

# **Highly Infectious Diseases and Isolation Room Capabilities in European Countries**

## **Introduction**

In the last years emerging and re-emerging infections, as well as the risk of terrorist events with deliberately released biological agents', have attracted more and more attention from healthcare authorities. The cases of anthrax in USA during 2001, the recent Severe Acute Respiratory Syndrome (SARS) epidemic in 2003, the introduction of sporadic cases of Viral Haemorrhagic Fever (VHFs) in European countries and the eventuality of a flu pandemic due to avian virus H5N1, or other highly pathogen strains, have highlighted that these threats are now a challenge for our governments and public health systems. These newly recognised problems have evidenced the need for institutional and hospital preparedness, for identification of referral centres for patients' isolation and care, and of laboratories with adequate capabilities. Moreover, as suggested by European Union, appropriate coordination among the referral centres in European countries is essential.

As a result of the increasing demand of a prompt and effective respond planning, the European Community in 2003 co-funded the European Network for Infectious Diseases (EUNID) project. EUNID is a 3-years-long project, led by the Italian National Institute for Infectious Diseases (Istituto Nazionale per le Malattie Infettive, INMI) "L. Spallanzani", Rome. The main target of EUNID is promoting co-operation, communication and exchange of information among experts on preparedness and response to emerging or deliberately released highly infectious agents. EUNID partners are national officials from 16 European Union countries (Austria, Belgium, Denmark, Estonia, Finland, France, Germany, Greece, Ireland, Italy as Project leader, Luxembourg, Netherlands, Portugal, Spain, Sweden and United Kingdom), and work together with the Coordination Team based in Rome, and with some specifically co-opted experts. All participants are respected as authority within their fields, have broad and multi-disciplinary experience on the management of highly infectious diseases, and their participation has been agreed by relevant national authorities.

Main topic of the project are Highly Infectious Diseases (HIDs). A HID has been defined by EUNID members as 'a disease transmissible from person-to-person, that causes life-threatening illness, and presents a serious hazard in health care settings and in the community, requiring specific control measures'. The partners agreed that the diseases and agents that meet the previous definition are the following: Viral Haemorrhagic Fevers (VHFs) (Marburg virus, Ebola virus,

Crimean Congo haemorrhagic fever virus, and Lassa virus), and South American haemorrhagic fever (Junin, Machupo, Sabia, and Guanarito) viruses; SARS Co-V; multi-drug and extensively-drug resistant *M tuberculosis* (MDR- and XDR-TB); emerging highly pathogenic strains of Influenza virus; Smallpox and other orthopox infections (eg monkeypox, camel pox, but excluding vaccinia virus); other emerging highly pathogenic agents, including agents of deliberate release that meets the definition (pneumonic plague).

In the management of HIDs, in order to prevent the spreading of the diseases in the hospital setting and in the community, the isolation measures are essential. In particular, the availability of hospital rooms equipped with some technical features, such as negative pressure or anteroom, is greatly important.

With the aim of monitoring the current availability of hospital rooms appropriate for the isolation of patients with HIDs, EUNID project performed the ascertainment of a minimum dataset inventorying the isolation rooms appropriately equipped in participating countries.

The results of the inventory are presented in this report.

## **Methods**

A questionnaire was drafted by the coordination team, reviewed and edited by the co-opted experts, and sent to all national officials. In the questionnaire the following items were investigated: number of hospitals equipped with negative pressured rooms, total number of hospital beds with negative pressure, number of air changes ( $\geq$  or  $<$  of 6 air changes per hour), presence of an anteroom, route of exhausting of air and connection with a laboratory at Bio Safety Level (BSL) 3 or 4. Moreover, additional information about location of isolation rooms and availability of Intensive Care (IC) capabilities, were gathered. In the questionnaire an High Isolation Room (HIR) is defined as a single or double hospital room provided with at least negative pressure and anteroom.

Answers to the questionnaire were discussed and reviewed during both the first and second annual meeting of EUNID project (27-28 May, 2005; Rome, Italy, and 7-8 April; London, UK).

## **Results**

In **Austria** there are not HIRs. Also negative pressure rooms without anteroom are not present in the country.

Data from **Belgium** are partial: we know that there are 199 isolation beds in the country in negative pressure rooms, mostly with anteroom, distributed in 27 hospitals. We don't have additional information about logistic issues, technical characteristics and Intensive Care capabilities.

In **Denmark**, 5 hospitals have 21 HIRs with  $\geq 6$  air changes per hour, for a total number of 38 beds in HIU. All the rooms are sealed, and the air is exhausted from HIRs directly to outside without HEPA filters. These HIRs are located in the Infectious Diseases Units of the hospital building. None of these HIRs are equipped with IC capabilities.

In **Estonia**, at West-Tallinn Central Hospital a total of 15 hospital beds are available in 13 HIRs with  $< 6$  air changes per hour. The rooms are placed in the same building as other hospital facilities, and the air is exhausted outside through HEPA filters. All these rooms have no IC capabilities. At Pärnu Hospital there is 1 double Intensive Care room with  $< 6$  air changes per hour, but without anteroom. Patients with tuberculosis are treated separately in 2 specialized hospital. One of these, the Noth-Estonian Regional Hospital Kose, has HEPA outflow filters for the whole building, but not for each room.

In **Finland**, according to a survey made in May 2003, 10 hospitals have HIRs with  $\geq 6$  air changes per hour located in different wards (Infectious Disease, General Internal Medicine, Intensive Care, Surgery, Haematology). The overall number of beds in these rooms is 66. In the whole country there are 19 high isolation beds with Intensive Care capabilities. The largest facility in the country is in the Aurora Hospital of Helsinki University Central Hospital where there is a High Isolation Unit constituted by 8 rooms with 14 beds located in a separate building, devoid of IC capabilities. There are 3 additional single HIRs in the Intensive Care Unit located in the main campus of the University Hospital. In both wards the HIRs are sealed and the air is exhausted directly to outside with HEPA filters.

The data from **France** are partial: in 17 hospitals there are 67 rooms provided with negative pressure. Unfortunately, accurate information about the number of hospital beds, the presence of anteroom, the number of air changes per hours and the IC capabilities in the country are not available. Detailed data are available only about Hopital Nord in Marseille. This hospital is provided with an High Isolation Unit with 8 isolation beds in 4 sealed HIRs, placed in a separate building together with Infectious Diseases Ward. All rooms are sealed and each bed has Intensive Care capabilities. The system of air is double HEPA-filtered, both in ingress and egress, directly to outside.

In **Germany** there are 5 hospitals with HIRs with  $\geq 6$  air changes per hour, and the total number of hospital beds in these units is 16. Among these, 2 hospitals, located in Frankfurt and Berlin, have HIRs with direct connection with a BSL 3 laboratory area, while one hospital, the

Bernhard-Nocht-Institut in Hamburg, has 2 isolation beds with direct connection to a BSL 4 laboratory area. Moreover, in 2 additional hospitals there are 4 hospital beds in HIRs with  $< 6$  air changes per hour and direct connection with BSL 3 laboratory area.

All the HIRs are located in standing-alone buildings, separated from other hospital facilities. In the whole country, the number of hospital beds in HIRs with IC capabilities is 10. Data about way of exhausting of the air and the sealing of the rooms in HIRs are not available.

Three additional High Isolation Units, with a total capabilities of 14 hospital beds, are currently under construction. In particular, a High Isolation Unit with 10 beds, 6 of which with direct connection with BSL 3-4 laboratory area, is under construction at the Bernhard-Nocht-Institut in Hamburg.

In **Greece**, according to a 2004 survey conducted before the Olympic Games, there are 25 hospitals provided with HIRs with  $< 6$  air changes per hour, with a total of 67 hospital beds. HIRs are located both in a separate building from the main hospital or in a dedicated separate ward in the same building, and the HIR may be the responsibility of various specialties (Infectious Disease, General Internal Medicine, Intensive Care Units). All the rooms are sealed, and the contaminated air is exhausted directly to out side without HEPA filtration. Among these, some hospital beds have IC capabilities, but the exact number is not available.

In **Ireland** there are 10 hospitals with HIRs, with a total number of 67 hospital beds. Five additional hospitals have 10 hospital beds in rooms with negative pressure with  $\geq 6$  air changes per hour, but without anteroom. All these rooms are located in the Infectious Diseases ward, and the exhausting of the air is performed directly to outside without HEPA filters. In the country, there are not isolation hospital beds with IC capabilities.

In **Italy** 2 hospitals – the National Institute for Infectious Diseases “L. Spallanzani” (Istituto Nazionale per le Malattie Infettive, INMI), in Rome, and the Hospital “L. Sacco”, in Milan - have rooms with  $\geq 6$  air changes per hour and anteroom. At “L. Spallanzani” there are 38 single and 62 double rooms, and at “L. Sacco” there are 13 single and 34 double rooms. Totally, there are in Italy 243 hospital beds in HIRs. All these rooms are sealed, and the air is exhausted directly outside through HEPA filters. In both hospitals further isolation hospital beds (80 at National Institute for Infectious Diseases “L. Spallanzani”, and 60 at Hospital “L. Sacco”) are not routinely available but can rapidly become operative. In these hospitals, capabilities for IC can be provided in each room with portable devices. At INMI there are 2 additional hospital beds in 2 single rooms with  $\geq 6$  air changes per hour, anteroom, and direct connection to BSL3 laboratory area, while a BSL4 laboratory is present in the same campus. Moreover, a High Isolation Unit with 10 hospital beds is currently under construction in a separate building of the same campus. In the whole country 61

additional hospitals have negative pressure rooms without anteroom, with a total of 1164 hospital beds.

In **Luxembourg** the Centre Hospitalier has HIRs with  $\geq 6$  air changes per hour, with 15 hospital beds. The HIRs are not sealed, are located in the same building with other hospital facilities, are provided with an outside HEPA filtered air exhausting system, and are placed both in the Infectious Disease ward, and in the IC Unit. The total number of beds in HIRs with IC capabilities is 7.

In the **Netherlands** HIRs with  $\geq 6$  air changes per hour are located in the University Medical Centre of Utrecht, in a single ward in the same building as other hospital facilities. The total number of hospital beds is 4, and Intensive Care capabilities are available in the Unit. The rooms are sealed, and the air is exhausted directly to outside with HEPA filter. No other HIRs are present in the country, while the total number of hospitals provided with negative pressure room without anteroom is not available.

The information obtained by **Portugal** are partial but probably exhaustive. We have data from main hospitals located in the capital, centre and north of the country, Lisbon, Coimbra and Oporto respectively. According to available data, 6 hospitals have rooms with  $< 6$  air changes per hour without anteroom, and among them, 5 hospitals have HIRs with  $\geq 6$  air changes per hour and anteroom. The total number of hospital beds is 84, of which 29 in HIRs. The HIRs are placed in the same building as other hospital facilities in three of the 5 hospitals and in a single ward in two. Three hospitals have IC capabilities for 6 beds in HIRs. HIRs are not sealed and the air is exhausted directly outside through HEPA filters.

Data from **Spain** are partial, too. We have accurate information only about Catalonia, while data from other regions are not available. In Catalonia there are not HIRs. Four hospitals have rooms with negative pressure with  $< 6$  air changes per hour, without anteroom. The total number of hospital beds with these features is 53. The rooms are located in the same building as other hospital facilities, and are placed in different wards, such as Infectious Diseases, ICU and Pneumology. Among these hospital beds, 36 are equipped with IC capabilities. All these rooms are sealed, and the air is exhausted through an HEPA filtered inside re-circulation system.

In **Sweden**, Huddinge University Hospital has one HIR with  $\geq 6$  air changes per hour, with 2 hospital beds, which means only one if intensive care is needed. 28 hospitals have HIRs with  $< 6$  air changes per hour. The total number of hospital beds in these units is at least 231, but a complete audit of these facilities has not been carried out. Among these hospitals, the Linköping University Hospital has HIR with  $< 6$  air changes per hour and direct connection with BLS 3 lab area, and the hospital beds in this unit are 3, reduced to two if intensive care is needed. The HIRs are placed in

the same building as other hospital facilities, in single wards, or in Infectious Diseases wards. In the whole country, except the 3 hospital beds mentioned above, there are not other hospital beds with IC capabilities in HIRs.

In the **UK** 10 hospitals have specialist Infectious Diseases Units in which there are negative pressure rooms with  $\geq 6$  air changes per hour, each having 2 to 9 beds of this type. Many other hospitals have between one and three beds of this type, but do not have specialist infectious diseases services or direct connection to laboratory services. It is likely that hospital building regulations will lead to the provision of many more such beds in the next 5 to 10 years

There are (in London and in Newcastle) two High Isolation Units with HIRs with  $\geq 6$  air changes per hour and direct connection with a BSL 3+ laboratory area (which is BSL 3, with the agreed facility to handle Hazard Level 4 pathogens, but not to replicate them or concentrate them). BSL 4 virology laboratories exist in two sites in the UK: the Health Protection Agency Centre for Infections (CfI) in London, and the HPA Centre for Emergency Preparedness and Response (CEPR) at Porton Down near to Salisbury in the South of England. The same hospitals have high-level specialized infectious diseases units with  $< 6$  air changes per hour for the entire clinical area, with HEPA filtration of the outgoing air. The associated BSL 3+ laboratories provide patient management investigations, also, such as haematology, coagulometry, clinical chemistry, bacteriology and parasitology. The two High Isolation Units provide a total of four specialist beds. The placement of current HIUs depends on the hospital. One of the HIUs with  $\geq 6$  air changes per hour and direct connection with a BSL 3-4 laboratory area is located in a separate building, while the other one is placed in the same building as other hospital facilities, in the Infectious Diseases ward. There are 3 hospital beds in HIRs with IC capabilities. All the HIRs are sealed and the exhausting of the air is directly to outside with HEPA filters.

**Totally**, in the countries of the EUNID members, about 150 hospitals have HIRs (exact number can't be calculated, because partial data from Belgium, France, Portugal and Spain), with 915 confirmed hospital beds. Including negative pressure hospital beds from Belgium and France, mostly provided with anteroom, the number of high isolation hospital beds available may raise up to 1183. Nine out of the 150 hospitals have HIRs with direct connection with BSL3-4 laboratory area, with a total of 23 hospital beds. These "advanced" HIRs are present in 4 countries: Germany, Italy, Sweden and UK.

The data about the rooms with negative pressure but without anteroom are largely incomplete, because this information is not available for 8 countries. At the best of our knowledge, there are 71 hospitals in 4 countries with 1229 hospital beds. 61 out of the 71 hospitals, with 1164 hospital beds, are present in Italy, where a comprehensive survey was conducted short time ago by

public health authorities. The total number of beds in HIRs equipped with IC capabilities is 297, mostly present in Italy (245 beds), where the Intensive Care is provided by means of portable devices, as in the Netherlands (4 beds). The other 48 hospital beds, distributed in 6 countries, are mostly located in Intensive Care Units. Also in Greece some HIRs are provided with IC capabilities, but the exact number is not available.

Information about way of air-exhausting are available from 10 countries and from one hospital in France, while data are completely not available for 4 countries. The preferred technical solution for air-exhausting is directly to outside with HEPA filter, while in 3 countries the air is exhausted to outside, but without HEPA filtration (see figure 1).

About location of the HIRs data are available for 13 countries. As showed in the figure 2, there is not a strongly preferred solution.

**Table 1 – Isolation facilities in European countries**

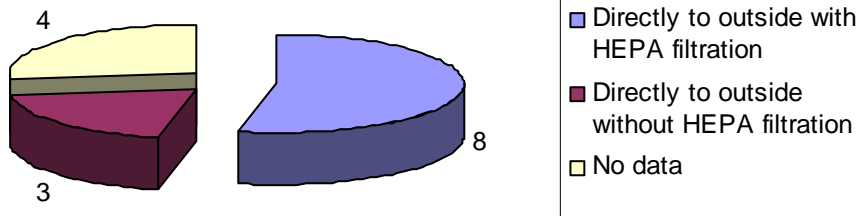
Countries		Hospital provided with HIRs with $\geq 6$ air changes per hours + direct connection with a BSL 3-4 lab area, and number of beds within	Hospital provided with HIRs with $< 6$ air changes per hours + direct connection with a BSL 3-4 lab area, and number of beds within	Hospital provided with HIRs with $\geq 6$ air changes per hours and number of beds within	Hospital provided with HIRs with $< 6$ air changes per hours and number of beds within	Hospital provided with negative pressure room with $\geq 6$ air changes per hours and number of beds within	Hospital provided with negative pressure room with $< 6$ air changes per hours and number of beds within	HIRs hospital beds with IC capabilities
Austria	Current hospitals	0	0	0	0	0	0	0
	Hospital beds	0	0	0	0	0	0	
Belgium	Current hospitals	199 negative pressure rooms in 27 hospitals, mostly with anteroom. Further data not available.						
	Hospital beds							
Denmark	Current hospitals	0	0	5	0	Data Not Available	Data Not Available	0
	Hospital beds	0	0	38	0	Data Not Available	Data Not Available	
Estonia	Current hospitals	0	0	0	1	0	1	0
	Hospital beds	0	0	0	15	0	2	
Finland	Current hospitals	0	0	10	0	0	0	19
	Hospital beds	0	0	66	0	0	0	
France	Current hospitals	67 negative pressure rooms in 17 hospitals. Further data not available.						
	Hospital beds							
Germany	Current hospitals	3	2	2	1	Data Not Available	Data Not Available	10
	Hospital beds	10	4	6	4	Data Not Available	Data Not Available	



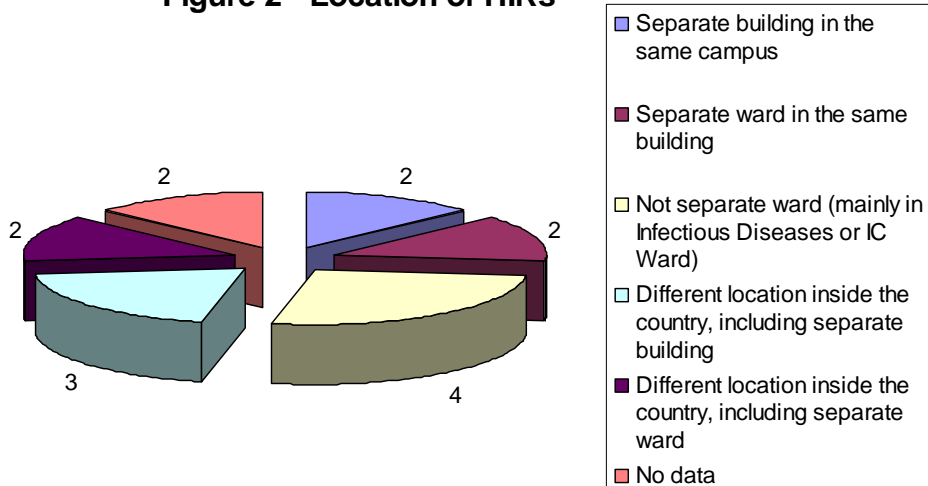
Greece	Current hospitals	0	0	0	25	0	0	Data Not Available
	Hospital beds	0	0	0	67	0	0	
Ireland	Current hospitals	0	0	10	0	5	0	0
	Hospital beds	0	0	67	0	10	0	
Italy	Current hospitals	1	0	2	0	61	0	245 (portable devices)
	Hospital beds	2	0	243	0	1164	0	
Luxembourg	Current hospitals	0	0	1	0	0	0	7
	Hospital beds	0	0	15	0	0	0	
Portugal	Current hospitals	0	0	5	6	Data Not Available	Data Not Available	6
	Hospital beds	0	0	29	55	Data Not Available	Data Not Available	
Netherlands	Current hospitals	0	0	1	0	Data Not Available	Data Not Available	4 (portable devices)
	Hospital beds	0	0	4	0	Data Not Available	Data Not Available	
Spain (Catalonia only)	Current hospitals	0	0	0	0	0	4	0
	Hospital beds	0	0	0	0	0	53	
Sweden	Current hospitals	0	1	1	28	Data Not Available	Data Not Available	3
	Hospital beds	0	3 (2 if IC)	2 (1 if IC)	231	Data Not Available	Data Not Available	
UK	Current hospitals	2	2	10	0	Data Not Available	Data Not Available	3
	Hospital beds	2	2	About 50	0	Data Not Available	Data Not Available	

Total*	Hospital beds	14	9 (8 if IC)	520 (Belgium and France not included)	372 (Belgium and France not included)	1174#	55#	297 (249 with portable devices)
<p>* = total number of hospital can not be calculated, because some hospital have more type of rooms, and are reported on more than one column</p> <p># = partial data, information not available in most countries</p>								

**Figure 1 - Way of air-exhausting from HIRs**



**Figure 2 - Location of HIRs**



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