Occupational zoonoses in animal husbandry and related activities

Giorgio Battelli[a], Raffaella Baldelli[a], Massimo Ghinzelli[b] and Adriano Mantovani[c]

[a]Dipartimento di Sanità Pubblica Veterinaria e Patologia Animale, Università degli Studi, Bologna, Italy

[b]Servizio Veterinario, Agenzia Sanitaria Locale, Mantova, Italy

[c] WHO/FAO Collaborating Centre for Veterinary Public Health, Dipartimento di Sanità Alimentare ed Animale, Istituto Superiore di Sanità, Rome, Italy

Summary. The fact that people working with animals or their products may contract some infections has been known for centuries, before the introduction of the concept of zoonoses. Only recently, at least in Italy, was the prevention of occupational risks taken into account by legislation in spite of the fact that some zoonoses of livestock are of noticeable socio-economic importance. Nowadays some factors such as new production technologies, trade globalisation, movements of people, changes in working conditions, are generating new zoonotic and occupational risks, some of which are considered re-emerging. The prevention of occupational zoonoses must be implemented jointly by both veterinary and medical services through prevention and epidemiological surveillance of human and animal health, risk evaluation, diagnosis of infections and working safety. Hopefully, we expect that in the future there will be better interdisciplinary collaboration and that legislation be timely tailored to the need to safeguard working health and safety.

Key words: veterinary public health, occupational zoonoses, animal husbandry, World Health Organization, legislation, Italy.

Riassunto *(Zoonosi occupazionali nelle attività zootecniche e correlate)*. Il fatto che le persone che lavorano con gli animali e i loro prodotti possano contrarre alcune infezioni è conosciuto da secoli, ancor prima dell'introduzione del concetto di "zoonosi". Solo di recente, almeno in Italia, la prevenzione dei rischi biologici occupazionali è stata presa in considerazione dalla legislazione, nonostante che alcune zoonosi degli animali in produzione zootecnica siano di notevole importanza socio-economica. Attualmente alcuni fattori, quali nuove tecnologie produttive, la globalizzazione dei commerci, gli spostamenti delle persone, cambiamenti nelle condizioni di lavoro, stanno generando nuovi rischi zoonotici ed occupazionali, alcuni considerati riemergenti. La prevenzione delle zoonosi occupazionali deve essere condotta congiuntamente dai Servizi veterinari e dai Servizi medici, attraverso la prevenzione e la sorveglianza epidemiologica della sanità animale ed umana, la valutazione dei rischi, la diagnosi delle infezioni e la loro rapida segnalazione. Per il futuro, si auspica che migliori la collaborazione interdisciplinare e che la legislazione si adegui prontamente alle necessità di tutelare la salute e la sicurezza del lavoro.

Parole chiave: sanità pubblica veterinaria, zoonosi occupazionali, zootecnia, Organizzazione Mondiale della Sanità, legislazione, Italia.

INTRODUCTION

The fact that people working with animals or their products may contract some infections has been known for centuries, before the introduction of the concept of "zoonoses". *Anthrax* and glanders are the occupational zoonoses most cited in historical references. A paper on the history of zoonoses as occupational diseases has been presented at the 35th International Congress of the World Association for the History of Veterinary Medicine [1]: hypotheses on the prehistoric evolution, on the developments in historical times and on the evolution of the concept of zoonosis were discussed.

The present paper will consider the occupational zoonoses in the Italian legislation, the involvement of the World Health Organization (WHO) in this subject, the infections considered most important in animal husbandry and related activities and the occupational categories at risk, some research performed in Italy, and finally some opinions will be expressed on the present situation and future needs and trends.

ITALIAN LEGISLATION AND OCCUPATIONAL ZOONOSES

From the legislative point of view, it should be stressed that in Italy only recently have occupational zoonoses been taken into due consideration [1, 2].

In 1865, at the dawning of the Italian Reign, the first organic health regulation of the Italian State was issued in the form of an annex to the law on the "Administrative

Indirizzo per la corrispondenza (Address for correspondence): Giorgio Battelli, Dipartimento di Sanità Pubblica Veterinaria e Patologia Animale, Via Tolara di Sopra 50, 40064 Ozzano dell'Emilia (Bologna) Italy. E-mail: giobat@vet.unibo.it.

unification of the State". This regulation, a substantial reproduction of a Sardinian law of 1859, attributed the health competences to the local administrative authorities, in co-operation with a High Health Council and with provincial and territorial health Councils. A professor of veterinary science was included among the temporary counsellors of the high health Council. The regulations of 1865 were modified in 1888 by the health Law, called Crispi-Pagliani, that was given its executive rules in 1901, pending the title discipline on the practice of health professions which was issued only by the Royal Decree of the 1st of August of 1907. The first health Laws, a result of the eagerness for reforms which shaped the new State, have laid the foundations of the Italian health services and sanctioned the belonging of veterinary action to public health.

In the field of meat safety, Royal Decree 3298 of 1928 "Regulation for the health surveillance of meat" centralised slaughter in public abattoirs promoted to the level of health structures and ruled by a veterinarian, thus becoming a focal point of zoonoses control. This Regulation was a pillar of the public veterinary practice until 1994, when it was replaced by the European Community regulations.

In 1938, the Consolidation act of health laws, partially still in force, provides for health personnel, veterinarians included, and the obligatory notification of the major communicable diseases including zoonoses.

The Regulation of veterinary police of 1954 provided the still current legal instruments for the control of infectious animal diseases. The Regulation gives a list of zoonoses which require reciprocal notification between the municipal veterinarian and the health officer. The need for medical-veterinary collaboration in the fight against zoonoses is stated by law, and will be confirmed by the Presidential Decree 264 of 1961.

In 1956, Presidential Decree 303 General regulations for occupational health established basic rules, still relevant and indispensable in the prevention of occupational diseases.

In 1965, the "Consolidation act of regulations for compulsory insurance against work accidents and occupational diseases" is issued, which constitutes a milestone in the social rules of labour protection. A distinction is here made between occupational diseases and accidents, whereas zoonoses were formerly considered "accidents", thus actually creating serious difficulties in obtaining compensation for many occupational zoonoses. In 1973, the "tables" are published of those occupational diseases liable to insurance compensation, but another 31 years shall pass before many occupational zoonoses of the zootechnical and para-zootechnical sectors are included in the lists by the Ministerial Decree (MD) of the 27th of April 2004 (List of compulsorily notifiable diseases under article 139 of the consolidation act, approved by the Presidential Decree of 27 April 1965 and subsequent integrations).

The institution of the National Health Service in 1978 strongly promotes prevention and definitively recognises the official veterinarian's role in the prevention of diseases transmissible from animals and their products.

Finally, on the 19th of September 1994, in compliance with some EC Directives, Legislative Decree (LD) 626 is issued (Implementation of Directives 89/39/EC, 89/655/EC, 89/656/EC, 90/270/EC and 90/679/EC concerning the improvement of workers' safety and health, on the workplace), which represents, along with subsequent modifications and integrations, a real turning point in the prevention of biological occupational risks, also in the veterinary field. Employers are invested with their responsibilities and the concept is introduced of the preventative evaluation of occupational risks.

Public veterinarians, although not directly involved by LD 626/94, must today comply with the duties they are given by the pre-existing regulations in collaboration with the new administrative figures committed to prevention.

This decree, by stressing again the need to safeguard workers' health, also first recognises in Italy the possibility of biological risks in the working environment. In this context, those working activities are included that imply contacts with animals, their organs and products. Biological detrimental health consequences mainly include allergic diseases (due to hairs, moulds, mites, etc.) and transmissible diseases (occupational zoonoses) caused by bacteria, fungi, viruses, protozoa, metazoa and prions. These agents are listed in the annex VIII of LD 626/94 (modified by MD 12 November 1999) and in the above-cited MD 27 April 2004. As for transmissible spongiform encephalopathies, although no certainty exists as to their transmissibility to personnel working in abattoirs and to those handling at-risk materials, MD 29 September 2000 (Annex IV) provides specific instructions on individual protection measures and equipment.

OCCUPATIONAL ZOONOSES AND WORLD HEALTH ORGANIZATION

The involvement of Veterinary Public Health (VPH) of the WHO started since the foundation of the latter (1948) and has developed over the years in cooperation with other international organizations [2].

Among the many initiatives, documents and expert meetings promoted by the WHO, mention must be made of some events we believe to be fundamental in the sector of occupational diseases in animal husbandry and related activities, since they have strongly fostered the assignment of prevention and surveillance of these pathologies to the competence of VPH.

In 1975, a joint WHO/FAO meeting of VPH experts [3] recognised zoonoses and traumas caused by different species of animals as occupational risks and stressed the need for specific knowledge for securing their prevention and control. At the meeting, the committee, upon Italian proposal, classified zoonoses from the socio-economic viewpoint as follows: 1) zoonoses with serious effects on animal production; 2) zoonoses with serious consequences both for man and for economically important animals; 3) zoonoses with serious consequences for man, but much less serious in economically important animals. Such a classification takes into account the socio-sanitary and socio-eco-

nomic significance of zoonoses. Many zoonoses possibly associated with occupational activities (brucellosis, bovine tuberculosis, anthrax, dermatomycoses, leptospirosis) belong to the first two categories.

In 1977, WHO convened an expert consultation at the Istituto Superiore di Sanità (National Institute of Health, Rome) on some VPH problems, in which occupational diseases were discussed and a recommendation on "protection of workers at special risk to zoonoses" [4] was made.

In 1982, a WHO meeting on bacterial and viral zoonoses [5], following the suggestion by Schwabe [6], classified the occupational groups and populations at high risk of zoonotic infection, and the zoonotic infections representing high risk to different occupational groups and populations.

In 1988, an international conference organised to celebrate the 900th anniversary of the University of Bologna, with a conspicuous participation of WHO members, devoted a section to problems associated with occupational hazards, especially connected with cattle farming in the Mediterranean region [7].

A chapter on the control of occupational disease hazards in animal industry was included in the guiding principles for VPH programmes published by WHO, FAO, ISS, and the Istituto Zooprofilattico Sperimentale of Teramo in 1990 [8].

A more recent event is the meeting of the WHO expert group convened in Teramo in 1999 to discuss the "future" of VPH in the XXI century, with the participation of FAO and Office International des Epizooties (now World Organization for Animal Health). The issue of occupational diseases associated with work with animals and their products is included both in the final document [9] and in the working contributions, since it is considered an emerging component of the VPH competences and activities.

The WHO/OIE Manual on echinococcosis [10] considers occupational risks and dedicates a special chapter to transhumant situations.

OCCUPATIONAL ZOONOSES: WORKS AND RISK

There exist several occupational diseases possibly involving personnel working in animal husbandry and related activities [11, 12]. Regarding proper *(sensu stricto)* zoonoses, they may affect many occupational categories, first of all farmers, and personnel working in abattoirs and processing products of animal origin *(Table 1)*. The same applies to some workers not directly working in the above sectors but sharing frequent contacts with living animals or their carcases (firemen) or with faeces or urine present in the environment (tyre repairers).

Some hundreds of such diseases are known, but those of primary importance, at least in countries with averagely developed Health Services and Plans, are far less numerous. *Table 2* lists the main zoonotic agents involved in zootechnical activities, following the classification of the LD 626/94, modified by MD 12 November 1999. Referring to the farming sector alone, we may cite, as an Italian example, brucellosis (especially in sheep and goats), leptospirosis (mainly in swine), bovine tuberculosis, dermatophytozoonoses (mainly in rabbits and cattle), cystic echinococcosis (linked to pastoral environment). These zoonoses may be a threat for a number of people who are not exclusively involved in working activities.

It is important to note that for many zoonoses, despite the importance they are attributed, epidemiological data needed to evaluate the occupational risk are most of times insufficient. For instance, the data about notified cases are often very different from those regarding really occurred or diagnosed cases. As for the Mediterranean area, the necessity to build up an information system to monitor zoonoses and risk factors had been proposed since 1993 [13].

It should be remembered that the risk (R) is considered as the product of the probability (P) an infection has to occur (incidence) within a given period of time by the negative consequences, *i.e.* the damage (D) associated with it (R = P x D). If the probability cannot be evaluated, the risk cannot be assessed either. This does not allow workers to be correctly informed about the probability to come into contact with different transmissible and potentially dangerous agents and to educate them on how to take specific defence measures.

In the majority of cases, therefore, only information can be provided on "dangers" rather than on "risks" of biological nature. Also, when cases of zoonoses occur in humans (that, unfortunately, are often not diagnosed), it is necessary that the causative agent be recognised as associated with the execution of the working activity in order that the diseases be proved linked to the profession and, hence, to receive compensation from the insurance. The demonstration of this association is often complex and verifiable (not always) only through very accurate epidemiological investigations. As a result, in the absence of recognition of many zoonoses as work-associated infections, their number will certainly be underestimated.

Table 1 | *Zootechnical and related activities, with special reference to those exposed to biological risks*

Presence of animals
- Farms, animal trade plants, fairs, markets, exhibitions, hippodromes
- Animal transportation
- Mating and seminal material production centres
- Kennels, catteries, animal housing
- Surgeries and clinics
- Diagnostic laboratories (collection and analysis of biological samples, organs, carcases)
Presence of products of animal origin
- Slaughtering (also presence of animals)
- Meat processing
- Milk collection and transportation
- Production of cheeses, dairy and egg products
- Collection, transportation and processing of carcases, wastes of animal origin, slaughtering by products (hides, hooves, horsehairs, feathers), manure and guano
- Maintenance of plants for animal waste depuration or recycling (biological refuse from farms, abattoirs, meat processing industries)
- (Production, trade and utilisation of simple and composed feeds of animal origin)

Table 2 | *Main zoonotic agents in animal husbandry and related activities (List drawn from the classification of the Legislative Decree 626/94, modified by Ministerial Decree 12 November 1999)*

By viruses and prions*
BSE and other animal TSE* (3)° , Newcastle disease (2), Rift Valley fever (3), Tick encephalitis (TBE) (3)…
By bacteria
Brucellosis (3), Anthrax (3), Chlamydiosis (avian strains) (3), Tetanus (2), Q fever (3), Swine erysipelas (2), Leptospirosis (2), Bovine tuberculosis (3), *Streptococcus suis, Salmonellae, Helicobacter pylori* infections (2) …
By fungi
Cryptococcosis (2), Histoplasmosis (3), Dermatomycoses (2)…
By parasites (protozoa and metazoa)
Cryptosporidiosis (2), Cystic echinococcosis (*Echinococcus granulosus*) (3), Larval ascaridosis (*Toxocara canis*) (2)…
( ): Classification of biological agents according to infection risk (groups 1-4).

The probability to come into contact with zoonotic agents during work depends upon such different factors as animals' health status, the worker's type of activity, the periodicity of contacts with living animals, their carcases and organs, individual and environmental preventive measures taken, the level of professional training/information on risks. The consequences of such contacts may be different and essentially depend on the immunologic status and general health conditions of the person, on the timeliness and accuracy of diagnosis in case of disease, and on the therapeutic and rehabilitative interventions adopted.

SOME INVESTIGATIONS CONDUCTED IN ITALY

From a historical point of view, mention must be made of the work carried out by Diez in 1939 on brucellosis as an occupational risk [14]. The author deals in details with risk factors for workers and categories specifically exposed and also makes a precise analysis of other authors' opinions, the role of the infection in the insurance field and which conditions should be needed to consider the infection as an occupational disease or an incident. He also cites one of his previous works of 1929 *(Infectious and parasitic diseases caused by work within the legislative framework of social insurance)* where he maintains that some infections are closely linked to the working environment.

Some epidemiological investigations will be here reported conducted on farming and abattoir personnel, which allowed us to determine the transmission risk for some zoonoses and, in some cases, to assess their prevalence and incidence in the workers examined.

In a sero-epidemiological survey on leptospirosis carried out in 1996 on 75 workers on 12 swine farms in the province of Mantua [15], 32% proved positive to pathogenic leptospira strains with titres >1:50. On all of the farms, at least one worker was found positive. The highest prevalence rates were recorded for serogroups *pomona*, *australis* and *tarassovi*, which are the most widespread in pigs in the Po Valley. Some months after the investigation, a worker found seronegative contracted a serious form of leptospirosis and was hospitalised.

During the same period, a similar research was performed on the workers of an industrial slaughterhouse where the pigs were brought from the farms under test [16]. Two blood samples were taken at 20 months' interval: the first sampling involved 52 out of a total of 80 workers of the plant (65%); the second was carried out in 83 out of 95 workers (87%). Considering 1:100 as threshold titre, 11.7% and 21.6% proved positive to at least 1 leptospiral strain at the first and the second sampling, respectively. Two people showed a titre of 1:1000, which was suggestive of a probable actual infection, while another three exhibited a titre of 1:320 possibly suggesting a recent infection, without obvious clinical signs. During such a period the incidence was reckoned to be 12.5%. In this case too, the strains with the highest prevalence were the same most frequently found in the pigs of the farms previously considered.

Streptococcus suis 2, responsible for several clinical conditions in the pig, was reported as a cause of occupational zoonosis in farmers and slaughtering personnel, which manifests itself with septicaemia and meningitis. Investigations performed in the '90s led to the isolation of the organism in swabs from the trachea and tonsils in 34% of pigs regularly slaughtered and in tonsilar swabs from swine slaughterers and farmers in the province of Mantua [16].

An episode of brucellosis reported in 1993 in the personnel of an important industrial abattoir in Lombardy involved 8 workers, 7 of whom showed evident clinical symptoms and 5 were hospitalised. The prevalence rates of the infection were 20% and 60% of the total number of slaughter workers and of the workers who had only contacts with uteruses and udders, respectively [16].

Serological investigations to detect antibodies against verocytotoxin-producing *Escherichia coli* were carried out in 63 workers of three different cattle abattoirs and in control subjects. The abattoir workers exhibited antibody titres significantly higher than those of the control group [16].

The occupational risk by *Erysipelothrix rhusiopathiae* was confirmed by a serological survey conducted in 1991 in workers of a slaughterhouse plant where *erysipelas*-affected pigs had been brought during the previous two years [17]. 15 out of the 52 individuals tested proved positive to complement fixation test (titre $\geq$ 1:8) whereas no individual was found positive of the 42 control people working in sectors completely alien to animal productions. The highest titres were observed in 6 workers with active clinical forms (2 cases of erysipeloid and 4 of influenza syndrome).

In this connection, due mention must be made of the study performed in 1999 on behalf of the Istituto Superiore per la Prevenzione e la Sicurezza del Lavoro (ISPESL) *(High Institute for Prevention and Work Safety)*, on the definition of occupational risks in farming and allied sectors. The results of the survey, stemmed from the collaboration among veterinarians, physicians and agronomists of the University, the National Health Service and the ISS, have been published in a special issue by the ISPESL [18].

During forty years of activity, the Istituto di Malattie Infettive, Profilassi e Polizia Veterinaria (presently Dipar-

timento di Sanità Pubblica Veterinaria e Patologia Animale) of the University of Bologna has observed many (mostly unpublished) cases of occupational dermatophytozoonoses [19] and mange connected with cattle, sheep, dogs, cats, rabbits and laboratory mice. Occupational zoonoses, such as listeriosis, erysipelas, brucellosis, Q fever, chlamydiosis, and cystic echinococcosis, have also been observed or investigated in epidemiological surveys, mainly performed in collaboration with physicians [20-22]. Courses and health education programmes for the control of occupational zoonoses were organised, many of which in cooperation with WHO Collaborating Centres, ISS, Istituti Zooprofilattici Sperimentali, Regional and Local Health Services, and Italian Farmers Union.

PRESENT AND FUTURE: SOME FINAL REMARKS

In the long run, the application of preventative veterinary medicine, such as abattoir inspection, diagnostic tests, vaccine prophylaxis and farming hygiene, has largely modified the occurrence of zoonoses in animals and their impact on man. Governmental prophylactic campaigns have strongly reduced the diffusion of bovine brucellosis and tuberculosis. The condemnation (and destruction) of infected carcases and viscera at the slaughterhouse have limited the spread of cystic echinococcosis, trichinellosis, taeniosis/cysticercosis, and of many other pathologies of humans and animals.

Contextually, dramatic changes have occurred in the animals' role in farming techniques and in the types of animal-man contacts. Relevant examples are the disappearance of exploitation of animals for work (draft, etc.), the introduction of machine milking or the marginalisation of horses for sporting purposes due to the advent of agricultural, military and transport motorisation. Each change has influenced the epidemiology of zoonoses and led to the gradual decrease in the number of diseases associated with obsolescent production cycles or farming techniques and, as a result, to the reduction or disappearance of some biological risks for workers involved in farming or related activities. As an example, glanders has become extinct in Italy not only thanks to the enforcement of Veterinary Police regulations but also to the disappearance of huge concentrations of equines in the army and civil transport.

The advent of the "antibiotic era", improved living conditions of animal industry workers and accessibility of health structures have mitigated the consequences of zoonoses as well as of other infectious diseases. Although no statistical data are available on this item, we may affirm that animal-associated accidents decreased in time due to the drastic reduction in the number of zootechnical workers and to the changes in the type of contacts.

Over the years new farming forms have developed such as pisciculture, rearing of wildlife for repopulation and of companion animals, while activities with exotic animal species have become important for research or for recreational purposes. The rearing of some "traditional" species such as pigs or poultry has conversely undergone so profound a change that it has actually become a reality far more different than in the past.

The introduction of animal welfare practices in the human-animal activities and veterinary responsibility is reducing the risks connected with animal-related occupations.

New activities and technologies have generated new zoonotic and occupational risks. Examples are sensitisation to zootechnical drugs, allergic alveolitis due to organic dusts, dermatomycoses in intensive breeding, mainly of beef-cattle and rabbits. Scientific research must still fully define the importance of some so-called emerging zoonoses (transmissible encephalopathies, *Escherichia coli* O157: H7 infection, avian influenza, etc.) for workers' health and the infection risks they run. In addition, some zoonoses are feared not so much as possible infectious risks for certain working categories but because they could endanger the whole population. Avian influenza, for instance, has been acquiring noticeable importance since public attention was warned against such problems as the possible transmission to man of highly virulent virus strains, the maintenance of this virulence in humans, the possibility that the virus becomes capable of inter-human transmission, the possible escape of the infection from the traditional Asian areas of rural farming.

Emerging (and re-emerging) zoonoses may derive from alterations of the ecological balances, natural or artificial mutations of infectious agents, wildlife migrations, introduction of allochthonous species, trade globalisation, movements of people from distant areas of the planet. They may also derive from changes in working conditions or workplaces, lifestyles, defence capabilities of persons to infections. But also "classical" zoonoses, often wrongly considered a problem of the past, affect people in near countries and may again spread also in Italy. Tuberculosis is an evident example of this. It is not a memory of the past century but a still present problem for so many inhabitants of the planet. Should also bovine mycobacterium be shown to play a significant role in this reappearance and in the increase of human cases then, in areas where eradication has been achieved in livestock and many workers come now from zones with high prevalence of tuberculosis, we should speak of health risks for both workers and animals, with serious socio-economic repercussions on the community.

For many years man had been living in close promiscuity with animals and the occurrence of diseases, especially when these had long incubation periods, was not perceived as an occupational accident. In addition, people in contact with animals (cowboys, shepherds, swineherds, soldiers, etc.) were usually not considered so important as to deserve medical care. Finally, available knowledge did not allow the different diseases to be always distinguished.

The professionalisation of zootechnical and parazootechnical activities led to a definition of work and risks. The social role of the workers and availability of resources (including medical ones) increased gradually. The knowledge of diseases has enabled diagnoses to be made and timely and efficacious therapies to be applied, especially in countries (or localities) with advanced social services.

Present challenges are the safeguard (defence) of laboriously attained social services and their extension to areas in want of them, adequate instruction of the per-

sonnel involved in zootechnical and related activities, and the monitoring of such activities in order to identify all existing or emerging diseases they imply. This shall be done also with the contribution and involvement of international health organizations. The role of immunodepression in increasing the susceptibility of infected workers should also be considered.

In addition, it should be stressed that the fight against occupational zoonoses coincides with the application of rational farming techniques and that human and animal health and zooeconomics are three fundamental pillars of modern farming. Indeed, rational farming techniques are not only capable of favouring animal "wellbeing" and, as a consequence, of improving their quantitative and qualitative productive performance, but also of assisting in making workplaces and different activities safer, not only as far as biological risks are concerned. To meet this goal it is also indispensable to maintain a high level of attention to animal health, implement or strengthen plans of prophylaxis and/or elimination of animal diseases of socio-economic relevance, ameliorate the training of physicians and veterinarians in the field of zoonoses control and epidemiology, and provide medical services with adequate facilities for zoonoses diagnosis.

The basic prevention of occupational zoonoses must be implemented by Veterinary Services throughout the whole production chain through appropriate tools of control, diagnosis, epidemiological surveillance and evaluation of health interventions. Medical Services must be charged with the responsibility for the prevention of risks for workers in their workplaces, the verification of the measures taken by the employer and by individual workers, the diagnosis of human pathologies and their timely notification.

Occupational zoonoses are a "common field" among different professional figures, and only interdisciplinary collaboration allows the problem to be rationally faced. Labour and health laws must follow this process and be tailored to needs in modes and times.

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