



Quali-quantitative study of the social variables defining transmission scenarios of Argentine Hemorrhagic Fever in the provinces of Buenos Aires and Santa Fe, 2001-2010

Estudio cualicuantitativo de las variables sociales que definen escenarios de transmisión de la fiebre hemorrágica argentina en las provincias de Buenos Aires y Santa Fe, 2001-2010

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ABSTRACT The aim of this paper was to characterize transmission scenarios of Argentine Hemorrhagic Fever in the post-vaccination period (2001-2010). The study was made up of three phases. The first consisted of a quantitative analysis using the database of the Dr. Julio I. Maiztegui National Institute of Human Viral Diseases [*Instituto Nacional de Enfermedades Virales Humanas*] regarding the confirmed cases in the period of study (221 cases). Taking into account the transmission site and the known endemic area, cases were grouped into three hypothetical transmission scenarios, identified as: a) classical, b) emerging-reemerging, c) traveling. In the second phase, in order to test these hypotheses, in-depth interviews were carried out from August to September 2011 within an intentionally selected sample of patients distributed proportionally among the three hypotheses. Finally, in the third stage, the data obtained for each hypothetical scenario were grouped into three spatiotemporal scales: the microscale (subject), the mesoscale (locality) and macroscale (region). The results show that new transmission sites are associated with the social dynamics of cereal production and port-bound routes.

KEY WORDS Argentinian Hemorrhagic Fever; Anthropology; Disease Prevention; Argentina.

RESUMEN El objetivo de este artículo es caracterizar los escenarios de transmisión de fiebre hemorrágica argentina (FHA) en el período de vacunación (2001-2010). El estudio constó de tres etapas. En la primera, se realizó un análisis cuantitativo de la base de datos del Instituto Nacional de Enfermedades Virales Humanas "Dr. Julio I. Maiztegui" (INEVH) de casos de FHA confirmados en el período (221 casos) que, sobre la base del lugar de transmisión y la zona endémica conocida, se agruparon según tres hipótesis de escenario: clásico, emergente-reemergente, y viajero. En la segunda etapa, para poner a prueba las hipótesis, se realizaron entrevistas en campo, entre agosto y octubre de 2011, a una muestra de selección intencional de pacientes distribuida proporcionalmente entre las tres hipótesis. Finalmente, en una tercera etapa, los datos generados para cada hipótesis de escenario se agruparon en tres escalas espacio-temporales: microescala (sujeto), mesoescala (localidad) y macroescala (región). Los resultados muestran que los nuevos lugares de transmisión estarían asociados a las dinámicas socioproductivas del cereal y las rutas al puerto.

PALABRAS CLAVES Fiebre Hemorrágica Argentina; Antropología; Prevención de Enfermedades; Argentina.

INTRODUCTION

Argentine Hemorrhagic Fever (AHF) is a zoonosis with its reservoir in a wild rodent, *Calomys musculinus*, thus making eradication impossible. As rodent control is not feasible due to the geographical extension of the endemic area, most efforts were aimed at the development of a vaccine. As a result of an international collaboration project led by Dr. Julio I. Maiztegui National Institute of Human Viral Diseases (INEVH) [*Instituto Nacional de Enfermedades Virales Humanas*], the Candid #1 vaccine was developed and finally registered in 2006 with the national regulatory authority: National Administration of Drugs, Foods and Medical Devices (ANMAT) [*Administración Nacional de Medicamentos, Alimentos y Tecnología Médica*]. Since the year 2007, the vaccine has been included in the National Immunization Schedule. Moreover, there is an effective specific treatment for AHF: immune plasma, which reduces lethality when transfused within the first week of the onset of symptoms (1,2).

A decrease in the incidence of the disease has been observed as a consequence of the vaccination applied to the population at risk (3); after comparing 10-year periods pre- and post-vaccination, the incidence fell from 9.8 cases per 100,000

inhabitants to 2.6 cases per 100,000 (4). After the administration of the vaccine to the population at risk, an increase in the lethality rate was registered (4) (Figure 1).

Between 2001 and 2010 relative changes have occurred in the classic epidemiological pattern (gender, age, occupation and rural-urban distribution of AHF) which, in some cases, are connected with the described public health interventions (for example, an increase in the ratio of affected women due to male-centered vaccination), while others, such as the emergence in non-historical non-endemic localities such as La Dulce (county of Necochea) and Mar del Plata (county of General Pueyrredón) in the province of Buenos Aires (5), still remained unexplained.

Who contracted AHF after the introduction of the vaccine? This research study set out to answer this question by characterizing the new possible scenarios of disease transmission.

METHODS

Design

The research design consisted of three phases. Firstly, a quantitative analysis of the spatiotemporal distribution of the frequency of confirmed cases – resulting in both cure and death – was carried out in the counties of the provinces under study. The hypotheses and the design samples were based on this data. Secondly, qualitative instruments of data collection and recording were designed. Semi-structured interviews and participant observation based on proper guidelines for patients, health care providers and employers were carried out. In a third phase, the data of the quantitative and qualitative bases were integrated and analyzed and reports, maps and graphs were developed.

Bioethics review

The Bioethics Committee of the INEVH carried out a bioethics review of the project and of the ad hoc Informed Consent form. Researchers were trained in Good Research Practices [*Buenas Prácticas de Investigación*]. Informed Consent was

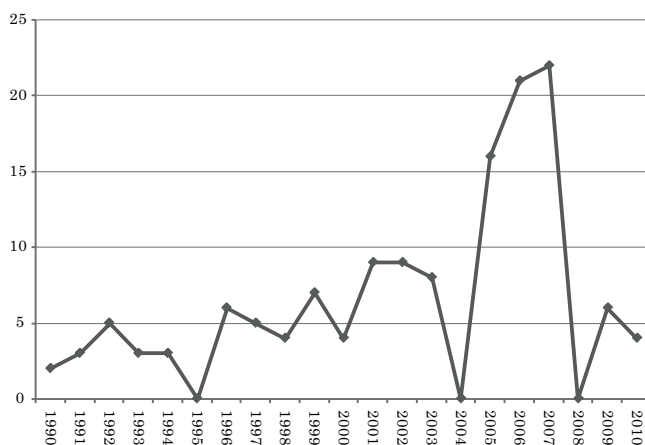


Figure 1. Progression of the lethality rate of confirmed cases of Argentine Hemorrhagic Fever in the endemic area, 1990-2010.

Source: Own elaboration using data from the National Program of Argentine Hemorrhagic Fever Control, 2011, Dr. Julio I. Maiztegui National Institute of Human Viral Diseases (INEVH), Ministry of Health, Argentina.

obtained from all interviewees and the confidentiality of the participants was protected.

Population and sample

Between 2001 and 2010 in the INEVH, the total number of AHF cases confirmed by Polymerase Chain Reaction (PCR) and/or viral isolation and/or serological seroconversion (ELISA) was 221. In the first phase, a quantitative analysis of the frequencies and spatiotemporal distribution was carried out for the total number of confirmed cases. Of these cases, 93.2% were registered in the provinces of Buenos Aires and Santa Fe.

For the second qualitative phase, a sample of 38 patients was taken from the 206 cases in these two provinces (8 from Buenos Aires, 30 from Santa Fe) with a geographical criterion of proportionality with respect to the total confirmed cured patients (5). Using the location and social relationships of the context of these 38 cases, two groups of social actors relevant to the characterization of the social representations of the health-disease-care process (HDPC) were theoretically sampled: employers and workers in the different health care facilities from different areas of health provision (prevention, assistance and management). In-depth interviews were carried out with the 38 confirmed and cured AHF cases (8 from Buenos Aires and 30 from Santa Fe); 22 workers in the different health care facilities in areas of prevention, assistance and management; and 7 employers of those with confirmed cured cases or deaths due to AHF. A total of 20 participant observations were carried out in risk scenarios identified on the basis of previous research studies about the ecology of the reservoir (6).

Variables

First phase: quantitative method

Frequencies in space and time of epidemiological records of confirmed AHF cases (cured patients and deaths) were analyzed. Data on sex, age, and place of transmission were grouped in absolute values. Spatial relations between the variables *place of transmission/residence* were

examined. Hypotheses on transmission scenarios were tested with the universe of data for the selected variables. Data was grouped according to the hypotheses created and sample cases were selected on the basis of the hypotheses (theoretical non-probabilistic intentional selection of interviewees). The predominant occupations in the epidemiological record and in the bibliography on the classic transmission of the disease were analyzed to select the sites to carry out participant observation.

Second phase: qualitative methods

The phase began with the identification of three universes of social actors relevant to characterizing the social representations of the HDPC of AHF: patients, employers and workers in different health care facilities and areas (prevention, assistance and management).

In the sample of patients the following variables were assessed: economic activities over the last 5 years; territory and work, territory and recreation; patient trajectory: first symptom of alarm, self-care practices, reasons for the medical consultation, diagnostic efficacy, burden to the health system, treatment, convalescence, complications, relapses, medical discharge, immune plasma donation; labor and health: labor legislation and AHF; current work and risk; AHF as a specific disease: agent, means and mode of transmission, symptoms, treatment, consequences and sequelae; transmission: analysis of transmission scenarios from the perspective of the actor by photo elicitation; prevention: vaccines, changes in behavior after transmission.

In the sample of employers the following variables were assessed: economic activities over the last 5 years; territories and work; labor and health: protection of the health of workers; AHF as a specific disease, AHF and labor risks, AHF prevention in the workplace.

In the sample of staff in different health care facilities the following variables were assessed: AHF as a specific disease, AHF and fever syndromes; prevention, treatment, labor and AHF. In the management staff, the additional variables were: diagnostic efficiency, burden to the health system, record of epidemiological reporting, labor and AHF. In the medical assistance staff, additional

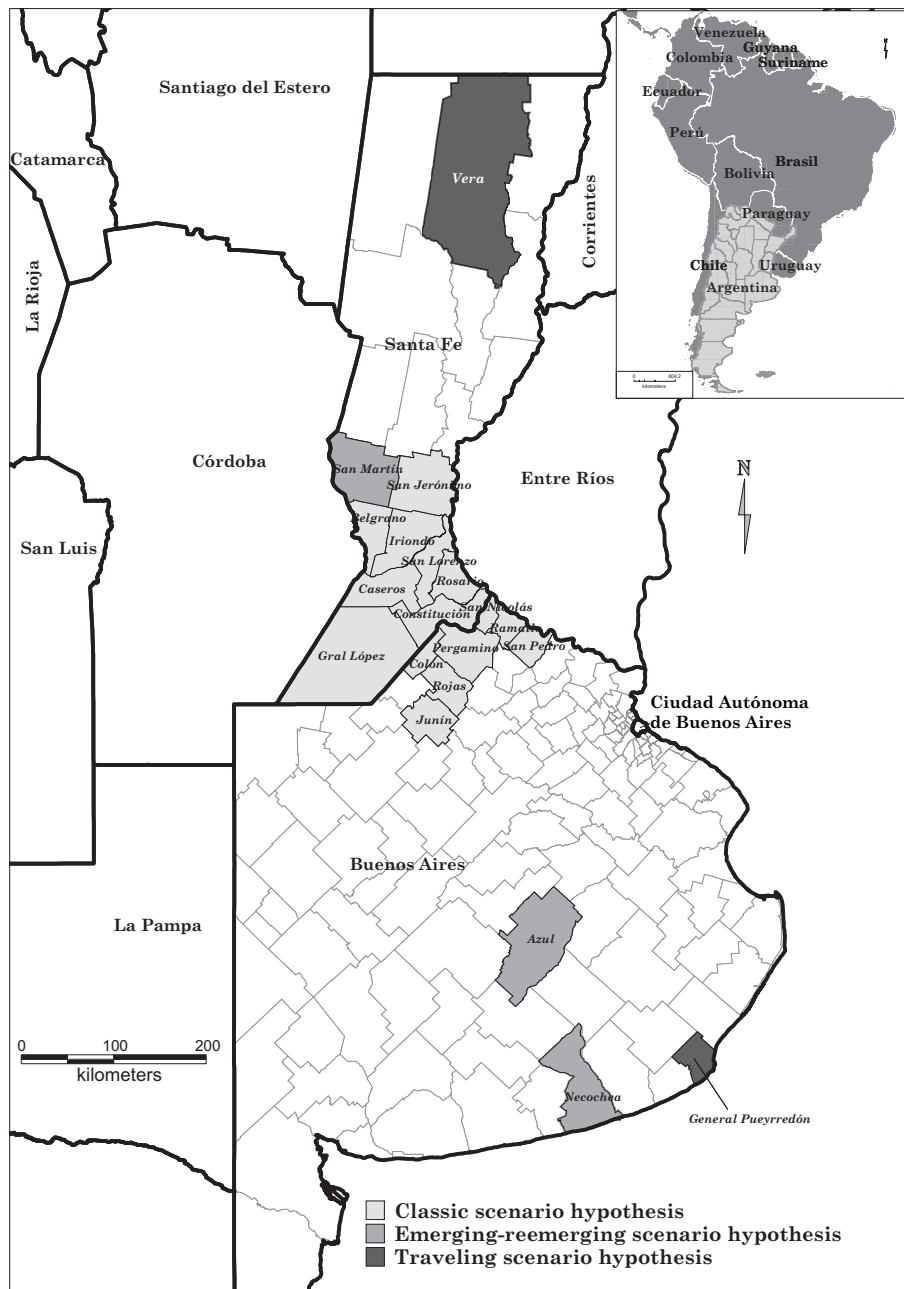


Figure 2. Distribution of counties/departments according to hypothetical transmission scenarios. Province of Buenos Aires and Santa Fe, 2001-2010.

Source: Own elaboration based on the 2001-2010 epidemiological record of the Dr. Julio I. Maiztegui National Institute of Human Viral Diseases (INEVH), Ministry of Health, Argentina.

variables were: first symptom of alarm, diagnostic efficiency, burden to the health system, treatment, convalescence, medical discharge, record of epidemiological reporting, prevention through vaccination, labor and AHF. In the prevention staff, additional variables were: primary

care, programmatic area, prevention through vaccination, record of vaccinated individuals, labor and AHF.

The integration of socio-environmental variables involved in AHF transmission was carried out through an eco-epidemiological analysis of

the scenarios of transmission (Figure 2) in three spatial and temporal scales (micro-, meso- and macroscales) and through participant observations in potential risk-generating scenarios, for example, truck stops or gas stations or truck lines along the access to ports in routes in the endemic area; silos for cereal storage in suburban areas; linear habitats: railways, perimeter fences, roadway shoulders; bag silos; rural dwellings in the endemic area (neo rural migrants, country estates); vacant lots used as pasturelands and school at the edge of a town or village.

Three semi-structured interview guides that were applicable to each of the universes under study were created and a list of sites to observe potential practices involving exposure to the risk of transmission was generated.

Third phase: plan for result analysis

The plan for result analysis distinguished three spatiotemporal scales: microscale (subject), meso-scale (locality) and macroscale (region). This plan set out to associate the environment with human practices, avoiding the overdetermination of macro variables in individual exposure to risk (7).

Microscale (subject): listening and codification in Atlas.ti software (variables selected according to hypothesis):

- Classic scenario hypothesis: *sample of patients*: economic activity and AHF as a specific disease; *sample of employers*: AHF and labor risks, AHF prevention in workplaces; *sample of health care providers*: prevention staff; primary health care, programmatic area, prevention through vaccination, record of vaccinated individuals.
- Emerging-reemerging scenario hypothesis: *sample of patients*: economic activity and AHF as specific disease; *sample of employers*: AHF and labor risks, AHF prevention in workplaces; *sample of health care providers*: medical care staff, diagnostic efficacy.
- Traveling scenario hypothesis: *sample of patients*: economic activity and AHF as specific disease; *sample of employers*: AHF and labor risks, AHF prevention in workplaces; *sample of health care providers*: medical care staff, diagnostic efficacy.

Mesoscale (locality): map drafting, analysis of space relations between environment and AHF cases for each hypothesis.

Macroscale (region): secondary data collection and analysis.

RESULTS

The quantitative analysis of the 2001-2010 epidemiological record of the INEVH evidenced that confirmed cases of AHF were concentrated in the provinces of Buenos Aires and Santa Fe.

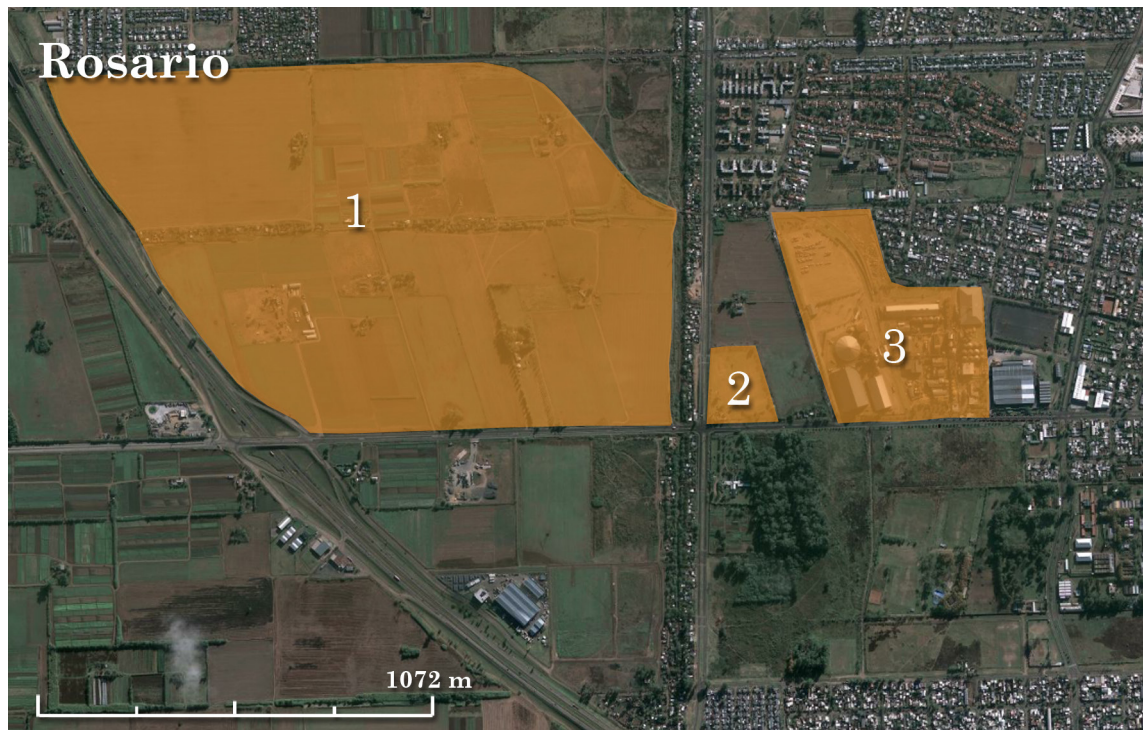
Seasonal concentration of cases was registered only in autumn, which coincides with the months of grain harvest, transportation to the port and an optimum annual rodent population rate. Many cases were grouped in particular jurisdictions of the Central Grain-growing Region [Zona *Núcleo Cerealera*] – Rosario and its outskirts, and Pergamino (5).

Within the period of study, the behavior of the total number of cases was different in Buenos Aires and Santa Fe, as if they were epidemics ruled by different social and environmental determinants. For this reason it was necessary to look at those years retrospectively to examine soil use, economic activities and vaccination, to characterize the socio-environmental variables that could have caused this differentiation.

CLASSIC SCENARIO HYPOTHESIS

The classic transmission scenario of AHF correlates the seasonal (autumn) increase of grain production and transportation with the presence of the *Calomys musculinus* reservoir and the circulation of people moving to and from the countryside, the city and the port.

The socio-environmental aspects of this scenario are defined by the grain export agro-industrial complex. The greater spatial mobility at the peak of economic activity increases the possibilities of transit through spaces within which the virus circulates.



1. Farm area.
2. Sports field of the Latin American Educational Center (CEL) [*Centro Educativo Latinoamericano*].
3. Molino Río de la Plata SA (vegetable oil and derivatives factory).

Figure 3. Area of residence of one of the informants and possible place of transmission of Argentine hemorrhagic fever, according to the classic scenario hypothesis analyzed at the microscale. Department of Rosario, province of Santa Fe, Argentina, 2011.

Source: Own elaboration using data from the research study (informant 2002390).

Classic scenario hypothesis: microscale

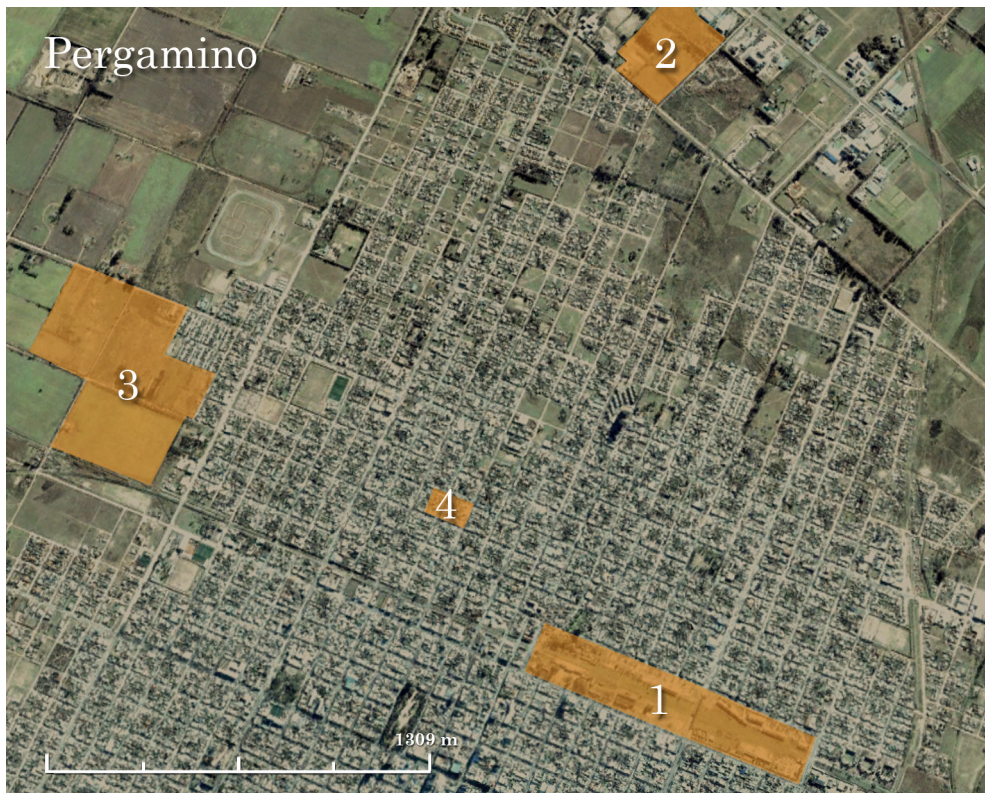
The study allowed for the specification that AHF cases confirmed between 2001 and 2010 were not only related to permanent rural occupation and/or residence (Figure 3). The following testimony gives an account of this:

When I got sick I was working as a construction worker, we were working in a rural property. At the time we were refurbishing some seed storage warehouses and we could smell the rats and mice. The seed warehouses are less than 3 kilometers away from the town [...] Most jobs are in town, but from time to time we have jobs in the countryside. I work on anything I'm called for, anything: houses, warehouses, pool remodeling. (Interview

2001590, department of Caseros, province of Santa Fe)

Transmissions have occurred in workers residing in urban areas who carried out temporary tasks in rural areas, in the context of both recreational and educational activities which implied traveling through areas of transmission (Figure 4). The association of the rural space with a natural area and the idea of nature with a healthy life decreased the perception of risk:

As an anecdote, when my children were 4 months old I made them a kite, and we'd go to the countryside to fly it. I've always enjoyed having my children grow up in the countryside, just as I did, not because I used to live there but because I like outdoor life



- 1. Railway station / warehouses
- 2. Cultivated land with recreational use
- 3. Current house of informant 200843.

Figure 4. Area of residence of one of the informants and possible place of transmission of Argentine hemorrhagic fever, according to the classic scenario hypothesis analyzed at microscale. Department of Rosario, province of Santa Fe, Argentina, 2011.

Source: Own elaboration using data from the research study (informant 200843).

[...] I'd see a wire fence, jump over it and go into the land with my children, each of us carrying a stick in hand. While we were playing, my wife would prepare mate [infusion made from yerba mate leaves] next to the wire fence under some plants and we would drink it. As time goes by, you realize that you can get sick anywhere. (Interview 200843, county of Pergamino, province of Buenos Aires)

Argentine Hemorrhagic Fever as a specific disease: patient sample

The drylands vesper mouse was identified as the transmission agent, by direct contact or aerosolization of rodent feces. Some testimonies

related transmission to transformations in rural areas, associating it with the application of herbicides and agrochemicals. Others defined the disease as rural, considering that which is rural as poor and deserted:

I used to think it was a disease of poverty. My friends made fun me. It's not my way of thinking but people associate the disease with people who live in distant or precarious places, that's what I thought before I got infected, and after I caught it I realized that had nothing to do with it, I'm not rich, I belong to the middle class, I've never been to the countryside and I caught it anyway. (Interview 2002390, department of Rosario, province of Santa Fe)

Classic scenario hypothesis: mesoscale

Rural studies on the region of the pampas during the reference period describe transformations in the model of spatial distribution of the population, as a consequence of the effect of the dismantling or closure of railway lines, agricultural intensification, technological interventions in seeds, the cultivation system, outside capital investment in agricultural activity and the agro-industrial export complex. These changes had a wide impact, since the soy production circuit (the main driver of the process) requires neither the same number of workers nor the same worker specialization. In the new rural scenario technology plays the main role in the demographic structure of the territory. The changes in the social relationships of production, in the intensification of work activities in the countryside as agribusiness, at the expense of family production, also led to cultural changes in the appraisal of the countryside and rural work. Several cities within the area of study have presented a new landscape of enclosed neighborhoods or gated communities where the producers with the highest incomes live (8-12). These residential spaces have been scenarios for AHF transmission.

Classic scenario hypothesis: macroscale

In 1996 the Argentine RR (Roundup Ready) soybean, a genetically modified organism resistant to glyphosate, was officially introduced in the markets. This "closed package," an invention of Monsanto, led to a number of transformations in agricultural and livestock production and their agro-alimentary subsidiaries (vegetable oil producers and flour mills).

The concentration of production occurred as a result of two parallel mechanisms: strong financial capital aimed at soy production and the transnationalization of supplies (seeds, biocides, fertilizers) (13-17).

The combination of direct sowing, the genetically modified seed and the agrochemical substance allowed a substantial reduction in the time spent on each season, the costs of labor and fixed expenses, resulting in an extremely simplified management of exploitation (11).

For the five-year period 2005-2009, the greatest percentages of exported grains, vegetable oil or pellets or expellers were taken abroad through the ports near the AHF endemic area of the Central Grain-growing Region (San Lorenzo-San Martín and Rosario), which could have contributed to generating the ecological conditions for the reproduction of the reservoir, since silos, storage facilities, vegetable oil producers and flour mills near the ports multiplied, increasing the possibilities of contact between humans and reservoirs, creating moments of transmission not strictly related to rural work (18).

EMERGING-REEMERGING SCENARIO HYPOTHESIS

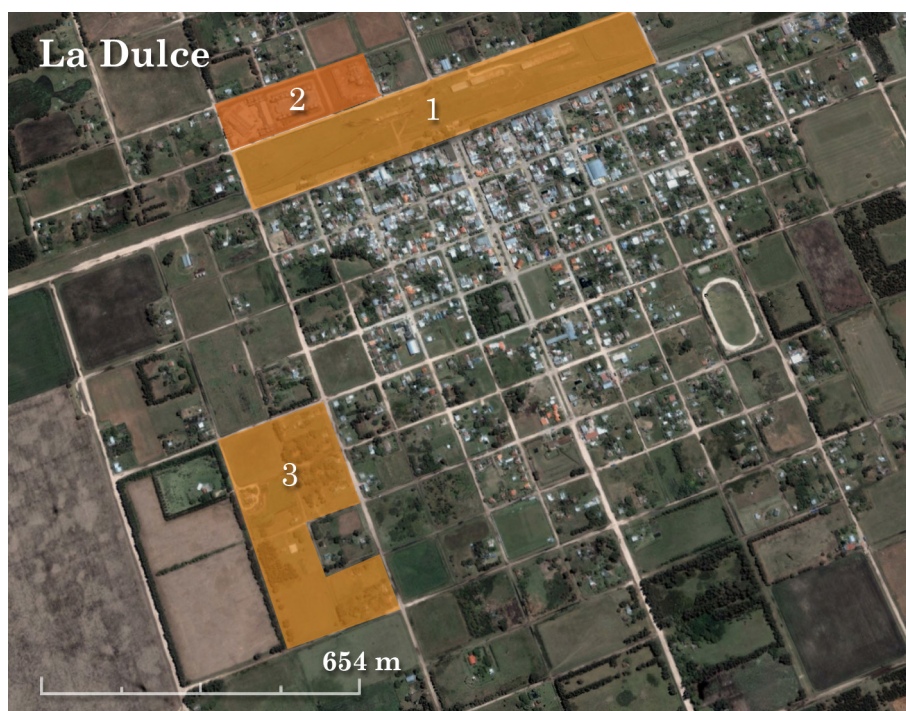
In localities situated far from the Agro-industrial Grain Complex and San Lorenzo-San Martín-Rosario port complexes, autochthonous AHF cases can possibly occur insofar as this complex operates and the rodent reservoir exists.

Emerging-reemerging scenario hypothesis: microscale

Testimonies of confirmed AHF cases were collected in Azul, La Dulce and San Jorge. At the time of transmission, the patient from La Dulce (Figure 5) was performing rural work traveling across the localities of 25 de Mayo, Tandil, Balcarce and Necochea. At the time of the interview, the patient was working for an employer in Pergamino, driving grains to Quequén Port:

I've always done the same type of work; I'd work during three seasons, most of the year sowing. The work with seeds is only seasonal, starting in October and finishing around April-May. I've worked in this kind of jobs for 8 years, and the rest of my life in the countryside, I started driving the truck this year. (Interview 2008390, county of Necochea, province of Buenos Aires)

In the county of Azul (Figure 6), the interviewee works as a driver for a paper mill located



1. Railway station.
2. Grain silos area.
3. Vacant lots / truck garages.

Figure 5. Area of residence of one of the informants and possible place of transmission of Argentine hemorrhagic fever, according to the emerging-reemerging scenario hypothesis, analyzed at the microscale. Estancia La Dulce (Nicanor Olivera), county of Necochea, province of Buenos Aires, Argentina, 2012

Source: Own elaboration using data from the research study (informant 2008390).

in Tornquist, province of Buenos Aires. His usual journey starts in that locality and ends in the western peripheral area of the Autonomous City of Buenos Aires. The informant describes that he rests and eats by the side of the route, a situation that may involve risk exposure in linear habitats with reservoirs of the virus:

Once we leave Tornquist, we sometimes buy steaks and stop in the shade and cook them right next to the road. You can lie on the grass, in the shade. You can leave the truck there and lay in the shade, on the grass, drinking some mate. But the trucks inside must remain clean, there can't be a single crumb. (Interview 2010114, county of Azul, province of Buenos Aires)

In San Jorge, the informant works in a cold storage plant; he neither lives in a rural area nor is engaged in rural activities. However, the commute to and from work, as well as the informant's recreational activities involve spaces that could entail risk exposure:

The cold storage plant is nearby, a few blocks away from the cultivated land. It's three blocks away, on the other side of the road, I walk right by when I go to work [...] I used to play in a soccer field next to the drain; now it's a sports club, but the place was neglected, it used to be rented as pastureland. I always had the bad habit of chewing on a blade of grass. (Interview 2005380, department of San Martín, province of Santa Fe)



1. Ferrosur SA railway station.
2. Area of grain silos / vegetable oil production / mills.
3. Area of silos / linear habitats.
4. Cerealera Azul (grain company).
5. Bus station.
6. Truck garage / paper transportation.

Figure 6. Area of residence of one of the informants and possible place of transmission of Argentine hemorrhagic fever, according to the emerging-reemerging scenario hypothesis analyzed at the microscale. Estancia La Dulce (Nicanor Olivera), county of Necochea, province of Buenos Aires, Argentina, 2011

Source: Own elaboration using data from the research study (informant 2010114).

Regarding the representations of disease, in an emerging-reemerging scenario, the symptoms are not associated with the AHF. This situation is shown in the testimony of one of the informants:

Some 20 years ago, I got brucellosis from working in a cold storage plant, I was treated, and then I never had any other check-ups. Since I felt almost the same symptoms, like

fever and pain in my bones and my hands, I checked into a hospital thinking it could be that. I got tested for brucellosis and the results were negative, the fever went down for a while and then up again. I spent four days feeling that way. (Interview 2005380, department of San Martín, province of Santa Fe)

Argentine Hemorrhagic Fever as a specific disease: patient sample

In the case of the emerging scenario in the county of Necochea, the informant lives in Estancia La Dulce, which was the operating village of a ranch whose railway grain station stopped running in 1975 and is now filled with grain transportation trucks that collect the harvest that has to be taken to Quequén, the closest port. Silos, truck stops, and linear habitats surrounding the abandoned railway station render it compatible with an AHF transmission scenario (Figure 5) (19).

Argentine Hemorrhagic Fever and labor risks

The case interviewed in the district of Azul exemplifies the circumstances regarding one's workplace in a reemerging context of the disease. The issue is whether AHF is a work-related disease or not, especially because the risk is associated with strictly rural work activities. In his trajectory, from the first symptoms of AHF until his recovery, a number of conflicts arose between the employer and the labor risk insurance company, which were still going on at the time of the interview.

Emerging-reemerging scenario hypothesis: mesoscale

The county of Azul is an example of how a livestock region has been affected by agricultural intensification. In the intercensal period of 1988-2002, the sown surface increased. The highest increase was due to soy and sunflower, wheat, and contract farming (a) of barley for beer (17,18).

At the beginning of the period, the agricultural social structure was characterized by the predominance of capitalized non-family producers, who owned the best lands and promoted agriculturalization. Agricultural invigoration increasingly provided more capital to family producers of mixed lands, and by 2010 they were producing grains with percentage profits by harvest with machinery under different forms of share-farming (17).

Emerging-reemerging scenario hypothesis: macroscale

The Argentine region of the pampas is the most dynamic geographical area in terms of local agricultural capitalism. In the 1960s a process of continued agriculturization began. In the vicinity of Quequén Port between 1999 and 2007, the expansion of cultivated areas was led by wheat production, followed by soy, sunflower and corn, oriented to production for the agricultural manufacture complex of raw oil, pellets and expellers, thereby generating a concentration of stockpiling systems in the areas near the ports (17,18).

Quequén is the closest port for producers in the county of Azul (271 km), followed by Bahía Blanca, which has a better infrastructure but is situated 330 km away. The locality of Estancia La Dulce, also known as Nicanor Olivera, county of Necochea, is 56 km from Quequén Port.

Most export goods mobilized by Quequén Port are grains and derivatives (vegetable oils). It is the third largest port in terms of volume of grains handled. Regarding the potential epidemiological impact of the operations on AHF transmission, the months of winter, from May to July, are those with the greatest number of lost days for loading due to wind or waves. Accordingly, since the seasonal increase of AHF transmission and the grain harvest are in autumn, an increase in transmissions is to be expected due to greater levels of activities in this port.

TRAVELING SCENARIO HYPOTHESIS

The confirmed cases not falling within the classic transmission scenario and not linked at a working level to the grain agro-industrial complex, are infected by migration or transit in the endemic area.

Traveling scenario hypothesis: microscale

The hypothesis was considered using the testimony of a confirmed AHF case living in Mar del Plata, county of General Pueyrredón, province of Buenos Aires.

The informant entered the endemic area due to his working activity, as a driver/cereal freight carrier. As such, the informant travels through the endemic area (Pergamino-Rosario port) transporting grains:

Interviewer: *Do you work for a company that owns trucks?*

Informant: *No, I went by truck from here, Mar del Plata. I contacted a transportation company called 3 de Abril in Pergamino. The company gave you the load. They provided the service but did not own any trucks. Landowners can call, say they need trucks, and order 5, 10 trucks, the trucks they need... Then, that company would send the trucks there.*

Interviewer: *Generally, as far as you know, did all the drivers work this way in Pergamino?*

Informant: *Of course, all of them. All truck companies hire freight carriers.*

(Interview 2002540, district of General Pueyrredón, province of Buenos Aires)

The possibility of receiving proper medical treatment was fortuitous, made possible due to a chance situation: a roadblock that made the informant return to Pergamino to work while suffering the first symptoms. The patient upholds that in Mar del Plata doctors would not have suspected that it was AHF.

Traveling scenario hypothesis: mesoscale

When traveling through Route 3 from the county of Azul to the county of Necochea, a number of intersections of roads and railways are crossed and stations and grain silo plants may be seen.

The locality of Chillar, in the county of Azul, province of Buenos Aires, is one of those intersections where, in the vicinity of silos and in order to increase grain storage capacity, bag silos are placed, creating linear habitats which can be suitable to the ecology of *Calomys musculinus*.

The working conditions of drivers expose them to risky practices, such as resting on the edge of grasslands that grow under the perimeter fences of the fields.

Traveling scenario hypothesis: macroscale

Studies on grain transportation highlight the importance of river transportation through the waterway due to its efficiency regarding price, use of space and amount of fuel required in the transportation. Despite this fact, since the mid-1970s the process of public disinvestment in port-bound railway transportation stagnated the load capacity of this means of transport, while since 1996 the volume of grains to be transported to mills, vegetable oil producers and ports has increased exponentially (17,18,21).

Labor theorists in Latin America have observed that the work of drivers is and has been a self-managed job (22). In some instances, at the request of the companies providing the load, drivers set up cooperatives to provide the service. On other occasions, a wealthy employer turns the company into a cooperative, leaving its workers in a clearly precarious work relationship (23,24).

In practice, job offers are usually handled by associations or networks that "request to be hired" when a truck is available. This explains why the case analyzed in this hypothesis decided to travel 617 km to Pergamino to take grains to Rosario with 8 other drivers.

The demand for qualified workers to operate grain harvesting or sowing machines of the agro-industrial complex could be the source of seasonal migrations to the endemic area.

DISCUSSION

Previous studies associated AHF transmission with rural residence or work (1,26), establishing the edges of grain cultivated land and linear habitats as spaces of circulation of the reservoir. The socio-environmental changes that occurred in the post-vaccination period had been described in a very general manner (6). The collective social actors involved in the changes had also not been described (1,2). This study allowed for the identification of changes and the new possible transmission scenarios.

In the three hypotheses of the abovementioned transmission scenarios, the grain agro-industrial export complex was considered the

economic activity that conditions the social organization of space, hence the demographic distribution, road circulation, and residential and work areas. This analysis shows how the epidemiological pattern of AHF continues to be related to grain production, despite the changes in type, extension and intensity of agricultural activity. The following challenges are still pending:

- Analysis of the strategies and coverage of Candid #1 vaccination. Analysis of the interviews to health care providers.

- Testing of the hypothesis that suggests the existence of "new linear habitats" linked to changes in the handling of grain storage in fields and silo plants.
- Detailed analysis of seasonal migration of workers and the circulation of grain transportation, to identify the population at risk for the traveling scenario hypothesis.
- Proposal of Primary Health Care strategies for the population at risk that could be implemented by the National Control program for Argentine Hemorrhagic Fever.

ENDNOTES

a. Contract farming is a mode of agricultural production which involves an agreement (usually

prior) between producers and buyers that establishes the conditions for the production and commercialization of the harvest.

ACKNOWLEDGEMENTS

We would like to express our gratitude to Doctors Maria Rosa Feuillade, Ana María Briggiler and Gladys Calderón of INEVH-ANLIS for sharing their extensive research experience in the epidemiology of AHF; Mara Eraso for her efficiency and cordiality; Marianela Figueroa for her collaboration in map drafting; and all interviewees for their participation. This research study was financed as a Collaborative Multi-center Study by the Ramón Carrillo-Arturo Oñativia grants of the National Commission of Health Research [Comisión Nacional Salud Investiga], National Ministry of Health, Argentina, 2011.

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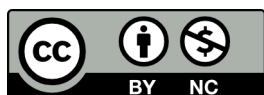
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CITATION

Mastrangelo A, Tagliabue P, Berro L, De Carolis D, Sinchi A, Digilio C, Enria D. Quali-quantitative study of the social variables defining transmission scenarios of Argentine Hemorrhagic Fever in the provinces of Buenos Aires and Santa Fe, 2001-2010. *Salud Colectiva*. 2014;10(2):171-184.

Received: 3 September 2013 | Revised: 4 February 2014 | Accepted: 20 February 2014



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The translation of this article is part of an interdepartmental collaboration between the Undergraduate Program in Sworn Translation Studies (English <> Spanish) and the Institute of Collective Health at the Universidad Nacional de Lanús. This article was translated by María Celeste Lovera and Ana María Ramírez, reviewed by María Victoria Illas and modified for publication by Vanessa Di Cecco.