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Biological Risk at Work in Italy: Results from the National Register of Occupational Exposures

Alberto SCARSELLI[1]*, Nicoletta VONESCH[1], Paola MELIS[1], Stefania MASSARI[1], Paola TOMAO[1], Alessandro MARINACCIO[1] and Sergio IAVICOLI[1]

[1]Occupational Medicine Department, National Institute for Occupational Safety and Prevention (ISPESL), Via Alessandria 220/E, 00198 Rome, Italy

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Abstract: The aim of this study is to analyze the information on workers and exposures to biological agents in Italy, collected by the National Institute for Occupational Safety and Prevention in the period 1994–2008 on the basis of a regulation. Employers are asked to identify the biological agents and to report data on employees exposed to biological hazards. Biological agents included in the system belong to risk group 3 and 4 of the European Union classification, and are grouped by family and transmission type. Data analyzed in this study regard 90 firms (28% in "Laboratory analysis clinics" economic activity) and 2,194 workers exposed to biological agents in the period 1994–2008. The most frequent biological agent reported is *Salmonella typhi*, while the one which counted more exposures is *Mycobacterium tuberculosis*. Nonetheless the incompleteness of Italian legislative framework about "exposure registers" to biological agents in the workplace, the identification of large groups of workers "at risk" can contribute to undertake epidemiological studies aimed at the prevention of occupational infection diseases.

Key words: Microorganisms, Bioaerosols, Exposed workers, Job-related risks

The relevance of occupational exposure to biological agents, and in particular to bioaerosols, has increased in recent years considering the growing number of studies and the improvement of assessment methods for microorganisms and microbial constituents[1)]. An estimated 320,000 workers worldwide die every year of infection diseases caused by virus, bacteria, and other microorganisms[2)], and in 2001 about 1,900 cases of recognized occupational diseases in the EU-15 were due to biological agents[3)]. In Italy the protection of workers from risks related to the occupational exposure to biological agents is regulated by the Chapter X of the Legislative Decree n. 81 of 9 April 2008, which recently amended the Legislative Decree n. 626/94 (enforced to adopt the Council Directive 90/679/EEC). According to the law, biological agents are classified in four risk groups on the basis of the severity of the harmful effects they may have on workers' health. Workers who use biological agents belonging to risk group 3 (can cause severe human disease and present a serious hazard to workers; they may present a risk of spreading to the community; there is usually effective prophylaxis or treatment available) and 4 (causes severe human disease and is a serious hazard to workers; they may present a high risk of spreading to the community; there is usually no effective prophylaxis or treatment available) are included in a register containing information regarding the type of work and the biological agent. The register must be notified to the National Institute for Occupational Safety and Prevention (ISPESL).

The aim of this study is to analyze and summarize the information on workers and exposures to biological agents in Italy, collected by ISPESL in the period 1994–2008.

Data concerning exposures to biological agents are recorded in an information system named SIREP (Information System for Recording Occupational Exposures), elsewhere described in detail[4)]. Employers are required to identify the biological agents, and to report data on exposed employees and exposures to biological hazards. This information is regularly sent by mail (every three years) to ISPESL. The information about biologi-

*To whom correspondence should be addressed.
E-mail: alberto.scarselli@ispesl.it

Table 1. Number of firms, workers and percentage of exposed workers on total employees, by economic activity (SIREP, 1994–2008)

Economic activity (NACE code)	*n* Firms	*n* Workers	% Exposed workers
Production, processing and preserving of meat and meat products (15.1)	6	262	66.6
Finishing of textiles (17.3)	3	357	2.8
Collection, purification and distribution of water (41.0)	6	1,372	12.9
Administration of the State; the economic and social policy of the community (75.1)	4	1,458	1.3
Human health activities (85.1)	48	4,304	33.9
Sewage and refuse disposal, sanitation and similar activities (90.0)	6	131	73.8

only economic activities with more than 2 firms are listed.

cal hazards is divided in two subgroups: the first is related to the firm, the activity involving exposure, the biological agents and the number of employees; the second refers to exposed workers, their type of job and the biological agents involved. Biological agents included in this report are those belonging to risk group 3 and 4, while group 2 agents, although notified and recorded in SIREP, are not taken into consideration (notification for this risk group is not mandatory). For the purpose of this study biological agents are grouped by family membership and transmission type. Bacteria are grouped according to Bergey' Manual of Systematic Bacteriology[5–8], virus according to the Universal Virus Database of the International Committee on Taxonomy of Viruses (available at: http://www.ncbi.nlm.nih.gov/ICTVdb/Ictv/index.htm, accessed July 9, 2008), fungi ad parasites according to databases of the National Center for Biotechnology Information (available at: http://www.ncbi.nlm.nih.gov/Taxonomy/taxonomyhome.html, accessed July 9, 2008). Transmission type follows the definitions taken from the handbook "Control of communicable diseases in man[9]" and is classified in three different modalities: direct, indirect, and by air. In case of multiple transmission types, the most common is taken into account. Economic activities of the firms are coded according to the NACE Revision 1 classification[10], and workers occupations follow the ISCO-88 classification[11]. Descriptive statistical analyses were carried out by type and family membership of biological agent, firm economic activity and worker occupation.

The number of firms resulting from the SIREP database in which workers were exposed to biological agents is 90, while the number of exposed workers is 2,194 (49% men). The compliance rate for reporting registries to ISPESL is quite low if compared to the last industry and services data census (2001), and strongly depends on the economic sector. For example, in the "Human health activities" sector, which is best represented in the database, only about 1% of firms sent data on exposed workers to ISPESL. Also if not all the firms belonging to this sector (Human health activities) may be considered being at risk of biological hazards, the underreporting is not questionable. The number of firms and the percentage of exposed workers (compared to total employees), by economic activity, are represented in Table 1. Biological agents notified to the ISPESL are 103 (28 bacteria, 5 fungi, 10 parasites and 60 viruses), and are classified in 24 different biological families. As regards the risk group, there are 93 agents belonging to group 3 and 10 to group 4 (all viruses). The most common transmission type is by air (45% of exposed workers, of which 94% bacteria and 6% fungi), followed by indirect (38%, of which 58% bacteria, 30% virus and 12% parasites), and direct (17%, of which 64% bacteria and 36% virus). The most frequently notified biological agent is *Salmonella typhi* (reported by 38 different firms), the one which counts more exposures is *Mycobacterium tuberculosis* (about 1,100 different exposures). The distribution of firms, exposed workers and exposures grouped by type and family is reported in Table 2. The highest number of firms is in "Laboratory analysis clinics" (25 firms, 28% of the total) and "Hospital" (20 firms, 22%). The most frequent job-title recorded is "Chemical technicians" (28% of the total), the less frequent is "Garbage collectors" (about 0.2%). Exposures with job-title undefined were 41 (less than 1% of the total). In Table 3 are shown the relations between biological agents (by type and family) and workers occupations. Among gender, the "Nursing professionals" is the major occupation in women for exposures to the *Mycobacteriaceae*, while "Butchers" is the profession emerging among males for exposures to the *Brucellaceae*. For virus, the first occupation is "Hygienists, health and environmental officers" for exposures to the *Hepadnaviridae* in men (1.63% of the total), and "Chemical technicians" for exposures to the *Retroviridae* in women (1.06%). Exposures to parasites and fungi are very few (about 4% and 9% of total exposures), and mainly for "Chemical technicians" (250 expo-

Table 2. Number of firms, exposed workers and exposures by type and family of biological agents belonging to risk group 3 or 4 (SIREP, 1994–2008)

Type	Family	*n* Firms	%	*n* Workers	%	*n* Exposures	%
Bacteria	Bacillaceae	7	2.7	29	0.9	31	0.6
	Brucellaceae	20	7.7	249	7.8	840	17.3
	Burkholderiaceae	11	4.2	52	1.6	104	2.1
	Chlamydiaceae	3	1.1	55	1.7	55	1.1
	Coxiellaceae	5	1.9	14	0.4	15	0.3
	Enterobacteriaceae	39	14.9	419	13.0	771	15.9
	Francisellaceae	3	1.1	20	0.6	20	0.4
	Mycobacteriaceae	34	13.0	1,111	34.6	1,433	29.5
	Rickettsiaecea	7	2.7	126	3.9	130	2.7
Fungi	Ajellomicetaceae	9	3.4	81	2.5	186	3.8
	Onygenaceae	5	1.9	42	1.3	43	0.9
Parasites	Plasmodiidae	8	3.1	95	3.0	95	2.0
	Taeniidae	11	4.2	123	3.8	223	4.6
	Trypanosomatidae	6	2.3	86	2.7	160	3.3
	Vahlkampfiidae	3	1.1	33	1.0	34	0.7
Virus	Arenaviridae	1	0.4	–	–	–	–
	Bunyaviridae	1	0.4	–	–	–	–
	Deltavirus	8	3.1	71	2.2	71	1.5
	Filoviridae	1	0.4	–	–	–	–
	Flaviviridae	24	9.2	156	4.9	161	3.3
	Hepadnaviridae	25	9.6	268	8.3	273	5.6
	Herpesviridae	2	0.8	–	–	–	–
	Poxviridae	1	0.4	–	–	–	–
	Prione	2	0.8	21	0.7	31	0.6
	Retroviridae	22	8.4	160	5.0	179	3.7
	Rhabdoviridae	2	0.8	–	–	–	–
	Togaviridae	1	0.4	–	–	–	–

a firm may have activities involving several biological agents, as well as a worker may be exposed to more than one agent and may suffer multiple exposure work situations to the same agent.

sures for parasites of which 64% in women, and 128 exposures for fungi of which 73% in women).

The SIREP system represents, in our knowledge, the first comprehensive database on exposed workers to biological agents in Europe after the emanation of the Council Directive 90/679/EEC. Despite that ISPESL, in order to assist employers to comply with the law, has arranged forms to collect uniformly information on exposures, employers have too often disregarded or incompletely filled out aforementioned forms. Epidemiological estimates or official numbers on the amount of firms and workers involved in the exposure to biological agents are currently unavailable. Therefore it is difficult to calculate the percentage of firms in compliance with the law. The obligation of keeping a list of workers shall be applied to exposure resulting from a deliberate intention to work with a biological agent. However, the distinction between deliberate intent to work with biological agents and unintentional use was hardly identifiable from the information sent. For example, the processing and preserving of meat and meat products seems to be a sector where the use of biological agents is non-intentional and the exposure is only "potential". The main reason for the failure of the registration of exposures to biological agents is the lack of a regulation on record keeping procedures and data transmission, that has led to a broad underreporting of exposure data. In any case, data in the system, although largely not comprehensive, are a representative framework of the Italian situation, particularly in sectors where the presence of biological agents is widespread (e.g., hospitals and analysis laboratories). The analysis and discussion of this data may help to improve reporting compliance and to enhance the surveillance system.

As stated before, for practical reasons biological agents are grouped by family, although it is known that classification of microorganisms, defined as the arranging into taxonomic groups on the basis of similarities or relationships, is complicated and not definitive because of the continuous evolving of them. Family, genera and species

Table 3. Number of exposures by type and family of biological agents (risk group 3 or 4) and workers occupation (SIREP, 1994–2008)

Type	Family	Occupation	*n* Exposures	%
Bacteria	Brucellaceae	Butchers and related food preparers	532	10.96
Bacteria	Mycobacteriaceae	Nursing professionals	422	8.69
Bacteria	Mycobacteriaceae	Medical doctors	314	6.47
Bacteria	Mycobacteriaceae	Chemical technicians	270	5.56
Bacteria	Enterobacteriaceae	Chemical technicians	240	4.94
Bacteria	Brucellaceae	Chemical technicians	215	4.43
Bacteria	Enterobacteriaceae	Hygienists, health and environmental officers	162	3.34
Bacteria	Mycobacteriaceae	Butchers and related food preparers	145	2.99
Parasites	Taeniidae	Chemical technicians	108	2.22
Fungi	Ajellomycetaceae	Chemical technicians	103	2.12
Bacteria	Enterobacteriaceae	Incinerator, water-treatment and related plant operators	90	1.85
Virus	Hepadnaviridae	Hygienists, health and environmental officers	81	1.67
Bacteria	Mycobacteriaceae	Medical assistants	81	1.67
Bacteria	Rickettsiaecea	Hygienists, health and environmental officers	80	1.65
Bacteria	Enterobacteriaceae	Medical doctors	73	1.50
Bacteria	Mycobacteriaceae	Chemists	73	1.50
Virus	Retroviridae	Chemical technicians	72	1.48
Parasites	Trypanosomatidae	Chemical technicians	72	1.48
Virus	Flaviviridae	Chemical technicians	70	1.44
Virus	Hepadnaviridae	Chemical technicians	64	1.32
Bacteria	Enterobacteriaceae	Chemists	61	1.26
Parasites	Taeniidae	Chemists	58	1.19
Parasites	Plasmodiidae	Chemical technicians	52	1.07
Others			1,417	29.19
Total			4,855	100.00

only occupations with more than 50 exposures are listed.

are successively smaller, non-overlapping hierarchical subsets; on the basis of the last characteristics preventive measures can be suggested. Biological agents are also grouped by transmission type. The mode of transmission includes any mechanism through which an infectious agent is widespread in the environment or to another person, and depends on the type of pathogen. A basic understanding of how the microorganisms are transmitted and the prevention measures available can help to decrease the spread of infections.

Our findings confirm that the most frequent exposure in "Human health activities" results for bacteria belonging to the *Mycobacteriaceae* family[12] and that occupational risks related to *Salmonella typhi* exposure can be found among microbiologists and clinicians[13, 14]. Moreover, in healthcare premises infection risk following exposure to blood or body fluids is well documented[15, 16]. High values of exposed workers are documented also for *Brucellaceae* in the "Production, processing and preserving of meat and meat products[17]", and for *Enterobacteriaceae* and *Hepadnaviridae* in the "Collection, purification and distribution of water[18]".

It clearly emerges from the data presented that the failure to issue implementing regulations has noticeably hindered the launch of the registers of individual exposures to biological agents in the workplace. This lack has implied a limitation in the current coverage of the surveillance system; nevertheless the distribution of the recorded data by family group and biological type is of great interest. The systematic recording of exposures could encourage the use of systems for the personal protection of workers, and can be used to indirectly assess the effectiveness of implemented prevention interventions. Furthermore, the identification of large groups of workers who are "at risk" may allow epidemiological studies aimed at prevention of occupational diseases.

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