

Awareness and practices regarding zoonotic influenza prevention in Romanian swine workers

Peter M. Rabinowitz,^a Eileen Huang,^b Blanca Paccha,^a Sally Vegso,^a Anca Gurzau^c

^aYale Occupational and Environmental Medicine Program, Yale University, New Haven, CT, USA. ^bYale School of Public Health, Yale University, New Haven, CT, USA. ^cEnvironmental Health Center, Cluj-Napoca, Romania.

Correspondence: Peter M. Rabinowitz, Yale Occupational and Environmental Medicine Program, Yale University, 135 College Street, 3rd Floor, Room 392, New Haven, CT 06510, USA. E-mail: peter.rabinowitz@yale.edu

Background Swine workers may play a key role in transmission of zoonotic influenza viruses. At the same time, little is known about the extent and effectiveness of influenza prevention programs for these at-risk workers.

Objectives To characterize practices and attitudes regarding zoonotic influenza transmission among swine workers in Romania.

Methods We conducted a convenience survey of swine workers in Romania. The confidential survey included questions about awareness of zoonotic influenza risk, work tasks performed, flu vaccination status, and reported influenza-like illness.

Results A total of 103 workers at seven farms completed the survey. The percentage of workers reporting concern about either contracting influenza from pigs or giving influenza to pigs was 78% and 70%, respectively. Although 60% of workers reported having a sick-leave policy at work, only 7% of workers reported receiving

seasonal influenza vaccination during the past flu season. Only 5% of the workers reported flu-like illness during the past year while 3% of workers reported that pigs appeared sick with influenza over the same time period. The majority of workers reported using protective overalls and rubber boots during swine work, with lower rates of use of gloves. Reported use of respiratory protection was rare, and use of any personal protective equipment did not differ when pigs appeared ill.

Conclusions Despite awareness and concern regarding zoonotic influenza, Romanian swine workers report low rates of influenza vaccine or respiratory protection. As part of global pandemic influenza preparedness, enhanced prevention programs for swine workers should address such gaps.

Keywords Infection control, influenza, influenza vaccines, occupational exposure, swine, zoonoses.

Please cite this paper as: Rabinowitz *et al.* (2013) Awareness and practices regarding zoonotic influenza prevention in Romanian swine workers. *Influenza and Other Respiratory Viruses* 7(suppl. 4), 27–31.

Introduction

Recent events have highlighted the importance of the swine–human interface in the worldwide circulation and emergence of novel influenza viruses. The 2009 pandemic H1N1 strain of influenza A was a triple recombinant virus with swine, avian, and human components. While the origin of this virus remains speculative, a recent European study suggests that occupational transmission of H1N1 strains of influenza A from pigs to swine workers was taking place prior to the 2009 pandemic.¹ In swine production environments, transmission of influenza A infection can be bidirectional between pigs and people: during the 2009 pandemic of influenza H1N1, outbreaks were recorded in domestic swine and other animals as well as humans, with evidence that the animals were infected by humans (reverse zoonosis).² Subsequently, the variant H3N2 influenza strain, with elements of the H1N1 pandemic strain, has appeared in swine populations and has crossed into humans.³ In response to such events,

there have been recommendations for including swine workers in influenza pandemic preparedness programs⁴ as well as enhanced use of personal protective equipment (PPE) such as gloves and masks, and other infection control measures to be taken by workers on commercial swine farms.

In 2009, guidelines developed by the Centers for Disease Control and Prevention in conjunction with the US National Institute for Occupational Safety and Health and the US Department of Agriculture included the recommendation that ‘swine workers should be required to wear PPE whenever they might be exposed to live swine possibly infected with swine influenza viruses,’ and that such PPE includes as follows: ‘safety goggles to protect the mucous membranes of eyes’ and ‘disposable NIOSH-certified filtering face piece respirators (e.g., N-95, P-100, or N-100 filtering face piece respirators) that are the minimum level of respiratory protection.’⁵ However, the extent to which such guidelines are followed in practice remains unclear, and in general, little is known about use of PPE or other influenza precautions in swine workers.⁶

To assess the current status of influenza precautions among workers in large swine production facilities, we performed a convenience survey of awareness and practices regarding influenza precautions for workers employed in commercial swine facilities in Romania. Romania is a country with high pork consumption, and a reorganizing pork production system that is rapidly shifting from smaller herds to larger, more industrialized swine farming.⁷ Besides general safety and health regulations, to the best of our knowledge, there are no specific guidelines in Romania for reducing worker exposure to swine influenza viruses on commercial farms. Therefore, Romania provides an opportunity to determine current swine worker infection control practices in a country where the swine production is rapidly changing to modern farming practices but without specific regulatory or government guidance about prevention of zoonotic influenza.⁸ In particular, we sought to determine routine rates of use of PPE and other precautions that could affect influenza transmission risk, and whether workers altered such practices when performing different types of work tasks or when pigs appeared ill.

Methods

Study location

The study was conducted during summer 2012 on seven farms from three counties in the Transylvania region, Romania. Romania is a country with increasing swine production in large commercial facilities as well as a significant degree of small-scale production. Farms were selected by convenience – these included large commercial farms located within a 1-day driving distance of the study institution. These commercial farms ranged in size at the time of the survey from 1200 to 33 000 pigs and from 2 to 69 employees, and the majority of these farms were engaged in the finishing of pigs imported from other parts of Europe. At each farm, permission was obtained from the farm owner to recruit workers on the farm for the study.

Survey development

A questionnaire survey that had been previously developed with input from producers, public health experts, and swine workers⁹ to assess swine worker influenza precaution practices in the USA was translated into Romanian and pretested with volunteers before being finalized. The survey included items about worker demographics, awareness of zoonotic influenza risk, routine occupational tasks performed, PPE and other infection control precautions used during tasks, and reported health status including influenza-like illness.

Subject recruitment and survey administration

During visits to farms, workers were invited to participate in the study and offered a small stipend for participation. After

providing informed consent, a Romanian-speaking study member conducted the survey in person in a confidential manner. All study protocols were reviewed and approved by the Yale Office for Human Research Protection and the Institutional Review Board of the Environmental Health Center of Cluj, Romania, to ensure the privacy and confidentiality of study subject information. Employers (farm owners) were not involved with subject recruitment and were not given access to individual subject data.

Data analysis

Survey responses were entered into an MS Excel database (Microsoft Inc., Redmond, WA, USA) and analyzed using SAS 9.2 (SAS Institute, Cary, NC, USA). Simple frequencies (categorical variables) and univariate statistics (continuous variables) were calculated for individual survey item responses.

Results

A total of 103 workers completed the survey. Subjects were all middle-aged Caucasian, mostly male, and had on average been working with swine for 8 years (Table 1). In terms of education, a high proportion of workers completed high school or professional school (86%) and rated their general health status to be good or better (84%).

Among occupational swine work tasks reported by workers, walking the aisles was most commonly reported (74%), followed by the task of moving pigs through aisles and between units (44%), cleaning the pigs barn or truck (40%), and disposing of pigs waste products (25%) (Table 2). Less than 20% of workers reported engaging in tasks involving direct contact with pigs. All workers reported use of some type of PPE at least some of the time during routine swine work tasks (Table 3). The most common form of PPE reported was protective coveralls (91%), followed by boots or shoe covers (84%) and disposable gloves (38%). Paper dust masks were used by only a small proportion of workers (3%), while no workers reported using N95 respirators or other more protective respirator.

Table 1. Characteristics of study participants

Variable	
<i>n</i>	103
age (mean ± SD)	42.2 ± 10
gender (male)	82.5
caucasian non-Hispanic	100
years of swine work (mean ± SD)	8 ± 7.7
completed high school or professional school (%)	86
general Health – good or better (%)	84

Table 2. Workers performing a task during routine work

Task	% Of workers
Moving pigs	44
Directly handling pigs	18
Walking the aisles	74
Recording	10
Handling equipment	8
Feeding pigs	9
Disposing of waste products	25
Cleaning pig barn or truck	40
Other	30

Table 3. Workers use of personal protective equipment during routine work

PPE	% Workers ever using (%)
Heavy rubber gloves	13
Disposables gloves	38
Paper dust mask	3
N95/other filtering respirator	0
Rubber/poly boots or shoe covers	84
Goggles	0
Disposable outer garments	0
Head cover	2
Overalls	91

PPE, personal protective equipment.

Approximately one-third of workers (36%) indicated that they could tell when pigs were possibly infected with influenza (Table 4). By contrast, more than three quarters (78%) of respondents indicated concern about getting influenza from pigs, and an almost equivalent number (70%) reported concern about transmitting influenza to pigs. Almost all workers reported always showering out of the facility at the end of each day (93%), being enrolled in a program that monitors worker health at their workplace (97%) and being aware of influenza guidelines for people in contact with pigs (93%). Despite such inclusion in worksite health programs and awareness of infection guidelines, only 60% of workers reported that their employer had a sick-leave policy, and only 7% and 5% of respondents reported receiving seasonal flu vaccine in the previous flu season (2011–2012) and previous year (2010–2011), respectively. At the same time, workers reported low rates of personal influenza-like illness (5%) over the previous season, and only 3% of swine workers surveyed reported that pigs on their farm had shown signs of influenza-like illness during the

Table 4. Workers' beliefs, awareness, and behaviors toward zoonotic influenza risk

Item	% Of workers
Believe can tell when pigs are possibly infected with influenza	36
Concerned about contracting influenza from pigs	78
Concerned about giving influenza to pigs	70
Shower outside the facility at end of each day	93
Participate in a program to monitor workplace health	97
Aware of influenza guidelines	93
Received influenza vaccine in	
2010–2011	5
2011–2012	7
Had worker sick-leave policy on farm	60
Reported influenza-like illness in past season	5
Believe pigs have shown signs of influenza in past year	3
Had pigs at home	41
Had four or more pigs at home	9

previous year. Moreover, 41% of the workers reported owning pigs at their homes, and 9% of them had four or more pigs.

Workers who reported using a particular type of personal protection indicated that they used such equipment routinely (i.e., 100% of the time) when performing different tasks, with the exception of the task of cleaning barns, which was the only task where workers reported ever wearing respiratory protection (Table 5). Even during cleaning tasks, use of masks by such persons was only occasional (8.3%). Workers did not report any increased frequency of use of PPE when pigs appeared ill. In general, most workers reported washing their hands after performing routine tasks.

Discussion

This convenience survey of swine workers in Romania found that while most were enrolled in some form of employee health and safety programs, and there was concern about risk of either contracting influenza from pigs or giving influenza to pigs, rates of influenza vaccination of workers were low, as was reported use of respiratory protection, even when pigs appeared ill. At the same time, use of certain types of personal protection was high, as were rates of reported handwashing. These findings suggest that additional steps could be taken to prevent occupational transmission of influenza viruses between pigs and humans in the swine production setting in Romania and other parts of the world.

The finding of low rates of use of masks for respiratory protection is consistent with other published studies of swine

Table 5. Median percentage of task-specific use of particular types of PPE during routine work*

Routine tasks	Rubber gloves	Disposable gloves	Mask	Goggles	Boots	Overalls	Head covering	Hand washing
Moving pigs	100	100	0	0	100	100	100	98
Walking aisles	100	0	0	0	100	100	100	95
Feeding pigs	0	100	0	0	100	100	100	89
Directly handling pigs	100	25	0	0	100	100	100	100
Cleaning barns	100	100	8.3	0	100	100	0	96

PPE, personal protective equipment.

*Responses did not differ when workers suspected pigs were ill.

worker use of PPE; for example, a study in Minnesota found that 70% of swine workers ‘never’ used a mask during work.⁶ While the risk of zoonotic influenza transmission through aerosols in swine barns is not well understood, a recent study reported recovery of influenza A virus at significant concentrations in aerosols of barns where pigs had influenza.¹⁰ Therefore, the use of masks could affect the exposure of workers to influenza in pigs. Although general Romanian safety and health work regulations require employers to provide the necessary PPE based on assessment risks of a workplace,¹¹ we are not aware of specific respiratory protection standards in pig farms. Hence, reasons for the low reported use of respiratory protection in Romanian pig farms could include low availability of respirators, lack of training and education about the importance of respirators, or workers being uncomfortable when wearing respirators.

The rate of reported seasonal influenza vaccination among Romanian swine workers was lower than reported in studies of US swine workers.⁹ It was also strikingly lower than vaccine coverage rates for another occupational group considered being at high risk of influenza: healthcare workers. Seasonal influenza vaccination rates for US healthcare workers in 2011–2012 were nearly 70% in some surveys.¹² While vaccination rates even for this well-recognized and well-organized occupational group have been reported to vary widely between countries for both seasonal influenza vaccination and the 2009 pandemic H1N1 vaccine, Romania has reported relatively high (>89%) influenza vaccination coverage in healthcare workers.^{13,14} Currently, national recommendations in Romania for influenza vaccination cover only individuals aged 65 or older.¹⁴ Hence, explanations for the low vaccine coverage rate in this group of Romanian swine workers could be the voluntary condition of influenza vaccination for most adults, and the limited vaccine supply and coverage in Romania; international efforts are underway to increase national capacity for vaccine production in Romania and other countries.¹⁵ Other possibilities include the low perceived incidence of influenza in both swine workers and pigs, which could lead to a

reluctance to take additional protective measures, even though reported concern about infection was high.

While the total number of swine workers in Romania is not precisely known, agriculture workers accounted for 29% of the working population (about 9.3 million people) in that country in 2012.¹⁶ The Romanian swine industry is in rapid transition from smaller farms to larger facilities. The high rate of contact with pigs at home may not be typical of many other regions. It is possible that countries where larger production has been longer established could have more developed infection control practices. It is likely, however, that the circumstances of swine production in Romania resemble those in other rapidly industrializing locations. Regardless, there is a need to better understand worker practices across multiple types of swine production.

Study limitations include the limited sample size, convenience sample design, and the reliance on self-report of PPE usage. Larger studies that include direct observation of worker protective behavior would be useful to confirm these findings. Similarly, while workers reported low rates of influenza-like illness in both workers and pigs, it would be useful to confirm the actual incidence of influenza transmission in workers using serology or virus detection. Although about one-third of the workers indicated they believe they can tell when pigs are possibly infected with the flu, they were not asked to describe the symptoms they specifically associated with influenza infection in swine. Future studies could address the accuracy of such worker assessment of influenza in the swine herd as well as the risk of transmission of influenza either from pigs to humans or from humans to pigs.

In contrast to swine workers in many countries, the workers in this study reported being enrolled in workplace health and safety programs, which are required under Romanian law. At the same time, even though workers reported being aware of influenza guidelines, it does not appear that there are any such guidelines specific for influenza in swine production in Romania. In the future, however, existing health and safety programs could provide a structure for enhanced influenza prevention interventions,

such as increased seasonal flu vaccination as well as appropriate use of respiratory protection, measures which have been associated with reduced influenza transmission in the healthcare setting.¹⁷ Influenza prevention programs for workers also have the potential to reduce risk of reverse zoonotic transmission of influenza from workers to swine, as occurred during the 2009 H1N1 pandemic.² There is an urgent need for research to better understand the feasibility and effectiveness of such measures to reduce bidirectional influenza transmission in the swine production setting.

Acknowledgements

This study was supported by funding from the Yale School of Public Health fellowship fund as well as a feasibility grant from the Northeast Center for Agricultural Safety and Health. Portions of the work were presented at the 2nd ISIRV International Symposium on Neglected Influenza Viruses, March 7–8, 2013, Dublin, Ireland.

References

- De Marco MA, Porru S, Cordioli *et al.* Evidence of cross-reactive immunity to 2009 pandemic influenza A virus in workers seropositive to swine H1N1 influenza viruses circulating in Italy. *PLoS ONE* 2013; 8:e57576.
- Forgie SE, Keenlside J, Wilkinson C *et al.* Swine outbreak of pandemic influenza A virus on a Canadian research farm supports human-to-swine transmission. *Clin Infect Dis* 2011; 52:10–18.
- Wong KK, Greenbaum A, Moll ME *et al.* Outbreak of influenza A (H3N2) variant virus infection among attendees of an agricultural fair, Pennsylvania, USA, 2011. *Emerg Infect Dis* 2012; 18:1937–1944.
- Gray GC, Trampel DW, Roth JA. Pandemic influenza planning: shouldn't swine and poultry workers be included? *Vaccine* 2007; 25:4376–4381.
- Centers for Disease Control and Prevention (CDC). CDC Interim Guidance for Workers who are Employed at Commercial Swine Farms: Preventing the Spread of Influenza A Viruses, Including the 2009 H1N1 Virus. CDC [Internet]. 2009 Nov. Available at CDC: http://www.cdc.gov/h1n1flu/guidelines_commerical_settings_with_pigs.htm (Accessed 29 May 2013).
- Beaudoin A, Gramer M, Gray GC, Capuano A, Setterquist S, Bender J. Serologic survey of swine workers for exposure to H2N3 swine influenza A. *Influenza Other Respi Viruses* 2010; 4:163–170.
- Marquer P. Eurostat Statistics in Focus: Agriculture and Fisheries. European Union, Brussels [Internet]. 2010 Aug. Available at Eurostat: http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-SF-10-008/EN/KS-SF-10-008-EN.PDF (Accessed 6 June 2013).
- Carvajal D, Castle S. A U.S. hog giant transforms Eastern Europe. *The New York Times* [Internet]. 2009 May 5. Available at NYTimes: <http://www.nytimes.com/2009/05/06/business/global/06smithfield.html?pagewanted=all&r=0> (Accessed 15 August 2013).
- Rabinowitz PM, Fowler H, Odofoin LO, Messinger C, Sparer J, Vegso S. Swine worker awareness and behavior regarding prevention of zoonotic influenza transmission. *J Agromedicine* 2013; In press.
- Corzo CA, Culhane M, Dee S, Morrison RB, Torremorell M. Airborne detection and quantification of swine influenza A virus in air samples collected inside, outside, and downwind from swine barns. *PLoS ONE* 2006; 8:e71444.
- Parliament. Law no 319 of 14 July 2006 on safety and health of workers at work. [Internet] Romanian Official Gazette no 646/26 July 2006. Available at <http://www.inspectmun.ro/site/Legislatie/Legislatie%20SSM%20engleza/Law%20319%20on%202006.pdf> (Accessed 8 August 2013).
- CDC. Influenza vaccination coverage among health-care personnel: 2011–12 influenza season, United States. *MMWR Morb Mortal Wkly Rep* 2012; 61:753–757.
- Prematunge C, Corace K, McCarthy A, Nair RC, Pugsley R, Garber G. Factors influencing pandemic influenza vaccination of healthcare workers— a systematic review. *Vaccine* 2012; 30:4733–4743.
- Mereckiene J, Cotter S, D'Ancona F *et al.* Differences in national influenza vaccination policies across the European Union, Norway and Iceland 2008–2009. *Euro Surveill* [Internet]. 2010; 15. [cited 2013 Aug 08]; Available at Eurosurveillance: <http://www.eurosurveillance.org/ViewArticle.aspx?ArticleId=19700>.
- Tarbet EB, Dorward JT, Day CW, Rashid KA. Vaccine production training to develop the workforce of foreign institutions supported by the BARDA influenza vaccine capacity building program. *Vaccine* 2013; 31:1646–1649.
- Teichgraber M. Labour market and labour force statistics. European Union Labour force survey- annual results 2012. European Commission, Statistics in focus 14/2013. [Internet] 2013 Aug. Available at Eurostat from: http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Labour_market_and_labour_force_statistics#Data_sources_and_availability (Accessed 8 August 2013).
- MacIntyre CR, Wang Q, Cauchemez S *et al.* A cluster randomized clinical trial comparing fit-tested and non-fit-tested N95 respirators to medical masks to prevent respiratory virus infection in health care workers. *Influenza Other Respi Viruses* 2011; 5:170–179.