duration of residence in the surveyed community, or higher income have not shown any significant correlation with the zoonoses score. Although significance was not reached, a negative correlation between animal keeping and zoonoses awareness was observed, ie, HHs without animals have a 3.4% (Coef. 0.034; 95% CI: -0.027 to 0.096) higher zoonoses awareness score. On the one hand, people that prefer public health facilities have 2% higher awareness scores (Coef. 0.019; 95% CI: -0.031 to 0.071). On the other hand, more health system contacts at the community level correspond to higher chances of awareness of zoonoses, for the human health system 1.3% (Coef. 0.013; 95% CI: -0.039 to 0.065) and the animal health

Table 5. Factors accountable for the zoonoses awareness among the surveyed households of Ahmedabad, India from October 2018 to July 2019.

Factors	Coef. [95%CI] of Model-I#	Coef. [95%CI] of Model-II*
Age (cont. per year)	0.003 [0.001 to 0.005]	0.002 [0.001 to 0.004]
Gender (Female vs Male)	0.013 [-0.041 to 0.068]	0.022 [-0.028 to 0.073]
Education (No vs Formal)	0.168 [0.109 to 0.228]	0.157 [0.102 to 0.212]
Living with APL (BPL vs APL)	0.017 [-0.039 to 0.072]	0.016 [-0.035 to 0.067]
Income (cont. per what sum?)	$1.98e^{-6}$[$-5.26e^{-8}$ to $4.00e^{-6}$]	$1.88e^{-6}$[$1.51e^{-8}$ to $3.75e^{-6}$]
Residency in the surveyed area (cont. per year?)	0 [-0.000 to 0.001]	0 [-0.001 to 0.001]
Households without animal(s) (No vs Yes)	0.034 [-0.027 to 0.096]	0.036 [-0.020 to 0.092]
Public health facilities as preferred point of care (Pvt. vs Public)	0.019 [-0.031 to 0.071]	0.018 [-0.028 to 0.065]
Mass media as preferred source of awareness (No vs Yes)	0.047 [-0.003 to 0.097]	0.047 [0.001 to 0.093]
Healthcare worker as preferred source of awareness (No vs Yes)	0.005 [-0.042 to 0.059]	0.006 [-0.039 to 0.053]
Human health system contact (No vs Yes)	0.013 [-0.039 to 0.065]	0.008 [-0.040 to 0.056]
Animal health system contact (No vs Yes)	0.086 [0.017 to 0.154]	0.077 [0.014 to 0.141]

Normalized zoonoses score as the dependent variable
Adj. R-squared= 0.083 (Model-I) and 0.084 (Model-II) for the surveyed HHs (N=460)
#Model-I: Awareness score does not accounted for the wrong response, ie, correct, no/wrong responses(scored as 1-0)
*Model-II: Awareness score accounted for the myths and/or wrong response, ie, correct, no, wrong (scored as 1-0-(-1))

system 8.6% (Coef. 0.086; 95% CI: 0.017 to 0.154). Among HSC, the animal health system contact was found to be significantly correlated with the awareness of the zoonoses, ie, HHs who have contacted any veterinarian within the last year were found to be aware about the zoonoses. On accounting for the myths/wrong response this animal HSC score reduced from 8.6% to 7.7% (Coef. 0.077; 95% CI: 0.014 to 0.141). Another interesting finding about the preferred source for the awareness of zoonoses found to be mass media, it appears to increase the awareness score by almost 5% in the model-II (Coef. 0.047; 95% CI: 0.001 to 0.093), compared to 0.5% (Coef. 0.006; 95% CI: -0.039 to 0.053) for community workers. The regression outcome indicates non-significance for all factors except age, education, and animal health system contact, the details are shown in Table 5. It also signifies that there is no difference between the two models, ie, accounting for the wrong response in the awareness score, except mass media as preferred source of awareness in the second model.

DISCUSSION

The HSC as one of the accountable factors for the zoonoses awareness (as hypothesized) is investigated deeply in this study with its different dimensions. The majority of HSC to the human health system occurs through female and/or male health workers; whereas for the animal health system, it was through private veterinarians at the community level. For the human health system, these grass root healthcare workers are often seen as heroes of the Indian public health system [7,36]; however, the impact of these workers on healthy behavioral changes remains a challenge to date [37,38]. The HSC with the animal health system was mostly with private veterinarians, who visit the HH only when there is a need for diagnosis or treatment. This might be because of the dearth of community animal health workers for the service delivery at the community level [8,39].

Comparing the HSC score of both systems, significant differences in the dimensions first contact, coordination, and the family centeredness are evident. This difference of impact between the human and the animal HSC might be attributed to the type of person who acts as prime contact and their different scope for the visit. A private veterinarian will not have high family centeredness and does not really serve as first contact, because he/she is the ultimate choice for explicit diagnosis and treatment. Interestingly the coordination score is also low in the animal sector, which indicates that the service is more scattered (done by different private actors) rather than a coordinated government-led service as for the human health system. For the human health system, the minimal qualification of the health workers is below matriculation, whereas for the animal health system it is a veterinary practitioner. Among the health workers of the human health system, coverage by the female health workers ie, ASHAs and/or AWWs was higher than by the male health workers,

which is evinced in the research literature, too [40,41]. For the animal health system, although the contact point was only through veterinarians, they might not serve as an entry-point, because most of them were private practitioners and curative service providers. This provides an insight into the shortcomings of the current health system and the need for more coordinated and integrated services to be provided at the community level.

As the regression result indicated that animal health system contact has (significant) influence on the degree of awareness, whereas on the contrary (but without significance) having an animal leads to lower knowledge, this seemingly contradictory finding might be attributed to the type of zoonoses assessed in this study. The factor contributing most to this negative correlation is the brucellosis awareness score (p=0.004). Rabies and flu are common to the public, whereas brucellosis is mostly of occupational origin and thus only or mostly mentioned in contact with veterinarians.

There is a dearth of studies which look at more than one zoonotic disease in a single research study in the general community in India [14,42]. Most of the studies focus either on a specific target population or a specific disease. The level of awareness on zoonoses found, defined and measured quite differently, ranges from as low as 4% to as high as 80% [14,15,42,43]. In this study, awareness about zoonoses was found to be rather low at the community level, depending on the type of zoonotic disease. This might be attributed to the type of sample selected in this study, ie, mixed general community (both HHs with and without animals), as compared to other studies where the target population were specific, eg, farmers, etc. Although 58% of the community were aware of rabies, and 47% were aware of the flu, a detailed understanding of the diseases was widely lacking. Similar findings from the literature could be traced in various studies conducted in different parts of India [44-46]. A study by Singh et al. [47] in the same geographic region among the rural communities highlighted traditional practices, ie, after dog bites, either doing nothing or adopting some religious practices, which was also observed in this study. Unlike other studies, the high awareness level for flu but low awareness about the vaccine availability [48,49], we found nearly half of the population to be aware of swine/bird flu, however, unaware of the availability of vaccines for prevention. Like Zhang et al. [50] in their review, who found the awareness level of brucellosis to be lowest in India, this study also demonstrated that only 4.7% of the population had at least heard of the disease without any detailed awareness about the disease. Although literature cites the differential practices of animal vaccination in India [51]; this study documented that about half of the HHs with animal(s) vaccinated their livestock in the last year.

Although non-significant, a finding indicated that the HHs, who reported the public health facilities as their preferred place for receiving primary health services (beyond the community level) showed higher awareness of zoonoses. The most attributed reason would be the high availability of information, education, and communication (IEC) materials at the public health facilities of India [52,53]. Similarly, mass media as the preferred mode of awareness was found to be correlated with the higher awareness score. Mass media appears to be an important channel for health promotion [54] and found to be an effective channel in changing health behavior in India for decades [55]. Therefore, as a policy recommendation, zoonosis specific (particularly awareness building for brucellosis (the risks of raw milk) and the availability of the flu vaccine) mass media campaigns may be more cost-effective and viable than trying to create a whole new system of animal health workers or strengthening the human health actors to visit door-to-door.

The hypothesis that was assumed in this study that regular contact with the health system and its actors increases awareness of zoonotic diseases has to be partially accepted. Having contact with an animal health system increases zoonotic awareness, therefore leading to the acceptance of the hypothesis. However, for the human health system the hypothesis is rejected. In order for either of these community health workers (in this case the human health actors) to serve as One Health entry points in near future, further exploration of the health system (supply-side) perspective is required.

There were several limitations of this study. First, this study was conducted in only two zones of Ahmedabad city, therefore not reaching representativeness for the whole city population. Second, the response collected for the HSC to the human system could not be clearly categorized, as respondents were not sure if the person was ASHA or AWW. Therefore, we were not able to attribute the effort to one of the cadres (ASHA is under the Department of Health & Family Welfare and AWW is under the Department of Women & Child Development). Third, as the study adapted, the snowballing (only to seek the information) in recruiting the HHs with animals, there might have been a potential selection bias, which leads to non-representativeness of the study with certain personal networks eventually over-represented. Fourthly, having just one interview partner per HH does not represent the awareness of the whole HH, but usually of those who are either the most present, the most responsible, or the most articulate person in the respective HH, which means that the actual awareness could be even lower.

CONCLUSION

At the community level, the most common HSC

was the female health care worker for the human health system and the private veterinarian for the animal health system. Although this contact was more common with the human health system (in about two-thirds of the HHs), it was not significantly correlated with the zoonoses awareness in this case. HHs with a HSC to the animal health system showed a significantly higher awareness level. The dimensions of the personal qualities of the HSC, especially their relation to the family, community, the cultural expectations, and the health system with all its elements, also need to be strengthened for these identified actors of the human health system for more coordinated and integrated services to be provided at the community level. In addition, the mass media as a public health promotion tool need to be focused for improving overall zoonoses awareness. The outreach to the HHs and the health system entry point at the community level is positioned with an elaborate network, which could be strengthened further to initiate preventive OH activities.

Key Points

- Regular contact with the human health system and its actors does not increase the awareness of zoonotic diseases in this setting, while contact with the animal health system increases the zoonotic awareness score.
- The most common HSC were female health care workers for the human health system and private veterinarians for the animal health system.
- The awareness on zoonoses and the HSC dimensions need to be strengthened through OH initiatives at the community level.

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