Feasability study
for a collaborative
surveillance of
Listeria infections
in Europe

Final Report

INSTITUT PASTEUR

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INSTITUT DE
VEILLE SANITAIRE

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Abbreviations in alphabetical order

CNS	Central nervous system
CSF	Cerebrospinal fluid
DNA	Desoxyribo Nucleic Acid
EU	European Union
EQS	External quality control
InVS	Institut de veille sanitaire
MOH	Ministry of Health
NCCL	National Culture Collection Laboratory
NRL	National Reference Laboratory
NSC	National Surveillance Centre
PCR	polymerase chain reaction
PFGE	Pulse Field Gel Electrophoresis
PHLS	Public Health Laboratory Services
UK	United Kingdom
WHO	Word Health Organization

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Summary

Summary

Apart from the economic consequences and dangers, listeriosis remains of great public health concern because of its high case fatality, and its common source epidemic potential. Changes in the way food is produced and distributed have created the potential for diffuse and widespread outbreaks involving many countries as a result of contamination of a widely distributed commercial food product. Because these outbreaks can be dispersed with a limited number of cases in each country, they are likely to go undetected without pooling information from these countries. Improved surveillance that combines rapid sub-typing methods, cluster identification, and collaborative epidemiological investigation can identify and halt these potentially large outbreaks.

The Institut de veille sanitaire in St Maurice and the Institut Pasteur in Paris received funding from the European Commission DG SANCO, to carry out a European survey on the surveillance of human listeriosis and on methodologies and practices of national reference laboratories for *Listeria*. The aim of this project was to identify the need for, and to define the feasibility and scope of a European network on *Listeria* infections based on an inventory and comparative analysis of existing surveillance systems as well as national reference laboratories for *Listeria* throughout the European Union (EU).

This reports summarises the findings from the survey and the results of the discussions during the project meetings with the participants. It also discusses the recommendations made by the participants for a future European network for human *Listeria* infections.

The project involved the epidemiologists responsible for *Listeria* infections and the microbiologists in charge of the national reference laboratory from 14 EU countries, Norway, Iceland, and Switzerland.

Data for the inventory were collected through two mail surveys sent to the National Centers for Surveillance of communicable diseases and to the reference laboratories for *Listeria*. When necessary, information obtained through the questionnaires was validated or completed through telephone interviews with the persons concerned. An expert panel composed of epidemiologists and microbiologists from 10 countries reviewed the findings of the inventory, assessed the feasibility of different scenarios for European surveillance, and drew up a proposal for the scope, the objectives, project components and operating procedures for a future *Listeria* surveillance network. During a final meeting with all participants, the findings and proposals were discussed and recommendations for a future network were drawn up.

The inventory shows that surveillance systems for listeriosis are operational in the large majority of countries and could form the basis of European surveillance. At present, all participating countries except Portugal have at least one surveillance system of listeriosis.

Listeriosis is statutorily notifiable in 10 countries, whereas 4 countries have universal voluntary reporting and 2 countries sentinel surveillance. Moreover, 5 countries have syndrome based surveillance of infections of the central nervous system and blood stream infections. Listeriosis surveillance data are available at the national level in 16 countries, either at the National Surveillance Centre (5 countries), at the National Reference Laboratory (1 country) or both (10 countries). These data at the national level are available as single case reports in all countries. Data transmission to the national level is immediate or weekly in all countries, except in Italy where it is quarterly.

All countries base their case definition of listeriosis on the isolation of *Listeria monocytogenes*, with or without specific requirements regarding the site of isolation and the presence of clinical symptoms. Two countries would also consider the presence of serial antibodies as a laboratory confirmation of a case, but in practice only cases with an isolate are reported. In general, countries with listeriosis surveillance collect at least basic demographic data (age or date of birth, sex), contact details of the reporting institute, laboratory confirmation (date of isolation of *Listeria monocytogenes* or date first positive specimen received in diagnostic laboratory), and the type of investigated material. Additional information such as principal diagnosis, associated pregnancy, outcome, and travel and food history, are available in between 5 to 10 countries.

The incidence of reported cases varies between 0.3 and 7.5 cases per million per year. Five countries reported an incidence of more than 4 cases per million and three countries of more than 6 per million population. These figures reflect the incidence of the disease, as well as the sensitivity of the surveillance systems. Few countries have formal evaluations allowing to estimate sensitivity, geographical coverage and representativeness of their surveillance systems. In general, the surveillance systems cover in principal the entire country except for Spain where approximately half of the autonomous communities are covered.

From 1991 to 2002, a total of 19 outbreaks of invasive listeriosis have been reported in 9 different countries. Whereas the number of reported outbreaks increased gradually over time, from 7 outbreaks detected in the period 1992-1996 to 11 in the period 1997-2001, the mean number of cases related to these outbreaks decreased from 57 to 11 over the same period. This suggest more efficient outbreak detection and investigation.

All countries, except Ireland, have a National Reference Laboratory (NRL). Ireland occasionally uses PHLS (UK) as their Reference Laboratory. Tasks of these NRL are microbiological surveillance (16), detection of outbreaks (14), provision of microbiological expertise (13), research on *Listeria* (12), training (9), and provision of reference material (8). Fifteen NRL receive strains from other, mostly hospital based laboratories. Strains are sent systematically in 7 countries, and in the remaining countries according to the will of the laboratory, or in specific situations such as outbreak or suspected outbreak settings. Fourteen NRL perform at least one typing method on human strains. At present, for outbreak detection, 12 countries have results of typing of strains available, routinely and on a real time or weekly basis: serotyping (12 countries), bio-typing (4 countries), ribotyping (3 countries), Pulse Field Gel Electrophoresis (PFGE) analysis (6 countries), and phage-typing (1 country). To participate to a common surveillance system, 7 countries which do not yet carry out routine ongoing PFGE-typing of strains, would be willing either to set up routine, at least weekly, PFGE with image analysis or to send their strains to the NRL of another country for PFGE analysis. Thus, European surveillance including results of harmonised characterisation of isolates by PFGE of *Listeria monocytogenes* strains isolated from human cases could cover at least 13 countries.

During the final meeting with all participating countries, the participants concluded that there is a clear added value of a European surveillance network of *Listeria* infections, and that a surveillance network based on the existing national surveillance systems is feasible and meaningful.

It was recommended that the main objectives of a future surveillance network should be to provide comparative data to monitor trends of international importance, and to rapidly detect and more efficiently investigate international outbreaks, through real-time sharing of information and the development of harmonised methods. In addition, the network should contribute to the strengthening of national surveillance in participating countries. In its initial phase the network should concentrate on surveillance of human cases of *Listeria* infection and not yet actively seek to collect data on food isolates. Once the network is well established and surveillance of human cases is operational, the possibilities to include data from food and animal surveillance should be studied.

The surveillance network should be developed using common case definitions, and a common minimum data set which would be further developed over time to include additional data (optimal data set). Case definitions, in line with those developed by the Community Network under decision N° 2119/98/EC, and a minimum and optimal data set, for which the collection is, at present, feasible for the majority of participating countries, were proposed.

Because of the disparity of *Listeria* outbreaks, a common European data base should include results of real time characterisation of strains to reinforce the ability to detect international outbreaks. The participants concluded that characterisation by both serotype and PFGE would be the most appropriate methods and the best option to meet the objectives of outbreak detection and trends analysis. The necessary harmonisation of microbiological methods and of the type of epidemiological data that are collected appears feasible considering the infrastructure already in place and the expressed willingness of countries to adapt or set up methodologies in the perspective of European surveillance.

The network should encourage individual countries to strengthen their national surveillance of *Listeria* infections and contribute to their strengthening by providing a model and specific tools for surveillance and investigations. Participating countries should be encouraged to increase the sensitivity of the surveillance systems to reinforce the ability to detect national and international outbreaks. Countries can participate in a stepwise manner, contributing initially with the data they have available, even if incomplete. With time, countries may wish to adapt their in-country data collection in order to cover all data fields in the data base. For those countries where routine and ongoing typing of strains is difficult to carry out because of the low number of isolates, the possibility of having their strains typed in NRL of another country, should be studied.

In addition to the harmonisation of epidemiological and microbiological methods and the creation of a common data base, it was recommended that the network should develop outbreak detection algorithms and a protocol for collaborative investigation of international clusters and outbreaks. The network will need to develop principles of collaboration that should deal with access to the data base by participants and by outsiders, confidentiality of country specific data, confidential and public domain reports, data protection requirements, as well as transmission to other programmes and projects. It was recommended to adapt the principles of collaboration of Enternet to *Listeria*.

Finally, the participants recommended that a project proposal will be developed by the coordinators of the actual feasibility study and that an application will be submitted to the European Commission under the programme of community action in the field of public health (2003-2008).

Introduction

Listeria monocytogenes has been recognised as a human pathogen for more than 50 years. It causes invasive illness mainly in certain well defined high-risk groups, including immunocompromised persons, pregnant women and neonates. However listeriosis can occur in otherwise healthy individuals, particularly in the setting of an outbreak. *L. monocytogenes* primarily causes abortion, infections of the central nervous system, or septicaemia. Unlike infection with other common food-borne pathogens, listeriosis is associated with a high case fatality rate of approximately 20-30% (1). Only recently has it been recognised that food borne transmission of *Listeria monocytogenes* can also cause a self-limiting acute gastro-enteritis in immunocompetent persons (2).

Epidemiological investigations during the last 20 years have shown that epidemic listeriosis is a foodborne disease (3). Similarly, recent studies have suggested that a substantial proportion of sporadic cases of listeriosis are also caused by consumption of contaminated foods (4,5). Discovery of *Listeria monocytogenes* mainly in raw and ready-to-eat meat, poultry, seafood, and dairy products prompted numerous product recalls which have led to large financial losses for the industry and numerous health scares. These discoveries and the multiple outbreaks that have occurred as a result of food contamination have led to increased regulatory activity, implementation of Hazard Analysis and Critical Control Points (HACCP) programmes throughout the food industry, and specific recommendations to high-risk groups. Following these measures, a substantial decrease in incidence has been documented in several countries, such as in France and the USA where respectively a 3 fold and a 2 fold reduction in incidence over the last decade was attributed to a series of preventive and control measures (6,7). However, several countries still have relatively high incidence rates and many countries do not have a surveillance system allowing them to estimate incidence or evaluate trends in incidence.

The public health importance of listeriosis is not always recognised particularly because listeriosis is a relatively rare disease compared to other common food-borne illnesses such as salmonellosis. Most countries within the European Union have an annual incidence between 2-10 reported cases per million population per year. However, because of its high case fatality rate, listeriosis ranks among the most frequent causes of food borne death: in the USA and France, it ranks second only after salmonellosis, in England it ranks fourth (8,9,10).

Therefore, besides its economical consequences, listeriosis remains of great public health concern. In addition, its common source epidemic potential presents a real threat and persists even in countries with a decreasing or low incidence.

Several host related and environmental factors contribute to an increasing risk of *Listeria* infection. The ongoing epidemic of AIDS, as well as the widespread use of immunosupppressive medications for treatment of malignancy and management of organ transplantation, has expanded the immunocompromised population at increased risk of listeriosis. Also, consumer life styles have changed with less time for food preparation, more ready to eat and take away foods. Changes in food production and technology have led to the production of foods with long shelf life that are often widely distributed often over several countries. These ready to eat foods with long shelf life are typical '*Listeria* risk foods', since the bacteria have the time to multiply, and the food does not undergo a listericidal process such as cooking before consumption. Increased mass production means outbreaks can change from being small and confined to a community or region, to large, affecting hundreds of people.

Thus, changes in the way food is produced and distributed have created the potential for diffuse and wide-spread outbreaks involving many countries as a result of contamination of a widely distributed commercial food product. Because these outbreaks can be dispersed with a limited number of cases in each country, they are likely to go undetected without pooling information from these countries. International exchange of data on disease incidence, characteristics of cases and strains, outbreaks and the foods involved, is extremely important to identify trans-national clusters originating from a common source. Improved surveillance, co-ordinated at a European level, that combines rapid sub-typing methods, cluster identification, and collaborative epidemiological investigation can identify and halt these

potentially large, outbreaks. Investigations of these outbreaks can require co-ordinated efforts of multidisciplinary teams in several countries to clarify the extent of the outbreak, implicate a specific food and determine the source of contamination.

The risk of trans-national outbreaks is not hypothetical. From 1987 to 1989, more than 350 cases of listeriosis occurred in England and Wales, due to an imported contaminated pâté (11). In 2001, an outbreak that occurred in Belgium was identified by French investigators since a case had developed symptoms during his vacation in France. Recently, an outbreak of 11 cases in France was linked to the consumption of spreadable raw sausage. The incriminated product, having been exported to Belgium, Germany, and Luxembourg, may have given rise to cases in these countries. In the absence of European surveillance and mechanisms for collaborative outbreak investigation, it is at present difficult to link cases in these countries to the French outbreak.

Because of the above described potential benefits of collaborative European surveillance, this project was initiated with the aim to define the feasibility and scope of a European network on *Listeria* infections and to develop common methodologies for surveillance of listeriosis in Europe.

Currently, a European database (named IRIDE) is being developed and updated, describing the most important means and resources available in Europe for the control of communicable diseases. However, at present there are no detailed data about existing surveillance systems for *Listeria* infection nor about algorithms and microbiological methods and tools used for surveillance and outbreak detection.

Therefore, this project started by carrying out an inventory of existing surveillance systems and outbreak detection methods for listeriosis in Europe as well as of reference laboratories and their role, practices and methods.

It was anticipated that a proposal for a *Listeria* network would be developed and submitted to the European Commission if it is concluded by the project participants that such a network is feasible and desirable under the conditions proposed by the project.

Methods

The project has been coordinated by the Institut de Veille Sanitaire (InVS) and the National Reference Centre for *Listeria* at the Institut Pasteur. The project leaders were assisted by an expert panel. This panel reviewed the data collection tools developed by the project team, discussed findings, evaluated the feasibility and scope of a European network on *Listeria* infections and provided recommendations for operating procedures for *Listeria* surveillance. The panel met twice during the project period and brought together microbiologists from national *Listeria* reference laboratories and epidemiologists in charge of surveillance of communicable diseases. The panel also included a representative from the Enternet network in order to build on the experience gained within an existing network and two participants of the WHO-International Multicenter *Listeria monocytogenes* subtyping study. The experts in the panel represented the whole spectrum of different settings of the participating countries in terms of epidemiology of listeriosis, surveillance systems and health systems.

Data for the inventory were collected through two mail surveys. When necessary, information obtained through the questionnaires was validated or completed through telephone interviews with the persons concerned.

I. Epidemiology and surveillance

A questionnaire was sent to epidemiologists in charge of surveillance of communicable diseases at the national level. This questionnaire collected information on the following items:

– type of surveillance systems (statutory notification, universal voluntary reporting, sentinel surveillance, syndrome based surveillance, surveillance through national reference laboratories), other data sources (surveys, ad hoc studies), information flow, case definitions, type of data collected, frequency of reporting and analysis, outbreak detection mechanisms, reported cases and outbreaks.

II. Microbiology

This questionnaire was sent to the national reference laboratory(ies) for human *Listeria* infections, whether these laboratories were «officially appointed» or not. In countries without national reference laboratory, the questionnaire was completed by laboratories that carry out reference tasks for human *Listeria* infections. These laboratories could be at regional, provincial or any other subnational level. In countries where several laboratories have a significant reference function, a questionnaire was completed by each of these laboratories. The laboratories that were asked to complete the questionnaires were identified by the person in charge of surveillance of communicable diseases at the national level.

The microbiology questionnaire collected information about the status of the laboratory, their role as reference laboratory, origin of isolates, identification and typing methods and practices (routine and specific investigations), antibiotic resistance surveillance, quality assurance and control.

Analysis of these first questionnaires suggested that for European surveillance, a central data base of cases and isolates and their characterisation by serotyping and PFGE would be the best option to meet the objectives of outbreak detection and trends analysis. Therefore it was decided to explore this option in further detail and a second questionnaire was sent out on acceptability, capacity and possibilities of reference laboratories to perform PGFE typing of *Listeria monocytogenes* routinely and with a common protocol.

Expert panel meetings

The expert panel met twice in 2002, once in March and once in June.

During the March meeting the panel:

• discussed the preliminary findings of the inventory of *Listeria* surveillance and laboratory methods in Europe,

- selected scenarios for European surveillance to be explored,
- made a preliminary assessment of the feasibility of these scenarios,
- identified supplementary data to be collected.

During the June meeting the panel:

- discussed the findings of the questionnaire on acceptability, capacity and possibilities of reference laboratories to perform PGFE typing of *Listeria monocytogenes* routinely and with a common protocol,
- drew up a proposal for the objectives, case definitions and data to be collected in a future Listernet project,
- discussed the strategy of project submission.

Working visits

The project proposal had foreseen that working visits would be carried out to selected countries if the panel would consider this necessary to better assess a specific country situation. In view of the findings of the inventory it was decided that such visits were not necessary since all the necessary information could be obtained through the questionnaires and telephone interviews. Therefore no such visits have been carried out.

Meeting with all participating countries

On September 13th 2002, a meeting with epidemiologists and microbiologists from each participating country was held in Paris. During this meeting the results of the inventory were presented and different scenarios for European *Listeria* surveillance were proposed and discussed by the participants. At the end of the meeting, recommendations for the development of a European listeriosis surveillance network were formulated.

Results

In total, 17 countries, 14 EU countries (Austria, Belgium, Denmark, England and Wales and Scotland, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal, Spain, Sweden) as well as Norway, Iceland, and Switzerland participated in the inventory. Scotland and England & Wales completed separate questionnaires. In this report, the results of Scotland are presented separately from England & Wales. However, when enumerating countries, England & Wales and Scotland are counted as one single country.

Epidemiology and surveillance

Surveillance systems

At present, all participating countries except Portugal have at least one surveillance system of listeriosis and 12 countries have more than one system (table 1). All 16 countries with surveillance mention monitoring of trends in incidence and improvement of epidemiological knowledge on the disease as objectives of their system(s) (table 2). In addition, outbreak detection is an objective of at least one of the systems in 13 countries (all except the Netherlands, Greece and Italy) and targeting food safety interventions in 12 countries.

Statutory notification

Listeriosis is statutorily notifiable in 10 countries: Belgium – the Flemish community only –, Denmark, Finland, France, Germany, Iceland, Italy, Norway, Sweden and Switzerland (table 3). In several countries, notification of food-borne illness (eg Austria and Ireland) or food-borne illness outbreaks (eg Belgium, the Netherlands, France) is statutory and theoretically *Listeria* infections could be notified through these systems. However, in practice, listeriosis cases are not notified through these systems. Therefore, in this inventory, we do not consider notification of food-borne illness and outbreaks as a system of statutory notification for listeriosis.

Most countries (Belgium, Denmark, Finland, Germany, Sweden, and Switzerland) have statutory notification since 1996 or earlier. In France and Iceland, statutory notification was introduced in 1998 and 1999, respectively. In Germany, only pregnancy-associated cases were notifiable, until 2001, when statutory notification was introduced for all listeriosis cases.

Cases are notified by physicians only (Flemish community in Belgium, Italy), by laboratories only (Denmark and Germany), by physicians and laboratories (Finland, France, Iceland, Norway and Switzerland) or by physicians, laboratories, and pathologists (Sweden).

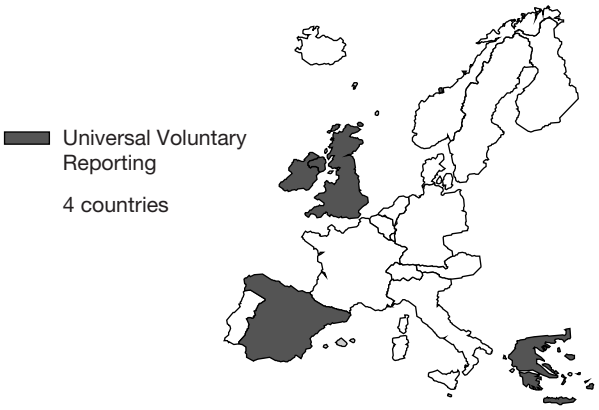
Statutory notification of *Listeria* infections, Western Europe, 2002

Universal Voluntary Reporting

Among the 7 countries with no statutory notification, 4 countries have universal voluntary reporting: Greece and Ireland, since 1998, England-Wales and Scotland, and Spain, since before 1990 (table 4).

Cases are reported by laboratories (Greece, Ireland, Scotland), or by laboratories and physicians (England and Wales, Spain). In Spain, only part of the 16 Autonomous Communities transmit their data to the national level.

Universal Voluntary Reporting of *Listeria* infections, Western Europe, 2002



Surveillance by the National Reference Laboratories (NRL)

All countries except Ireland, have a national reference laboratory (the PHLS in London acts as reference laboratory routinely for Scotland and, occasionally and for specific investigations, for Ireland) (table 5). Eleven countries (Austria, Belgium, Denmark, UK-Scotland, Finland, France, Iceland, Italy, Norway, Spain and Switzerland) have a surveillance system based on their national reference laboratory. These laboratories centralise *Listeria monocytogenes* isolates, from a relatively large proportion of diagnostic laboratories, often with at least a minimum of accompanying epidemiological data. Surveillance through these national reference laboratories exists since before 1995, except for Austria and Finland where this type of surveillance started in 1996 and 1999 respectively.

In Sweden and Switzerland, the sending of isolates to the national reference laboratory is statutory. In Spain, only part of the 16 Autonomous Communities send their isolates to the national reference laboratory.

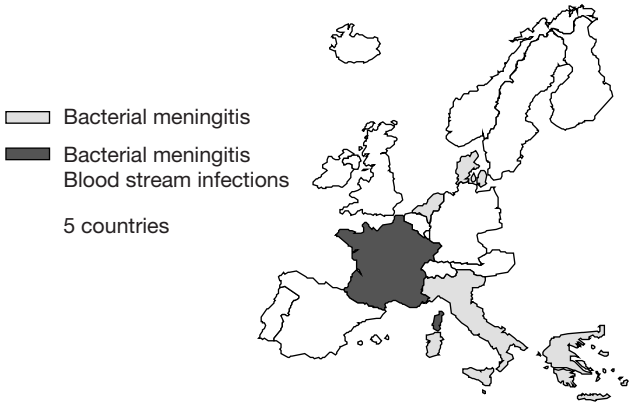
Of the 11 countries with NRL-based surveillance, 8 have developed a procedure for outbreak detection, by looking at an increase in total number of cases (Belgium, Iceland), an increase in number of strains by subtype (Denmark, England & Wales and Scotland, Finland, France, Norway, Switzerland), and or by other methods (geographic clustering or cluster suspected by any other means: England & Wales, Switzerland). For that purpose, data are analysed at different time intervals: every time a new strain is received (4 countries), whenever a cluster is suspected (2 countries), once a week (1 country) or monthly (1 country).

Surveillance by National Reference Laboratories for *Listeria*, Western Europe, 2002

Syndrome based surveillance

Five countries have syndrome based surveillance systems that cover, amongst others, *Listeria* infections (table 6). In Denmark, Greece, Italy and the Netherlands the systems includes bacterial meningitis; in France, the system includes bacterial meningitis as well as bacterial blood stream infections. In Denmark, the Netherlands and France the system was implemented before 1990, in Italy and Greece since 1990-1995. In France, cases are reported by hospital laboratories, in the Netherlands by microbiological laboratories, in Denmark and Italy by hospitals and medical practices, and in Greece by laboratories, hospitals and medical practices.

Syndrome based Surveillance, Western Europe, 2002



Sentinel surveillance

Two countries, Belgium and the Netherlands, have a sentinel surveillance system, both based on laboratories sending their *Listeria* isolates and data to the national surveillance centre (table 7). In the Netherlands sentinel surveillance has been carried out since before 1990, in Belgium it was introduced between 1990 and 1995.

Sentinel Surveillance of *Listeria* infections, Western Europe, 2002

Ad hoc studies

No country reported any ad hoc studies or other data source on *Listeria* infections in their country.

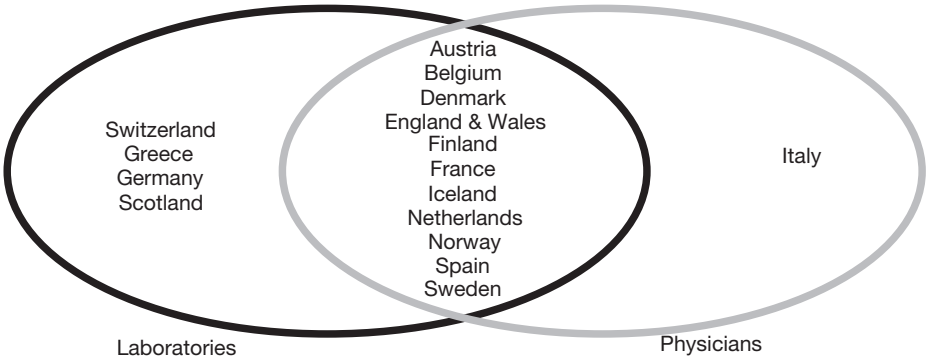
Most countries have several, often complementary, surveillance systems (table 1).

Three countries have only one operational system: Germany (statutory notification), Ireland (universal voluntary reporting), and Austria (national reference laboratory). Six countries have surveillance based on their national reference laboratory in addition to statutory notification (Finland, Iceland, Italy, Norway, and Switzerland) or in addition to universal voluntary reporting (England-Wales-Scotland). Belgium has a sentinel system in addition to surveillance based on the national reference laboratory and to statutory notification (Flemish community only). France, Italy and Denmark both combine statutory notification, surveillance through the national reference laboratory, and syndrome based surveillance. Finally, the Netherlands have sentinel surveillance and syndrome based surveillance, and Greece universal voluntary reporting and syndrome based surveillance.

Data flow, centralisation and analysis

In total, diagnostic laboratories are involved in reporting to at least one of the surveillance systems in 15 countries. In addition, physicians are involved in reporting in 13 countries. Only in Italy, physicians are the only notifying partners.

Listeriosis surveillance, notifying partners in European countries, 2002



In 9 out of the 10 countries with statutory notification, the notifications are sent to the National Surveillance Centre, the Ministry of Health (Switzerland), or both (Italy) either directly (Denmark, Finland, Iceland, Norway, Switzerland), through the local health authorities (France, Germany, Italy) or both directly and through the local health authorities (Sweden). Only in Belgium the notifications remain at the regional level and are not transmitted to the central level.

In the countries with universal voluntary reporting, the reports are transmitted to the respective National Surveillance Centres, either directly (Scotland and Greece), through the local level (Ireland, Spain) or both directly and through the local level (England and Wales). In Spain, only part of the 16 Autonomous Communities transmit the notifications to the central level. The number of participating Autonomous Communities is variable, but is usually estimated at about 50%.

All together, surveillance data of at least one surveillance system are available at the national level in 16 countries, either at the Ministry of Health or National Surveillance Centre (5 countries), at the National Reference Laboratory (1 country) or both (10 countries).

Data are forwarded to the national level as single cases in all countries. In Italy, data are transmitted as single cases to the Ministry of Health and as aggregated data to the National Surveillance Centre. Data transmission to the national level is immediate in most countries, weekly in Finland, Scotland and Spain, and quarterly in Italy.

Analysis of the data at national level is done continuously (France, Iceland, Denmark, Finland), weekly (Belgium, Germany, Norway, Scotland, Spain), monthly (Austria, Ireland), quarterly (England and Wales), yearly (Switzerland, Sweden, Italy) or at irregular intervals (the Netherlands). The analysis of data from the syndrome based surveillance systems is done at yearly intervals in Denmark, France, the Netherlands, and weekly, monthly and yearly in Greece.

Surveillance case definitions

Definition of listeriosis

All countries base their case definition of listeriosis on the isolation of *Listeria monocytogenes*, with or without specific requirements regarding the site of isolation and the presence of clinical symptoms. Only Norway and Ireland also consider serial antibodies against *Listeria monocytogenes*, but in practice cases with antibodies, but no isolate, are not reported.

Case definitions often vary between the different surveillance systems within one country. In Finland, France, Greece, Scotland, Belgium (sentinel system), the Netherlands (sentinel system), Italy and Denmark (statutory notification), a case of Listeriosis is defined as a person from whom *Listeria monocytogenes* is isolated, regardless of the site of isolation and the clinical symptoms. In Austria, Belgium (reference laboratory), Spain (reference laboratory), Switzerland and Sweden, the same case definition is used, with the restriction that *Listeria monocytogenes* must have been isolated from a normally sterile site. In Denmark (reference laboratory) and Spain (voluntary reporting) a case is defined as a person with a clinical presentation compatible with listeriosis and the isolation of *Listeria*

monocytogenes from any site. In Germany and England and Wales, isolates from not normally sterile sites are also included if they are from a newborn (Germany), or from vaginal swabs, placental or foetal tissue or surface swabs of a newborn at the moment of delivery or miscarriage (England and Wales). In Germany, the case definition also includes clinical cases with an epidemiological link with a laboratory-confirmed case.

In France, the case definition for *reporting* is based on the isolation of *L. monocyogenes* from any site. However, at national level, only cases with an isolate from a normally sterile site or from placental or foetal tissue or surface swabs of an ill newborn at the moment of delivery or miscarriage, are retained in the analysis.

Listeriosis with central nervous system involvement

Six countries have specific definitions for *Listeria* infection of the central nervous system (CNS). In France (syndrome based surveillance, and reference laboratory), Scotland, Sweden, the Netherlands (sentinel system), Denmark (reference laboratory) and England and Wales, a case of listeriosis with central nervous system involvement is defined by an isolate of *Listeria monocytogenes* from cerebrospinal fluid (CSF) or from brain tissue (specified by England and Wales only). In France (statutory notification) and in the Netherlands (syndrome based surveillance), a case of CNS infection is defined by the isolation of *Listeria monocytogenes* from CSF or blood and the presence of clinical symptoms compatible with CNS infection. Finally, in Denmark (syndrome based surveillance), CNS infection is defined by a clinical meningitis and an isolate of *Listeria monocytogenes* from CSF.

Pregnancy-associated listeriosis

Five countries have a specific definition to define if a case of listeriosis is pregnancy-associated. A case is pregnancy-associated if *Listeria monocytogenes* is isolated from a pregnant women (Scotland), from a pregnant women and/or her foetus or baby (Denmark), from a normally sterile site of a pregnant women, her neonate or foetus (Finland), from a pregnant women, abortion product, stillbirth, or neonate before 30 days of life (France) and from a normally sterile site of a pregnant women or her foetus or baby up to the first 28 days of life, or from a non – invasive site of a new-born (England and Wales).

Five countries (Belgium, Denmark, England and Wales, France and Sweden) count a mother infant pair as one case even if *Listeria monocytogenes* is isolated from both the mother and the child. In 4 countries (Finland, Germany, Norway and Spain) these mother infant pairs are counted as 2 cases. For 8 countries no information was available on how mother infants pairs are counted.

Listeria gastro-enteritis

None of the countries had a specific definition for acute *Listeria* gastro-enteritis. Theoretically, in countries with a case definition based on the isolation of *Listeria monocytogenes* from any site, these patients should be reported. In practice, none of the countries has acute *Listeria* gastro-enteritis cases reported, although occasionally outbreaks of acute *Listeria* gastro-enteritis have been identified and reported to the national level: in Italy in 1993 and 1997, in Denmark in 1996 and in Belgium in 2001.

Sensitivity, geographical coverage and representativeness of surveillance systems

Few countries have formal evaluations or studies allowing to estimate sensitivity, geographical coverage and representativeness of their surveillance systems. In general, the above described surveillance systems cover in principal the entire country, except for Spain, where approximately half of the autonomous communities transmit their data to the national level, and Belgium where notification of listeriosis is only statutory in the Flemish community.

In France, a capture-recapture study carried out in 2000, estimated the sensitivity of the surveillance system that combines the data from statutory notification and the national reference laboratory at 87% of all laboratory confirmed cases. For the same year, the sensitivity of the syndrome-based surveillance system was estimated at 59% for CNS and bloodstream infections.

In the Netherlands, sensitivity of the sentinel surveillance system is estimated at 35%. The sensitivity of the syndrome-based surveillance is assumed to be high since all microbiological laboratories are assumed to participate. A capture-recapture study carried out in 2001/2002 for *Neisseria meningitidis*, estimated the sensitivity of this syndrome-based surveillance at 70%.

In Denmark, the sensitivity of the notification by the laboratories is assumed to be 100%. The sensitivity of their syndrome-based surveillance is less sensitive: in 2000, only 6 CNS infection cases were reported through this system, whereas 8 CNS infections were notified by the laboratory notification system.

In most countries, the sensitivity of systems based on notification or voluntary reporting is higher than that of surveillance through the reference laboratories. For instance, in Sweden, in 2001, 67 cases were reported against 12 isolates received by the national reference centre, in Switzerland, in 2000, these figures were 54 cases reported against 46 strains received, in England and Wales, the reference laboratory receives the isolates from approximately 80% of the notified cases, and in Norway from an estimated 75% of reported cases. However, in Finland, the number of strains received by the laboratory is higher than the reported number of cases, in 2000, 25 strains were received compared to 18 notified cases.

Surveillance systems may have a different sensitivity for different clinical presentations of listeriosis, for instance be more or less sensitive for reporting of CNS infection or pregnancy- associated cases in comparison with other cases. As a result, reported cases may not be representative of all cases. The proportion of cases that have CNS involvement and that are pregnancy-associated cases vary between countries but remain roughly within a same order of magnitude (table 11). However, in Spain, the proportion of reported cases with CNS infection is particularly high (63%) compared to other countries where this proportion usually is between 10 and 30%. The Spanish system may be more sensitive for CNS infection cases than for other cases and it is possible that the reported cases are not representative of all listeriosis cases in Spain.

Type of data collected

All countries collect basic demographic data (age or date of birth, sex), and contact details of the reporting institute. Fifteen countries collect the place of residence of the case. Laboratory confirmation (15 countries), date of isolation or date first positive specimen received in diagnostic laboratory (14 countries), and the type of investigated material (16 countries) are collected by the large majority of countries. Clinical information is routinely transmitted in a smaller number of countries: principal diagnosis (CNS infection, septicaemia..) (10 countries), whether the case is pregnancy associated (6 countries), date of onset of symptoms (10 countries), outcome (8 countries), clinical symptoms (6 countries), existence of an underlying medical condition (5 countries). Travel history is routinely available in 6 countries, suspected source of infection in 5 countries, putative risk factors in 4 countries, link to other cases in 5 countries. Food histories are occasionally obtained in 5 countries, whereas in France a detailed food history is routinely forwarded to the national level (table 8).

Outbreak detection

Real-time reporting and analysis, high sensitivity, results of typing of strains available in real time for surveillance, and the existence of outbreak detection criteria and thresholds, are characteristics of a surveillance system that contribute to efficient outbreak detection. Eight countries (Belgium, Denmark, England and Wales, France, Ireland, the Netherlands, Spain, and Switzerland) have developed outbreak detection mechanisms and thresholds (table 9). In Germany these are currently in development. Real time reporting to national level, and real-time analysis, characterise the surveillance systems of 15 and 11 countries respectively. The estimated or assumed sensitivity is reasonably high or high in at least 10 countries, and can not be estimated in 4 countries (Italy, Germany, Greece, and in the participating autonomous communities in Spain). For outbreak detection, 11 countries routinely have results of typing of strains available: serotyping (Norway and Switzerland), sero- and biotyping (Belgium), sero- and ribotyping (Austria), serotyping and Pulse Field Gel Electroforesis (PFGE) analysis (Finland, France, Italy, Spain), sero- and ribotyping and PFGE (Denmark), sero- and phage- and biotyping (England and Wales and Scotland), and sero- and biotyping and PFGE (Sweden). In Germany, Greece, Iceland, Ireland and the Netherlands, real-time results of typing of strains are not available.

Reported *Listeria* infections

The incidence of notified or reported cases per million inhabitants varied between countries from 0.3 in Greece to 7.5 in Sweden. The mean incidence of reported cases was 3.4 per million inhabitants (data from 16 countries, latest year available) (table 10). Five countries reported an incidence of more than 4 cases per million and three countries of more than 6 per million population (table 10).

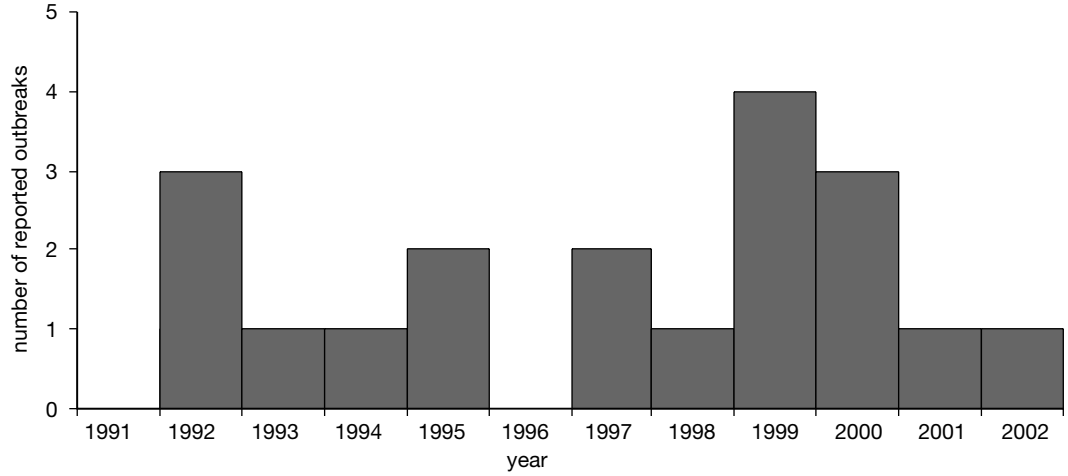
Reported outbreaks of invasive listeriosis and of *Listeria* gastro-enteritis

From 1991 to 2002, a total of 19 outbreaks of invasive listeriosis have been reported in 9 different countries, with a total of 526 outbreak related cases (table 12). In addition, 4 outbreaks of acute *Listeria* gastro-enteritis were reported, in Italy, in 1993 involving 18 cases and in 1997 involving 1566 cases, in Denmark in 1996 involving 3 cases, and in Belgium, in 2001, involving 2 cases of acute gastro-enteritis and one case of invasive listeriosis.

The incriminated food at the origin of the outbreaks of invasive listeriosis was a processed meat product (6 outbreaks), cheese (5 outbreaks), processed fish product (3 outbreaks), butter (1 outbreak) and undetermined (3 outbreaks). The outbreaks of gastro-enteritis were linked to the consumption of contaminated rice salad and corn salad respectively, whereas the Belgian outbreak of gastro-enteritis and invasive listeriosis was linked to a contaminated frozen cream cake. The origin of one outbreak of gastro-enteritis remained undetermined.

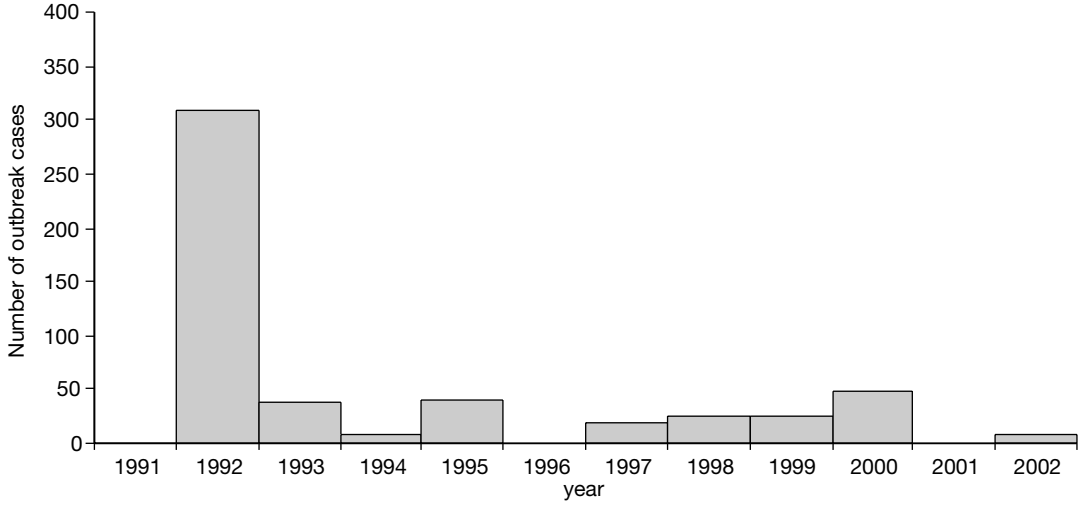
The number of reported outbreaks increased gradually over time: 11 outbreaks were reported in the 5 year period between 1997-2001 compared to 7 outbreaks in the period 1992-1996.

Figure 1. Reported outbreaks of invasive listeriosis in 9 European countries between 1991 and 2002



However, the mean number of cases related to these outbreaks decreased from 57 in the period 1992-1996 to 11 in the period between 1997-2001.

Figure 2. Number of reported outbreak related cases of invasive listeriosis per year in 19 outbreaks in 9 European countries, 1991-2002



From 1987 to 1989, a major outbreak in England and Wales involving over 350 cases, was shown to be linked to an imported product (pâté) (11). Since 1991, the incriminated product of at least 6 outbreaks were known to have been exported, creating the potential for the occurrence of outbreak related cases in other countries.

National reference laboratories (NRLs) for *Listeria*

Nineteen completed questionnaires (microbiological section) were received from 17 European countries. Germany sent back 3 questionnaires, including one from the NRL. Scotland and Ireland answered that they have no national reference laboratory. Scotland systematically uses PHLS (UK) as their NRL for *Listeria,* and Ireland occasionally uses PHLS as NRL for some strains. Overall, 17 countries are somewhat documented, if we consider that Scotland and Ireland refer to PHLS (UK) when necessary, but most of the data are available only for 16 countries.

Laboratories that perform reference tasks (as NRL) for *Listeria* exist in 16 European countries: all are situated either in States' owned laboratories, or are officially appointed. Eleven of these are in a Public Health Laboratory Institution, 4 in a University Hospital Laboratory, and 1 in a Foundation (but was officially appointed). The NRL was officially appointed in 10 countries (Austria, Denmark, France, Germany, Greece, Iceland, Portugal, Spain, Sweden and Switzerland), recommended in 2 (Belgium and Italy) and doing work on its own initiative in 3 (Finland, Netherlands and Norway). In Germany and Spain, the geographical coverage of the NRLs does not seem to be exhaustive.

Tasks of the NRLs

In 16 countries, the NRLs report to be in charge of one or more of the following tasks: microbiological surveillance (16), detection of outbreaks (14), provide microbiological expertise (13), conduct training courses (9) and provide reference material as strains or sera (8). Moreover, 12 NRLs perform research on *Listeria* (see Table 13).

In 7 countries (Denmark, Finland, Germany, Iceland, Norway, Portugal and Spain), the NRLs for *Listeria* strains of human and food origins are separated, while in 9 countries (Austria, Belgium, England & Wales, France, Greece, Italy, Netherlands, Sweden and Switzerland) the NRLs receive *Listeria* strains from both humans and foods.

Only few NRLs examine human specimens (and some do it occasionally) for the presence of *Listeria monocytogenes*, either by culture (Austria, Greece, Ireland, Iceland and Switzerland) or by genetic amplification (Greece, Switzerland), then acting as medical microbiology laboratories. Only 2 NRLs, in Norway for some clinical cases, and in Germany, receive information on *Listeria monocytogenes* strains without receiving the strains.

Collecting strains

Fifteen NRLs (all except Portugal) receive strains from other laboratories in their country. Most strains are sent by Hospital Laboratories (80-100%) with a participation (1-20%) of private medical laboratories in 6 countries. The 15 NRLs also receive information along with strains. This information concerns the site of isolation of the bacteria (13 countries), clinical data (11), epidemiological data (10), and strains characteristics (8) (see Table 14).

None of the European countries has a sentinel system to collect *Listeria* strains. In 2 countries (Sweden and Switzerland), it is statutory to send strains to the NRL, in the other countries strains are sent on a voluntary basis. Strains are sent continuously in 4 countries: UK, France, The Netherlands and Sweden. In 3 countries (Germany, Greece, and Portugal) strains are sent very occasionally. Depending of countries, strains are sent systematically (7 countries) or not (9 countries) to the NRL. In 5 out of 7 countries sending strains systematically, every strain is sent immediately after isolation.

As shown in Table 15, in two countries (Belgium and Spain), strains are sent systematically *and* not systematically, likely reflecting some heterogeneity, either geographical or in the Public Health system. When strains are not systematically sent to the NRL, they are sent according to the will of the laboratory (in 10 countries), to establish a link with a contaminated food (in 7 countries), when there is a suspicion of an outbreak (7 countries) or during an outbreak (6 countries), or for ad hoc studies (3 countries).

Microbiological methods and typing

Most NRLs, except in Sweden, carry out identification of the *Listeria* strains they receive. Ireland, although not a NRL, mentioned that they also identify *Listeria* strains. Methods of identification were described as «standard procedures» by 2 countries, Denmark and Norway. Only 4 countries, Austria, Greece, UK and Switzerland, perform a Gram stain and a catalase test. Biochemical characterisation was performed using API-*Listeria* in 8 countries, API-*coryne* in 1, while 4 countries use «home-made» sugars.

Nine countries look for haemolysis, 6 for motility. Two countries, Switzerland and Germany, also use PCR for diagnosis, and Italy also uses an automated system of bacterial identification. Nine NRLs said their method for *Listeria* identification was recommended, of which 3 mentioned the ASM Handbook.

Fourteen NRLs perform at least one typing method on human strains, routinely or not, and 2 NRLs (in Iceland and Portugal) do not type strains. Thirteen countries said their method of typing is recommended, by the NRL (4 countries), an international scientific society (5), another laboratory (1), an ASM Handbook (1) or by the WHO (2). Thus, only 2 countries, France and Switzerland, mentioned the recommendations of the «WHO International Study on typing methods of *Listeria monocytogenes*».

Serotyping (Table 17a). Three NRLs (Greece, Iceland and Portugal) do not perform serotyping of human strains, the 13 other NRLs perform serotyping routinely, either ongoing or at regular intervals, as in the Netherlands' NRL. Seven countries use home-made antisera, 6 use commercially available sera, and 2 use both**.**

Molecular methods of typing. The Table 17b gives details about the numerous molecular typing methods (sometimes referred to as subtyping methods) used in the different NRLs' countries, and in which circumstances they are used. As seen in Table 17b, at least 13 countries (Belgium, Denmark, Finland, France, Germany, Greece, Italy, The Netherlands, Norway, Portugal, Spain, Sweden and Switzerland) have developed the capacity to perform DNA macrorestriction on human strains of *Listeria monocytogenes*, and do it either routinely, for specific investigations or ad hoc studies. All use the «CHEF» system for PFGE, and most said to use two enzymes, *AscI* and *ApaI*. Several countries already possess a software (the majority used Bionumerics, or a related software) to analyse and compare PFGE patterns. In the year 2000, only the UK used routinely phage-typing. Sixteen countries completed the second questionnaire which enquired about the acceptability, the capacity and possibilities to perform PFGE typing of *Listeria monocytogenes* routinely and with a common protocol (Table 17c and 17d). Ten countries are already doing PFGE routinely, of whom 6 do it at least weekly or every time they receive a strain; 14 countries said to be ready to use a common standard protocol and 13 to use an image analysis software. Moreover, 12 countries said they would be willing to set up routine, at least weekly or immediately after reception of a strain, PFGE with image analysis to participate to a common surveillance system of human strains. These 12 countries are: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Italy, The Netherlands, Portugal, and Spain. Moreover, several countries, including Switzerland which is not willing to carry out PFGE routinely, said they would accept to send strains to another European laboratory to be typed by PFGE. Thus, European surveillance including results of harmonised characterisation of isolates by PFGE of *Listeria monocytogenes* strains isolated from human cases could cover at least 13 countries.

All countries who are performing, or intend to perform PFGE said they will accept to send PFGE profiles to a common European laboratory under the following conditions: access to common information (6 countries), confidentiality (4), access will be restraint to participants (1), if strains are not distributed and profiles are used only for the purpose of surveillance (1).

Antimicrobial susceptibility testing (AB-testing)

Ten of 17 Laboratories (62.5%; including Ireland) reported performing antimicrobial susceptibility testing (Austria, Belgium, UK-Scotland, Iceland, Ireland, Italy, France, Germany, Greece, Switzerland), while seven do not perform AB-testing. Austria, Belgium and Switzerland use the E-test method for testing, and 7 countries (UK-Scotland, France, Germany, Greece, Iceland, Italy and Switzerland) use Agar dilution break points (and two countries, Iceland and Switzerland, mentioned NCCL's method). Italy uses also a disk diffusion method.

The antimicrobial agents tested varied a lot between countries. Laboratories most frequently tested the susceptibility of *Listeria* for: Gentamycin and Trimethoprim-Sulfamethoxazole (7 countries); Ampicillin, Tetracyclin and Erythromycin (6 countries); Ciprofloxacin (5 countries); or Chloramphenicol, Streptomycin and Vancomycin (4 countries).

Listeria isolates from foods

In 11 countries (Austria, Belgium, Denmark, France, Greece, Italy, Netherlands, Portugal, Spain and Switzerland, UK) the NRLs for human *Listeria* also receive *Listeria* strains isolated from foods. In Finland, Germany, Iceland and Norway, NRLs do not deal with *Listeria* isolates from foods, although NRL in Finland, Norway and Sweden receive information on food strains. In 3 countries, Greece, the UK and Italy, the NRL perform routine testing of food stuffs, looking for *Listeria*. Overall, 14 European countries' NRLs for human *Listeria* receive information on, and/or *Listeria* strains isolated from foods. The situation in Germany is variable from one part of the country to another.

Reference laboratories receive *Listeria* isolated from foods for a variety of reasons: according to the will of laboratories (in 7 countries), to try to establish a link with human cases (6), when there is a suspicion of, or during an outbreak (4), and for various other reasons in 8 countries. In the UK, food strains are sent to the PHLS when foods are highly contaminated by *Listeria monocytogenes*. In Switzerland, selected laboratories send all strains, systematically, to the NRL (food sentinel system). The number of strains isolated from foods received at NRLs is highly variable (see Table 18), going from as few as less than 10 to several thousands. Strains are sent essentially by Public Laboratories (7 countries), sometimes by privates laboratories, or both.

When strains of *Listeria* isolated from foods are received by the NRLs, all 11 laboratories identify the strain, all but Greece using the same methods as for strains of human origin. Then, 10 of the 11 NRLs (all except in Portugal) type the food strain, essentially with the same methodology as for human strains, although Belgium does not perform biotyping on food strains, and Greece perform also ribotyping.

Laboratory services

Several NRLs provide material to other laboratories, such as strains (Austria, Belgium, Denmark, UK, France, Germany, Greece, Italy, Spain, Switzerland), sera (Greece, France and Switzerland, the two last both being WHO Collaborative Centres for Listeriosis), DNA profiles (Denmark), protein extracts (France), or phages (Greece). In the UK, the PHLS also provides guidelines for routine laboratory diagnosis of human listeriosis.

Most countries (9/16) do not conduct training courses for *Listeria* identification and typing. France, Greece, Italy and Switzerland provide training for both identification and typing procedures. Moreover, the NRL in Portugal provides training for identification procedures only, and in Germany, The Netherlands and Spain for typing only. The WHO Collaborative Centres in France and in Switzerland regularly train microbiologists from European and from extra-European countries.

Quality control and quality assurance, accreditation

Internal quality control means procedures that are decided by the laboratories themselves to control different steps during the analyses. The NRLs in 14 countries, have internal quality control (Table 19) for their identification procedures (9 countries: Belgium, Denmark, Finland, Germany, Greece, Ireland, Italy, The Netherlands, UK) and/or typing procedures (9 countries). Only 3 countries, Austria, France and Iceland, do not have an internal quality control procedure.

External quality control (EQS) means quality testing procedures that are organised by an external institution or company that provides controlled material for quality control testing. Seven countries participate to an external quality control, while nine do not. Six of the seven countries use NEQAS, from the PHLS, and 3 use also another EQS. All 6 countries use NEQAS for identification procedures only.

Seven NRLs (in Austria, Denmark, France, Germany, Greece, The Netherlands and Sweden) are engaged in a Quality Assurance System, while 8 are not, but 5 of them intend to be in the near future. Accreditation, based on internationally agreed criteria, is a procedure by which an authoritative body gives formal recognition that a body or person is competent to carry out specific tests. Accreditation is test specific. Certification is a commercial action by a third party, demonstrating that adequate confidence is provided that a duly identified product, process or service is in conformity with a specific standard or other normative document. Six NRLs said to be accredited ISO/UE 17025 and two more were accredited on an other standard: PHLS in UK (Clinical Path Accreditation Ltd) and the NRL in The Netherlands (accredited by CCKL-test). One NRL (in Austria) is certified ISO 9001.

Research

NRLs from 10 countries (Austria, Denmark, Finland, France, Greece, Italy, Spain, Sweden, Switzerland and UK) are doing research on *Listeria*, while the other laboratories do not perform research on this bacteria. Research on *Listeria* concerns typing (9 countries), epidemiology (6), genomic (4), pathogenicity (3) or diagnostic (3). Only 4 countries have no collaboration with other research laboratories, while 13 countries (Austria, Belgium, Denmark, UK, Finland, France, Germany, Greece, Ireland, Italy, Spain, Sweden and Switzerland) said they do collaborate with National (10 countries), European (4) and/or North American (4) research laboratories. These collaborations mainly deal with exchanges of strains (9 countries), and/or information (10 countries), and sometimes of reference material (5 countries). All countries think that such collaboration is mutually beneficial.

Summary and conclusion of the inventory

The inventory shows that surveillance systems on listeriosis are operational in the large majority of countries and could form the basis of European surveillance.

At present, all participating countries except Portugal have at least one surveillance system of listeriosis. Listeriosis surveillance data are available at the national level in 16 countries, either at the National Surveillance Centre (5 countries), at the National Reference Laboratory (1 country) or both (10 countries). These data at the national level are available as single case reports in all countries. Data transmission to the national level is immediate or weekly in all countries, except in Italy where it is quarterly.

All countries base their case definition of listeriosis on the isolation of *Listeria monocytogenes*, with or without specific requirements regarding the site of isolation and the presence of clinical symptoms. Countries with listeriosis surveillance collect at least basic demographic data (age or date of birth, sex), contact details of the reporting institute, laboratory confirmation (date of isolation of *Listeria monocytogenes* or date first positive specimen received in diagnostic laboratory), and the type of investigated material.

The incidence of reported cases varies between 0.3 and 7.5 cases per million per year. Five countries reported an incidence of more than 4 cases per million and three countries of more than 6 per million population. These figures reflect the real incidence of the disease, as well as the sensitivity of the surveillance systems. Few countries have formal evaluations allowing to estimate sensitivity, geographical coverage and representativeness of their surveillance systems. In general, the surveillance systems cover in principal the entire country except for Spain where approximately half of the autonomous communities are covered and Belgium where notification is statutorily only in the Flemish community.

From 1991 to 2002, a total of 19 outbreaks of invasive listeriosis have been reported in 9 different countries. Whereas the number of reported outbreaks increased gradually over time, the mean number of cases related to these outbreaks decreased, suggesting that outbreak detection and investigation are getting more and more efficient.

All countries, except Ireland, have a National Reference Laboratory (NRL), and Ireland occasionally uses PHLS (UK) as their Reference Laboratory. Fifteen NRL receive strains from other, mostly hospital based laboratories. Fourteen NRL perform at least one typing method on human strains. At present, for outbreak detection, 12 countries have results of typing of strains available, routinely and on a real time or weekly basis: serotyping (12 countries), bio-typing (4 countries), ribotyping (3 countries), Pulse Field Gel Electrophoresis (PFGE) analysis (6 countries), and phage-typing (1 country). To participate to a common surveillance system, 7 countries which do not yet carry out routine ongoing PFGE-typing of strains, would be willing either to set up routine, at least weekly, PFGE with image analysis or to send their strains to the NRL of another country for PFGE analysis. Thirteen countries are willing to use a common standardised protocol for PFGE and are willing to send profiles or strains to contribute to a European data base. Thus, European surveillance including results of harmonised characterisation of isolates by PFGE of *Listeria monocytogenes* strains isolated from human cases could cover at least 13 countries.

Based on the inventory, it appears that there is an appropriate basic infrastructure for a European surveillance network of *Listeria* infections, and that the necessary harmonisation of methods is feasible considering the infrastructure already in place and the expressed willingness of countries to adapt or set up methodologies in the perspective of European surveillance.

Recommendations

During the final meeting with all participating countries on September 13th, 2002, the participants concluded that there is an appropriate basic infrastructure for a European surveillance network of *Listeria* infections, and that a surveillance network based on the existing national surveillance systems is feasible and meaningful and would be able to meet at least the objectives of outbreak detection and trends analysis.

Specific objectives of European surveillance, different scenarios, and operating procedures were discussed and the following recommendations were formulated with regard to the development of a future listeriosis surveillance network.

1. Need for a European network for the surveillance of *Listeria* infections («Listernet»)

Listeriosis ranks among the most frequent causes of food borne death. Changes in food production, technology and distribution, changes in consumer life styles and the expansion of the population at increased risk of listeriosis, could lead to an increase in sporadic disease. In addition, its common source epidemic potential presents a real threat even in countries with a decreasing or low incidence. Within this context of changing host related and environmental interaction, surveillance of listeriosis is of great importance to detect outbreaks, analyse trends, and evaluate preventive measures. The international distribution of foods has created the potential for diffuse and wide-spread outbreaks involving many countries. Because these outbreaks can be dispersed with a limited number of cases in each country, they are likely to go undetected without pooling information from these countries. A European surveillance network would, by its real time sharing of information and the development of harmonised methods, allow not only a more efficient and earlier recognition but also a more efficient investigation of these outbreaks. In addition, a more harmonised surveillance of listeriosis within the EU will contribute to estimates of the relative magnitude of morbidity and mortality due to *Listeria* infections (disease burden) between countries as well as to the monitoring of preventive and control measures by comparison of trends between countries. Lastly, the creation of a European network may encourage individual countries to strengthen their national surveillance of listeriosis.

2. Aim and objectives of a European surveillance network «Listernet»

The overall aim of the project should be to contribute to the reduction in incidence of listeriosis by the identification of efficient and appropriate control measures preventing both sporadic and outbreak related cases. The participants recommended that the surveillance network would include the following objectives:

- Rapidly detect international outbreaks
- Report and share information on national outbreaks or outbreaks with an international potential
- Facilitate collaborative investigation of international outbreaks
- Provide comparative data to monitor trends of international importance in:
  – the incidence of invasive *Listeria* infections
  – the characteristics of cases
  – the characteristics of strains
- Contribute to the strengthening of national surveillance in participating countries
- Contribute to estimates of the relative magnitude of morbidity and mortality due to *Listeria* infections within and between countries

- Contribute to the monitoring or assessment of preventive and control measures by comparison of trends and or disease burden between countries

Additional objectives would be to generate hypotheses about risk factors and to encourage the investigation of these hypotheses.

3. A European data-base using common case definitions and a minimum data set including results of harmonised characterisation of isolates by PFGE

The surveillance network should be developed using common case definitions, and a common minimum data set, which would be further developed over time to include additional data (optimal data set). Case definitions, in line with those developed by the Community Network under decision N° 2119/98/EC, and a minimum and optimal data set, for which the collection is, at present, feasible for the majority of participating countries, were proposed by the expert panel (table 20 and 21). The network should create a common data-base to which the participating countries transmit their data on a real time or at least on a weekly basis. Data concerning characterisation of isolates would be essential to meet the objective of efficient outbreak detection. Whereas serotyping may be sufficient characterisation in a country with few cases, it was agreed that for European surveillance, further characterisation would be necessary to detect diffuse international outbreaks. Referring to earlier work by the WHO-International Multicenter *Listeria monocytogenes* subtyping study, there was a consensus among the participants that neither ribotyping nor phagetyping nor biotyping were appropriate methods for surveillance in a setting where data on a large number of isolates are pooled and compared. The working group concluded that characterisation by PFGE would be the most appropriate commonly used typing method and the best option to meet the objectives of outbreak detection and trends analysis. Although such a scenario has drawbacks with respect to timeliness, simplicity and geographical coverage, its adoption does not exclude the possibility of also creating a data base based on epidemiological data with or without data on serotype. Countries can contribute with the data available (epidemiological, serotype, and or PFGE) and different analyses can be carried out (all cases, cases by serotype, cases by PFGE).

4. Strengthening of national surveillance and stepwise participation

The network should encourage individual countries to strengthen their national surveillance of *Listeria* infections and contribute to their strengthening by providing a model and specific tools for surveillance and investigations. Countries can participate in a stepwise manner, contributing initially with the data they have available, even if incomplete. With time, countries may wish to adapt their in country data collection in order to cover all data fields in the data base.

5. Transmission of PFGE profiles or transmission of strains

Some countries, especially those with only few strains, may encounter difficulties in carrying out PFGE typing on a real time basis, even if they have the expertise and capacity to carry out PFGE typing in the setting of an outbreak or a study. It could be more efficient to centralise the strains from these countries in one or two NRL for typing. The possibilities for those countries to send their strains for typing to a NRL from another country should be studied, taking in account the cost of transport and the regulations concerning the safe transport of these strains.

6. Focus on human listeriosis

Ideally, a *Listeria* surveillance network should include data on human cases, contaminated foods and animal and environmental sources. However, in order not to delay its implementation, the working group recommended that «Listernet» should concentrate on surveillance of human cases of *Listeria* infection and not actively seek to collect data on food isolates. Once the network is well established and surveillance of human cases is operational, the possibilities to include data from food and animal surveillance should be studied. It was recommended that the project would work closely with other European surveillance and research projects to seek ways to compare data from humans, animals and feed and food stuff.

7. «Listernet» project components

The participants proposed that the network should develop the following project components

Development and adaptation of standard laboratory operating procedures for serotyping and PFGE and an external quality assurance scheme

Outbreak detection
The project should include the development of outbreak detection algorithms and their evaluation in terms of sensitivity, specificity, and predictive value positive. For the development of these algorithms countries will need to submit data retrospectively for the 2-3 years before the onset of European surveillance.

Outbreak investigation
A protocol for collaborative investigation of international clusters and outbreaks should be developed.

Principles of collaboration:
The network will need to develop principles of collaboration that should deal with access to the data base by participants and by outsiders, confidentiality of country specific data, confidential and public domain reports, data protection requirements, as well as transmission to other programmes and projects such as the Community network for communicable diseases, WHO HQ and regional office, and the Community Reference laboratory for the Epidemiology of zoonoses. It was recommended to use the principles of collaboration of Enternet, and adapt when necessary to *Listeria* (12).

Antibiotic resistance surveillance:
The working group recommended not to include antibiotic resistance surveillance in the projects initial phase since antibiotic resistance is at present not of major concern in *Listeria* infections. Once the project is running this could be included after development of common testing protocols and of external quality control.

8. Application for funding from the EU

The participants recommended that a project proposal will be developed by the co-ordinators of the actual feasibility study and that an application will be submitted to the European Commission under the programme of community action in the field of public health (2003-2008).

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Annexes

Annex 1 – Tables

Table 1: Countries by data source (and year or period of introduction) for Listeriosis surveillance

	Statutory notification	Universal voluntary reporting	Sentinel reporting	Surveillance of syndromes	National reference laboratory
Austria	[x (90-95)]*				x
Belgium Belgium Flemish community	[x (<90)]** x (95)		x (90-95)		x (<90)
Denmark	x			x (90-95)	x (<90)
England and Wales		x (<90)			x (<90)
Finland	x (95)				x (95)
France	x (99)			x (<90)	x (<90)
Germany	x (<90)				x (no surveillance)
Greece		x (98)		x (90-95)	x (no surveillance)
Iceland	x (99)				x (<90)
Ireland	[x] *	x (98)			(PHLS) (no surveillance)
Italy	x (90-95)			x (90-95)	x
Netherlands			x (<90)	x (<90)	x (no surveillance)
Norway	x (<90)				x (<90)
Portugal					x (no surveillance)
Scotland		x (<90)			x (<90) (PHLS)
Spain		x (<90)			x (<90)
Sweden	x (<90)				x (no surveillance)
Switzerland	x (<90)				x (<90)

[ ]* notification of foodborne infections/food poisoning

[ ]* * notification of foodborne outbreaks

Table 2: Objectives of listeriosis surveillance, by country and by system

		Outbreak detection	Trends monitoring	Food safety interventions	Improving epidemiology knowledge	Other
Austria	Stat.Notif.	x	x	x	x	
	Refer.Lab					
Belgium	Stat.Notif.	x				
	Sentinel	x	x			
	Refer.Lab	x	x		x	
Denmark	Stat.Notif.					
	Syndr.surv.					Bacterial Meningitis Surveillance
	Refer.Lab	x	x	x	x	
England and Wales	Univ.Vol.Rep	x	x	x	x	Providing a national case register
	Refer.Lab	x	x	x	x	
Finland	Stat.Notif.	x	x	x	x	
	Refer.Lab	x	x			
France	Stat.Notif.	x	x	x	x	
	Syndr.surv.		x			bacterial bloodstream and CNS infection surveillance
	Refer.Lab	x	x	x		
Germany	Stat.Notif.	x	x		x	
Greece	Univ.Vol.Rep		x			
	Syndr.surv.					Bacterial meningitis surveillance
Iceland	Stat.Notif.	x	x	x	x	
	Refer.Lab	x	x	x	x	
Ireland	Stat.Notif.					
	Univ.Vol.Rep	x	x	x	x	Audit tool for training purposes
Italy	Stat.Notif.		x			
	Refer.Lab					
	Syndr.surv.					Bacterial Meningitis Surveillance
Netherlands	Sentinel		x		x	Bacterial Meningitis Surveillance, Vaccine development
	Syndr.surv.				x	
Norway	Stat.Notif.	x	x	x	x	
	Refer.Lab	x	x	x	x	
Scotland	Univ.Vol.Rep	x	x	x	x	
	Refer.Lab	x	x	x	x	
Spain	Univ.Vol.Rep	x	x		x	
	Refer.Lab			x	x	
Sweden		x	x	x	x	
Switzerland	Stat.Notif.	x	x	x		
	Refer.Lab	x	x	x	x	

Table 3: Characteristics of listeriosis surveillance systems by country: statutory notification

	Statutory notification										
	Start of surveillance	Case definition	Used since when	CNS case definition	Pregnancy case definition	Who is reporting	To whom is it reported	Periodicity of reporting to central level	Format of data received at central level	Analysis at central level (periodicity)	Sensitivity, coverage, representativity
Austria	90-95	foodborne infection laboratory confirmed (isolate)		no	no	Physicians	Local level to regional level to MoH	Monthly	Aggreg	M	no listeriosis reported through this system
Belgium	<90 (outbr.)	outbreak: > 1 case (Isolate of *Lm*) /week/community	1995	no	no	All who diagnose an outbreak	Local health authority only	none	none	none	no data
Belgium flemmish community only	>95	Isolate of *Lm* from a human specimen	1996	no	no	Physicians	Local health authority only	none	none	none	no data
Danmark		Isolate of *Lm* from a human specimen				Laboratories	NSC	I	single	real time	sensitivity assumed to be high
Finland	1995	A culture confirmed case	1995	no	Pregnant woman, her neonatus or foetus with an *Lm* isolate from a normally sterile site	Physicians Laboratories	NSC	W	single	ongoing	2000: 18 notified cases compared with 25 isolates received
France	1998	Isolate of *Lm* from a human specimen	1998	Clinical signs of meningitis plus isolation of *Lm* from blood or CSF	Isolation of *Lm* from a pregnant woman, abortion product, stillbirth, neonate before the 30th day of life	Physicians Laboratories	Local health authority to NSC	I	single	Y or real-time if outbreak suspected	Sensitivity of Stat.Notif and NRL combined 87% (2000)
Germany	<90	*Lm* isolate from blood, CSF or other usually sterile site and swabs from newborn. Or clinical cases with epidemiological link with a lab confirmed case	2001	no	no	Laboratories	Local health authority first, then NSC	I	single	W	no data
Iceland	99	no		no	no	Physicians Laboratories	NSC directly	I	single	I	no data
Ireland		food poisoning		no	no						Listeriosis never reported through this system
Italy		Clinical picture compatible with listeriosis and an isolate of *Lm*	1992	no	no	physicians	Regional level to the MOH And to the NSC	quarterly	Single to MOH Aggreg to NSC	Y	No data
Norway	<90	Isolate from a normally sterile site, or antibodies against *Lm* consistent with *Listeria* infection	1995	no	no	Physicians Laboratories	NSC	I	single	W/Q/Y	no data
Sweden	<90	Isolate of *Lm* from a normally sterile site	<90	isolate of *Lm* from CSF	Isolate of *Lm* from a woman with a spontaneous abortion or from a newborn	Physicians Laboratories Pathologists	Local health authority first, then NSC; and NSC directly	I	single	Y	no data
Switzerland	<90	Isolate of *Lm* from a normally sterile site	1999	no	no	Physicians (no more since 99) Laboratories	MoH	I	single	Y	no data

Countries without STATUTORY NOTIFICATION of Listeriosis: England and Wales, Ireland, Netherlands, Scotland, Spain, Austria, Greece, Austria, Ireland, Belgium French community
with STATUTORY NOTIFICATION of foodborne illness or foodborne outbreaks : Austria, Ireland, Belgium
W= weekly; M= monthly; Q= quarterly; Y= yearly; I= immediately; NSC=National Surveillance Centre

Table 4: Characteristics of listeriosis surveillance systems: universal voluntary reporting

Universal voluntary reporting											
	Start of surveillance	**Case definition**	**Used since when**	**CNS case deifinition**	**Pregnancy case definition**	**Who is reporting**	**To whom it is reported**	**Periodicity of reporting to central level**	**Format of data received at central level**	**Analysis at central level (periodicity)**	**Sensitivity, coverage, representativity**
England and Wales	<90	Isolation of *L* spp from a normally sterile site (usually CSF or blood), or when a pregnant woman delivers or miscarries a pregnancy and vaginal swabs, placental or fœtal tissue or surface swabs of the baby indicate infection	<90	Isolation of *L* spp from CSF or brain tissue	All cases of invasive maternal infection (ie *Lm* spp isolated from normally sterile site) and fœtal or neonatal infection up to the first 28 days of life. Any newborn with *Lm* grown from non-invasive sites (eg surface swabs) is also considered to be infected with *Lm* due to vertical transmission or cross infection	Physicians Laboratories	NSC LHA then NSC	I	single	Q,Y, more frequent as required	sensitivity assumed to be high
Greece	1998	no		no		Laboratories	NSC	W	single	W	No information
Ireland	1998	no		no	no	Labs Public Health Depts	Local level then NSC	I	single	M	no information
Scotland	<90	An isolate of *Lm*		An isolate of *Lm* from CSF	Isolate from a case reported to be pregnant	Laboratories	NSC	W	single	W	no information
Spain	<90	A clinical compatible case with a *Lm* isolate	<90	no	no	Physicians Laboratories	LHA then NSC (some AC)	W	single	W-Y	Only part of the 16 autonomous communities transmit the notifications to the NSC

Countries without Universal voluntary reporting : Austria, Belgium, Denmark, Finland, France, Germany, Iceland, Italy, Netherlands, Norway, Portugal, Sweden, Switzerland

NSC=National Surveillance Centre; LHA=Local Health Authority; AC= Autonomous Communities; W= weekly; M= monthly; Q= quarterly; Y= yearly; I= immediately

Table 5: Characteristics of listeriosis surveillance systems: surveillance by reference laboratories

	Reference Laboratory								
	Frequency of sending isolates to the Lab	**Level of this Lab**	**Number of Reference Laboratories**	**Start of surveillance by Ref Lab**	**Case definition**	**Used since when**	**CNS case deifinition**	**Pregnancy case definition**	**representativity, sensitivity, coverage**
Austria		national	1		Isolate of *Lm* from a normally sterile site				No data
Belgium	often	national	1	<90	Isolate of *Lm* from a normally sterile site				No data
Denmark	often	national	1	<90	*Lm* isolated from any site from any patient with a clinical presentation compatible with Listeriosis in any form	<90	*Lm* isolated from CSF	*Lm* isolate from a pregnant women and/or her fœtus or baby	notification assumed to be 100%
England and Wales	often	national	1	<90	same as Universal voluntary reporting	<90	same as Universal voluntary reporting	same of other systems	isolates received from approx. 80% of notified cases
Finland	statutorily	national	1	95	*Lm* isolate	95			2001: 25 isolates compared to 18 notified cases
France	often	national	1	<90	*Lm* isolated from a human specimen	<90	Isolates from CSF	Isolate of *Lm* from a pregnant woman or neonate	strains received for > 95% of notified cases
Germany	sometimes		3	no surveillance					2000: 20 isolates received compared to 220 notified cases
Greece	sometimes	national	1	No surveillance	no		no	no	No data
Iceland	often	national	1	<90	no		no	no	No data
Ireland	rarely	strains sometimes sent to NRL in England (PHLS)	none (PHLS)	no surveillance	no		no	no	
Italy	sometimes	national	1	1993					
Netherlands	sometimes	national	1	no surveillance					25 human isolates in 2000 (only isolates from cases with CNS infections)
Norway	often	national	1	<90	no		no	no	estimated sensitivity 75%; 2000: 11 strains received (65%) compared to 17 cases notified
Portugal	rarely	national	1	No surveillance	no		no	no	no role in surveillance
Scotland	often	In England (PHLS)	(PHLS)	<90	Isolate of *Lm*	<90	Isolates from CSF	isolate from a case reported to be pregnant	It is assumed that all strains are sent to the PHLS
Spain	sometimes	national	1	<90	Isolate of *Lm* from a normally sterile site (eg blood, CSF, joints, pleural or pericardial fluid)		no	no	only part of the 16 autonomous communities send isolates
Sweden	Statutorily	national	1						
Switzerland	often	national	1	<90	Isolate of *Lm* from a normally sterile site	<90	no	no	2000: 46 strains received compared to 54 cases notified

Countries without Reference Laboratory: Ireland

Table 6: Characteristics of listeriosis surveillance systems: surveillance of syndromes

	Surveillance of syndromes										
	Start of surveillance	**Case definition**	**Used since when**	**CNS case definition**	**Pregnancy case definition**	**Who is reporting**	**To whom it is reported**	**Periodicity of reporting to central level**	**Format of data received at central level**	**Analysis at central level (periodicity)**	**coverage sensitivity representativeness**
Denmark	90-95	meningitis with isolate of *Lm* from CSF	<90	the same	no	Medical practices Hospitals	NSC	I	single	Y	in 2000, 6 cases compared to 8 cases reported through the laboratoy notification of *Listeria* infections
France	<90	*Lm* isolation from CSF or blood	<90	Isolate from CSF	no	Hospital laboratories	NSC	M/Q	single	Y	Sensitivity 59% for cases with *Lm* isolate in CSF or blood
Greece	90-95	no		no	no	Medical practices Hospital laboratories	NSC	I	single	W, M, Y	no information
Italy	90-95	Bacterial meningitis, but no case definition		no	no	Hospitals	NSC	I	single	Y	No information
Netherlands	<90	clinical meningitis and *Lm* isolate from CSF or blood	< 90	the same	no	Labs (often from hospitals)	National Ref Lab for meningitis	I	single	Y	All laboratories in the country participate. Sensitivity is estimated at about 70%

Countries without Surveillance of Syndromes: Austria, Belgium, England and Wales, Finland, Germany, Iceland, Ireland, Norway, Portugal, Scotland, Spain, Switzerland, Sweden

Table 7: Characteristics of listeriosis surveillance systems by country: sentinel surveillance

	Surveillance of syndromes											
	Start of surveillance	Case definition	Used since when	CNS case definition	Pregnancy case definition	Who is reporting	Additional investigation carried out	To whom it is reported	Periodicity of reporting to central level	Format of data received at central level	Analysis at central level (periodicity)	coverage sensitivity representativeness
Belgium	90-95	*Lm* isolation	90-95	no	no	Laboratories	no	NSC	w	single	w	129 (49%) of all laboratories +NRC
Netherlands	<90	*Lm* isolation	<90	*Lm* isolate from CSF	no	regional public health laboratories	no	NSC	I-W	Sing-aggr	irregular	coverage: whole country; sensitivity estimated at 35%

Countries without Sentinel Reporting : Austria, Belgium, England and Wales, Denmark, Finland, France, Germany, Iceland, Ireland, Italy, Norway, Portugal, Scotland, Spain, Sweden, Switzerland

Table 8: Type of information reported to the national level, by country and by Listeriosis surveillance system

		Sending institution	Demographics of patient	Clinical information	Diagnostic criteria	Lab Information	Epidemiological information
Austria	Refer.Lab.		Residence	Outcome		date of isolation site of isolation	
Belgium (flemmish speaking community)	Stat.Notif.	Name Address	Age Sex	Principal diagnosis	Isolation of *Lm* Clinical symptoms Serology	Investigated materials Date of isolation	Country where case was infected
	Sentinel	Name Address	Age Sex Residence		Isolation of *Lm*	Investigated materials Date of isolation	
Denmark	Syndr.surv.	Name Address Hospital	Name Age Sex Residence	Principal diagnosis Illness Treatment	Isolation of *Lm* Clinical symptoms	Investigated materials Date of isolation	
England and Wales	Univ.Vol.Rep	Name Address Hospital	Name Age Sex Residence	Type of symptoms Date of onset of symptoms Principal diagnosis Pregnancy associated Underlying illness Treatment Hospitalisation Outcome	Isolation of *Lm*	Investigated materials Date of isolation Date of first positive sample	Putative risk factors Suspected source of infection Link to other cases Food history Travel history Maternal contact with farm animals Contacts with animals such as veterinarians and farm workers
Finland	Stat.Notif.	Name Address Hospital	Name Age Sex Residence	Date of onset of symptoms Principal diagnosis	Isolation of *Lm*	Investigated materials Date of isolation	
France	Stat.Notif.	Name Address Hospital	Age Sex Residence	Date of onset of symptoms Principal diagnosis Pregnancy associated Underlying illness Treatment Hospitalisation Outcome Date of death, stillbirth, abortion	Isolation of *Lm*	Investigated materials Date of first positive sample	detailed food history
	Syndr.surv.	Name Address	Age Sex			Investigated materials Date of isolation	
Germany	Stat.Notif.	Name Address Hospital	Name Age Sex Residence	Type of symptoms Date of onset of symptoms Principal diagnosis Pregnancy associated Hospitalisation Outcome Date of death, stillbirth, abortion	Isolation of *Lm* Clinical symptoms	Investigated materials Date of isolation	Link to other cases Travel history

Table 8: Type of information reported to the national level, by country and by Listeriosis surveillance system (continued)

		Sending institution	Demographics of patient	Clinical information	Diagnostic criteria	Lab Information	Epidemiological information
Greece	Univ.Vol.Rep	Name Address					
	Syndr.surv.	Name Address Hospital	Name Age Sex Residence	Type of symptoms Date of onset of symptoms Principal diagnosis Hospitalisation Outcome Date of death, stillbirth, abortion	Isolation of *Lm*	Investigated material	Link to other cases Food history
Iceland	Stat.Notif.	Name Address Hospital	Name Age Sex Residence	Type of symptoms Date of onset of symptoms Principal diagnosis Hospitalisation Outcome Date of death, stillbirth, abortion	Isolation of *Lm*	Investigated material Date of isolation Date of first positive sample	Suspected source of infection Link to other cases Travel history Place of infection Time of infection Contact tracing
Ireland	Univ.Vol.Rep	Name Address Hospital	Name Age Sex Residence	Type of symptoms, Date of onset of symptoms, Principal diagnosis Pregnancy associated, Illness, Treatment, Hospitalisation, Outcome, Date of death, stillbirth, abortion	Isolation of *Lm* PCR Clinical symptoms Serology	Investigated material Date of isolation Date of first positive sample	Putative risk factors Suspected source of infection Food history
Italy	Stat.Notif.	Name Address Hospital	Name Age Sex Residence	Date of onset of symptoms Hospitalisation			
	Syndr.surv	Name Address Hospital	Name Age Sex Residence	Date of onset of symptoms, Principal diagnosis, Underlying illness, Hospitalisation, Outcome, Date of death		Investigated material	Travel history
Netherlands	Sentinel	Name	Age Sex Residence	Pregnancy associated	Isolation of *Lm*	Investigated materials Date of isolation Date of first positive sample	Suspected source of infection Travel history
	Syndr.surv.	Name	Age Residence		Isolation of *Lm*	Investigated materials	
Norway	Stat.Notif.	Name Address Hospital	Name Age Sex Residence	Type of symptoms Date of onset of symptoms Principal diagnosis Hospitalisation	Isolation of *Lm*, PCR, serology	Investigated materials Date of isolation Date of first positive sample	putative riskfactors
Scotland	Univ.Vol.Rep	Name Address Hospital	Name Age Sex Residence		Isolation of *Lm*	investigated material date of isolation	
Spain	Univ.Vol.Rep	Name Address Hospital	Age Sex	Principal diagnosis Pregnancy associated	Isolation of *Lm*	Investigated materials Date of isolation	

Table 8: Type of information reported to the national level, by country and by Listeriosis surveillance system (continued)

		Sending institution	Demographics of patient	Clinical information	Diagnostic criteria	Lab Information	Epidemiological information
Sweden	Stat.Notif.	Name Address Hospital	Name Age Sex Residence	Date of onset of symptoms	Isolation of *Lm*	Investigated materials Date of isolation Date of first positive sample	Putative risk factors Link to other cases Suspected source of infection Food history (occasionally) Travel history
Switzerland	Stat.Notif.	Name Address Hospital	Name Age Sex Residence		Isolation of *Lm*	Investigated materials Date of isolation	

Table 9: Characteristics of listeriosis surveillance systems contributing to efficient outbreak detection, by country and by system

		Real-time* reporting	Real-time* analysis	estimated or assumed sensitivity	Typing available for surveillance	Detection mechanisms	Criteria?
Austria	Refer Lab.	yes	yes	high	sero-ribo		
Belgium	Stat.Notif.	Local level only		no	yes	2 cases/w/community	
	Sentinel	yes	yes	high			
	Refer.Lab	yes	?	high	sero-bio-	yes	
Denmark	Syndr.surv.	yes	yes	high			
	Refer.Lab	yes	yes	100%	Sero-PFGE-Ribo	yes	2 (or more) cases/within 1 month, same ribo- pfge- type
England and Wales	Univ.Vol.Rep	yes	yes	high?		yes	2 (or more) cases linked by a common source
	Refer.Lab			80% of notified cases	sero-phage-bio-	yes	increase in cases with isolates having the same sero-, phage-, and biotype
Finland	Stat.Notif.	yes	yes	high?	sero-PFGE	no	
	Refer.Lab	partly	yes	high	sero-PFGE	no	increase in cases with isolates having the same serotype and PFGE
France	Refer. Lab +Stat.Notif.	yes	yes	87%	sero-PFGE	yes	3 strains with same PFGE-profile isolated in 14 weeks
	Syndr.surv.	no	no	57%	no	no	
Germany	Stat.Notif.	yes	yes	?	no	in development	under test
Greece	Univ.Vol.Rep	yes	yes	?	no	no	
	Syndr.surv.	yes	yes	?	no	no	
Iceland	Stat.Notif.	yes	yes	high	no	no	
	Refer. Lab.	yes	yes	high	no	no	
Ireland	Uni,v.Vol.Rep	yes	no	?		yes	2 or more linked cases
Italy	Stat.Notif.	no	no	?	no	no	
	Syndr.surv	yes	no	?	no	no	
	Refer.Lab			?	sero-PFGE	no	
Netherlands	Sentinel	yes	no	35%	no	yes	threshold based on 4 weeks averages of preceding 5 years
	Syndr.surv.	yes	no	70%	no	no	
Norway	Stat.Notif.	yes	yes	high	no	no	
	Refer.Lab	yes		estimated 75%	sero-	no	
Portugal							
Scotland	Univ.Vol.Rep	yes	yes	high	sero-phage-bio-		no
Spain	Univ.Vol.Rep	yes	yes	geographical			
	Refer.Lab	yes	yes	coverage incomplete	sero- PFGE	yes	2 or more linked cases (same period, place and/or source)
Sweden	Stat.Notif.	yes	no	high?			
	Refer.Lab	yes		12 (18%) isolates for 67 reported cases	sero-bio-PFGE	no	no
Switzerland	Stat.Notif.	yes	no	high?		yes	
	Refer.Lab	yes	?	high?	sero-		

* real-time= immediately or weekly; sero- = serotype; phage = phagetype; bio= biotype; PFGE= pulse field gel electrophoresis

Table 10: Reported *Listeria* infections, number of cases and incidence (last year available)

Country	Year	System	Observed cases or strains	Millions of inhabitants (x1000)	Observed Incidence (*1,000,000)	Characteristics of the system	Estimated incidence (*1,000,000)
Austria	2000	Refer.Lab	14	8 140	1.7		
Belgium (Fl)	1999	Stat.Notif.	26	5 940	4.4		
Belgium	2000	Sent+Ref.Lab	48	10 238	4.7		
Denmark	2000	Syndr.surv.(Meningitis)	6	5 314	1.1		
	2001	Stat. Notif	38	5 314	7.2		
	2001	Refer.Lab	38	5 314	7.2		
England & Wales	2001	Univ.Vol.Rep	135	52 943	2.5		
	2000	Refer.Lab	81	52 943	1.5		
Finland	2001	Stat.Notif.	29	5 181	5.6		
France	2001	Stat.Notif.+ Refer. lab	187	58 520	3.2	sensitivity 87%	3.7
	2000	Syndr.surv.(CNS+blood stream infections)	148	58 520	2.5	sensitivity 59%	3.6
Germany	2001	Stat.Notif.	220	82 133	2.7		
Greece	2001	Univ. Vol. Rep	3	10 600	0.3		
	2001	Syndr. Surv	2	10 600	0.2		
Iceland	2001	Stat.Notif.+NRL	0	276	0.0		
Ireland	2001	Univ. Vol. Rep	6	3 681	1.6		
Italy	1999	Refer.Lab	11	57 670	0.2		
	1999	Stat. Notif	40	57 670	0.7		
	2001	Syndr.surv. (Meningitis)	31	57 670	0.5		
Netherlands	2001	Sentinel	17	15 678	1.1	sensitivity 35%?	3.4
	2000	Syndr.surv. (Meningitis)	26	15 678	1.7	sensitivity 70%	2.4
Norway	2001	Stat. Notif	17	4 419	3.8		
	2000	Refer. Lab	11	4 419	2.5		
Portugal			–	9 869	–		
Scotland	2001	Univ. Vol. Rep	15	5 115	2.9		
Spain	2000	Univ.Vol.Rep	35	39 628	0.9	Data from certain regions not included	
	2000	Refer.Lab	60	39 628	1.5		
Sweden	2001	Stat. Notif	67	8 875	7.5		
	2001	Refer.Lab	12	8 875	1.4		
Switzerland	2000	Stat.Notif.	54	7 299	7.4		
	2000	Refer.Lab	46?				

Table 11: CNS and pregnancy associated *Listeria* infections, number and / or proportion of all listeriosis cases by system (last year available)

Country	System	Year	Reported cases	CNS infection cases (%)	Pregnancy associated cases (%)
Austria	Refer. Lab	2000	14	unknown	unknown
Belgium	Sent Syst	2000	42	13 (31%)	2 (5%)
Denmark	Syndr.surv. Refer.Lab	2000 2001	6 38	By definition 100% 10 (26%)	– 3 (8%)
England and Wales	Univ.Vol.Rep +Ref lab	2001	135	14 (10%)	16 (12%)
Finland	Stat.Notif	2001	29	unknown	unknown
France	Stat. Notif + Ref.lab Syndr.surv.	2001 2000	187 148	50 (27%) 40 (27%)	44 (24%) –
Germany	Stat. Notif	2001	220	45 (20%)	30 (14%)
Greece		2001	3	unknown	unknown
Iceland		2001	0	–	–
Ireland	Univ.Vol.Rep.	2001	6	2 (33%)	1 (17%)
Italy	Stat.Notif	1999	40	unknown	unknown
Netherlands	Sent Syst Syndr.surv.	2001 2000	17 26	22% By definition 100%	unknown –
Norway	Stat. Notif	2000	17	12-25%	18-38%
Portugal					
Scotland	Univ.Vol.Rep.	2001	15	1 (7%)	3 (20%)
Spain	Univ.Vol.Rep.	2000	35	22 (63%)	2 (6%)
Sweden	Univ.Vol.Rep.	2001	67	unknown	5 (7%)
Switzerland	Stat. Notif	2000	54	1998:27%	1998:13%

Table 12: Reported outbreaks of listeriosis and of *Listeria* gastro-enteritis in Europe since 1990

Year	Country	Number of cases*	Transmission	Incriminated food	Potential international implication
1992	France	279	foodborne	Pork tongue in jelly	Exported product
1992	Spain	24	foodborne	unknown	
1992	Norway	6	foodborne	sliced cold meat	
1993	France	38	foodborne	Rillettes (Pork meat)	Exported product
1993	Italy	18 gastro-enteritis	foodborne	rice salad	
1994-95	Sweden	9	foodborne	gravad trout	
1995	France	36	foodborne	Cheese (raw milk)	
1995	Iceland	5	unidentified	unidentified	
1996	Denmark	3 gastro-enteritis	unidentified	unidentified	
1997	France	14	foodborne	Cheese (raw milk)	Exported product
1997	Finland	5	foodborne	Cold-smoked rainbow trout	
1997	Italy	1 566 gastro-enteritis	foodborne	corn salad	
1998-99	Finland	25	foodborne	Butter	
1999	England and Wales	2	foodborne	Cheese/cheese salad	
1999	France	3	foodborne	Cheese	Possible cases in Germany?
1999	France	10	foodborne	Rillettes (Pork meat)	Exported product
1999-00	Finland	10	foodborne	Vacuum-packed fish products	Exported?
2000	France	32	foodborne	Pork tongue in jelly	Exported?
2000	Portugal	1	foodborne	cheese	
2000	Spain	15	foodborne	unidentified	
2001	Belgium	1 + 2 gastro-enteritis	foodborne	ice cream	Belgian case developping invasive illness in France
2002	France	11	foodborne	spreadable raw sausage	Export to Germany, Belgium and Luxembourg

*cases refer to invasive listeriosis unless otherwise specified

Table 13: Tasks of the NRLs for *Listeria* in European countries (n=16). Survey 2001

	Surveillance	Outbreak detection	Training	Providing expertise	Providing materials	Research
Austria	Yes	Yes	Yes	Yes	Yes	
Belgium	Yes			Yes	Yes	
Denmark	Yes	Yes	Yes	Yes	Yes	Yes
UK	Yes	Yes				
Finland	Yes	Yes				Yes
France	Yes	Yes	Yes	Yes	Yes	Yes
Germany	Yes	Yes	Yes	Yes	Yes	Yes
Greece	Yes	Yes	Yes	Yes	Yes	Yes
Iceland	Yes	Yes	Yes	Yes		Yes
Italy	Yes	Yes	Yes	Yes	Yes	Yes
Netherlands	Yes	Yes		Yes		Yes
Norway	Yes	Yes				
Portugal	Yes		Yes	Yes		Yes
Spain	Yes	Yes		Yes		Yes
Sweden	Yes	Yes		Yes		Yes
Switzerland	Yes	Yes	Yes	Yes	Yes	Yes

Table 14: Information on strains received by NRLs for *Listeria* in European countries (n=15). Survey 2001

	Site of isolation	Clinical data	Epidemiological data	Strain characteristics
Austria				
Belgium	Yes	Yes		
Denmark	Yes	Yes	Yes	Yes
UK	Yes	Yes	Yes	
Finland	Yes			
France	Yes	Yes	Yes	Yes
Germany	Yes	Yes	Yes	Yes
Greece	Yes	Yes	Yes	Yes
Iceland	Yes	Yes	Yes	
Italy	Yes	Yes	Yes	Yes
Netherlands	Yes		Yes	Yes
Norway		Yes		
Spain	Yes	Yes	Yes	Yes
Sweden	Yes		Yes	Yes
Switzerland	Yes	Yes		

Table 15: Circumstances in which *Listeria* strains are sent to the NRL in European countries (n=16). Survey 2001. See text for indications

	Austria	Belgium	Danmark	UK	Finland	France	Germany	Iceland	Italy	Nether	Norway	Portug	Spain	Sweden	Switz
Strain sent systematically		x	x		x			x					x	x	x
immediately		x	x		x			x					x	x	x
regularly													x	x	
irregularly													x	x	
Strain not sent systematically	x	x		x		x	x		x	x	x	x	x		
will of the lab	x	x		x		x	x		x	x	x	x	x		
contaminated food				x		x	x		x	x			x		
outbreak suspicion		x		x		x			x	x	x		x		
when outbreak		x				x			x	x	x		x		
ad hoc study						x			x		x				

Table 16: Number of *Listeria monocytogenes* strains of human origin received by NRLs in the year 2000 (or latest available), and estimate of the total number of bacteriologically confirmed cases by ountry

	Austria	Belgium	Denmark	UK	Finland	France	Germany	Iceland	Italy	NetherId	Norway	Portug	Spain	Sweden	SwitzerId
Year	**2000**	**2000**	**2001**	**2000**	**2000**	**1999**	**–**	**2000**	**1999**	**2000**	**2000**	**2000**	**2000**	**2001**	**2000**
Nb strains received at NRL	–	42	43	81	25	244	10	0	11	25	11	1	60	12	46
Nb strains isolated in patients	14	48	47	99	30	262	>200	0	NP	–	17	NP	NP	67	54

NP : not possible to estimate

Table 17a: Typing methods performed in NRLs for *Listeria* in different circumstances, 2001: phenotypic methods. (Iceland did not answer; for Germany, information comes from 3 laboratories; see text for details)

	routinely (ongoing)*	routinely (at intervals)*	for specific investigations**	ad hoc studies***
a) Serotyping	Switzerland Spain, Germany, France, Norway, Austria, Denmark, UK, Finland, Italy, Sweden, Belgium	Netherlands Italy	France, Italy Netherlands Germany	Italy Netherlands
b) Phage-typing	UK			
c) Bacteriocin typing				Switzerland
d) Biotyping (cadmium, arsenic, ….)	Belgium, UK, Sweden, Germany	(Netherlands)	Netherlands	Netherlands

Table 17b: Typing methods performed in NRLs for *Listeria* in different circumstances (Iceland did not answer), 2001: molecular methods. ([1]In Sweden, typing by PFGE is carried out routinely by a laboratory collaborating with the NRL)

	routinely (ongoing)*	routinely (at intervals)*	for specific investigations**	ad hoc studies***
a) Multilocus enzyme electrophoresis (MEE)	Germany			Switzerland
b) Plasmid profiles	Germany			
c) Sequencing	Spain	Greece	Norway	Portugal
d) PCR-based methods			Portugal	
RAPD	Italy,Germany	Italy	Netherld, Italy, Germany	Switz, Italy
Repetitive element sequence-based PCR	Italy,Germany	Italy	Netherld, Italy Greece	Italy
Other (specify)			Germany (iap-gen)	UK (AFLP)
e) Restriction fragment length polymorphism analysis				
Low frequency cutting enzyme with PFGE	Danemark, Finland France, Spain, Italy Sweden[1], Germany	Italy	Belgium, France Netherlands, Norway, Italy, Greece, Switzerland	Belg, France Portugal, Italy
Frequent cutting enzyme (REA)	Italy	Italy	Italy	Switzerld, Italy
f) Probe-based methods				Portugal
Ribotyping (Qualicon)	Austria, Danemark Germany		France, Greece	France

Table 17c: Questionnaire on acceptability, capacity and possibilities of your Reference Laboratory to perform PFGE typing of *Listeria monocytogenes* routinely and with a common protocol (this questionnaire concerns only human isolates of *Listeria monocytogenes*)

Country:.....

Name and address of in the person filling the questionnaire:

.....

.....

* * * *

Q1 Are you already doing PFGE typing? Yes ☐ No ☐

Q2 If No, do you plan to introduce PFGE typing in your Reference Laboratory in the year 2003? Yes ☐ No ☐

Q3 Do you perform PFGE typing **routinely**? Yes ☐ No ☐

Q4 If No to Q3, do you **intend** to perform PFGE typing **routinely** in the future (2003)? Yes ☐ No ☐

Q5 At which intervals of time do you perform PFGE typing?

Weekly ☐ Monthly ☐ Yearly ☐

Every time you receive a new *Listeria monocytogenes* strain ☐

Other interval..... Not concerned ☐

Q6 Do you use an image analysis software? Yes ☐ No ☐ Not concerned ☐

If Yes, which software(s) .....

Q7 If No to Q6, do you intend to use an image analysis software? Yes ☐ No ☐ Not concerned ☐

If Yes, which software(s) .....

Q8 Would you accept to use a common and standardized PFGE protocol for typing Listeria *monocytogenes*? Yes ☐ No ☐

Q9 Would you accept to perform PFGE typing **weekly** (if necessary), or **each time you receive a new strain**? Yes ☐ No ☐ Not concerned ☐

Q10 If yes to Q9, would you accept **to send image profiles** to a common European laboratory, to be compared to other european human isolates on real-time basis (i.e., immediately after they have been typed)? Yes ☐ No ☐

At which conditions? (examples: confidentiality, access to common informations, etc…)

.....

.....

Q11 If you do not perform (or intend to) PFGE typing routinely with a common protocol, would you accept **to send strain(s)** (as soon as you receive it) to a common European laboratory? Yes ☐ No ☐

Table 17d: Acceptability, capacity and possibilities of NRLs to perform PFGE typing of *Listeria monocytogenes* routinely and with a common protocol

	Austria	Belgium	Denmark	Finland	France	Germany	Greece	Iceland	Italy	The Nethld	Norway	Portugal	Spain	Sweden	Switz	UK
Doing PFGE in 2002	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Intend to do PFGE in 2003																No
Doing PFGE routinely	Yes	No	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No	Yes	Yes	Yes	No	No
Intend to do PFGE routinely		Yes						No		Yes	Yes				No	No
PFGE intervals (Q5):																
Weekly	Yes					Yes	Yes									
Monthly	Yes	Yes				Yes			Yes			Yes	Yes			
Each time *Lm*…	Yes			Yes	Yes	Yes								Yes		
Use a software (or intend to)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes		Yes	Yes
Accept common protocol (Q8)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes	
Accept to do PFGE weekly (Q9)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes		No	
Accept to send PFGE images	Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes	Yes	Yes	Yes	Yes			
Accept to send strains			Yes		Yes			Yes		Yes					Yes	

Table 18: Number of *Listeria* strains isolated from foods and received by the NRLs (for human strains), 2000 or 2001

Austria	251	Italy	63
Belgium	250	Netherlands	30
Denmark	4	Portugal	100
UK	132	Spain	157
France	5 076	Switzerland	323
Greece	250		

Table 19: Quality Control (QC), Quality Assurance (QA) and Accreditation of *Listeria* diagnostics in NRLs in European countries, 2001

	Internal QC identification	Internal QC typing	External QC	Quality Assurance	Accreditation Or Certification
Austria			Yes (NEQAS)	Yes	ISO 9001
Belgium		Yes		Intend to	
Denmark		Yes		Yes	ISO/UE 17025
UK	Yes	Yes			'Clinical Path'
Finland	Yes		Yes (NEQAS)		
France				Yes	
Germany		Yes		Yes	ISO/UE 17025
Greece	Yes			Yes	ISO/UE 17025
Iceland			Yes (NEQAS)	Intend to	
Ireland	Yes		Yes (NEQAS)		
Italy	Yes	Yes	Yes (NEQAS)	Intend to	
Netherlands		Yes		Yes	'CCKL-test'
Norway					ISO/UE 17025
Portugal	Yes		Yes	Intend to	
Spain	Yes	Yes		Intend to	
Sweden	Yes	Yes		Yes	ISO/UE 17025
Switzerland	Yes	Yes	Yes (NEQAS)		ISO/UE 17025

Tableau 20: Proposed case definitions for a European surveillance network of Listeriosis

The network should adopt the case definition for reporting communicable diseases to the Community Network DN 2119/98/EC of the European Parliament and of the Council:

Listeriosis (= invasive *Listeria* infection)
Clinical description
Infection caused by *Listeria monocytogenes*, which may produce any of several clinical syndromes, including stillbirth, listeriosis of the new-born, meningitis, bacteremia, or localised infections

Laboratory criteria for diagnosis
Isolation of *Listeria monocytogenes* from a normally sterile site (e.g., blood or cerebro-spinal fluid or, less commonly, joint, pleural, or pericardial fluid)

Case classification
Possible: NA
Probable: NA
Confirmed: a clinically confirmed case that is laboratory confirmed

In addition, the expert panel recommends that any new-born with clinical signs of listeriosis with *Listeria monocytogenes* grown at, or within 24 hours of, birth from non normally sterile sites (eg surface swabs, placenta, amniotic fluid, meconium, cervix of the mother) is also considered a confirmed case.

In summary, the proposed case definition for a **confirmed case of listeriosis** will be:
Clinical signs of listeriosis and isolation of *Listeria monocytogenes* from a normally sterile site, or from non normally sterile sites in a newborn or the mother at or within 24 hours of birth.

A **pregnancy associated** confirmed case of listeriosis is defined as

Isolation of *Listeria monocytogenes* from a usually sterile site from a pregnant woman or from a neonate within 7 days of life, or from an abortion product, or stillbirth.

Any new-born with clinical signs of listeriosis with *Listeria monocytogenes* grown at or within 24 hours of birth, from non normally sterile sites (eg surface swabs, placenta, amniotic fluid, meconium, cervix of the mother) is also considered to be a confirmed pregnancy associated case.

A case of **listeriosis with Central Nervous System involvement** is defined as

Isolation of *Listeria monocytogenes* from CSF or brain tissue (**confirmed case of CNS listeriosis**)

Clinical signs of central nervous system infection plus isolation of *Listeria monocytogenes* from blood (**confirmed case of listeriosis with probable CNS involvement**)

It is recommended that single ***Listeria* gastro-enteritis cases** will not be included in the surveillance for the following reasons:
✓ Stools are not usually examined for *Listeria*
✓ Very few laboratories currently perform stool examination for *Listeria*
✓ The imputability of *Listeria* is highly questionable in single cases of acute gastro-enteritis (AGE)

However, since the predictive value positive is much higher in case of clusters, it is recommended that outbreaks of *Listeria* AGE would be reported, separately from invasive cases.

An outbreak of *Listeria* gastro-enteritis is defined as

The occurrence of at least 2 cases, clustered in time and place, of gastroenteritis, usually accompagnied by fever and headache, and isolation of *Listeria monocytogenes* from stools and absence of other pathogens causative of gastroenteritis (*Salmonella, Campylobacter, Shigella, Yersinia*, EHEC, VTEC, calicivirus, rotavirus etc), linked to a common source.

Tableau 21: Proposed minimum and optimal data set for a European surveillance network of Listeriosis

The expert panel recommends the following 'minimal' and an 'optimal' data set to be transmitted to the central data base:

Minimal data set

Identification number (countrycode labcode patientcode)

Age:
✓ Age (years) of the patient or of the mother in a pregnancy associated case
✓ Age (days) of the newborn
✓ Gestational age

Sex

Province or region of residence of patient (if not available: of diagnostic laboratory)

Investigated material(s) (e.g. blood, placenta, CSF)

Date first positive specimen received in diagnostic laboratory

Isolate characteristics
✓ serotype
✓ PFGE profil 1
✓ PFGE profil 2

Optimal data set

Clinical presentation:
✓ CNS infection
✓ Bacteriemia
✓ Localised infection

Pregnancy associated

Underlying medical condition (illness or treatment)
✓ Solid neoplasm
✓ Haematological malignancy
✓ Organ transplant
✓ Haemodialysis
✓ AIDS
✓ Cirrhosis
✓ Diabetes
✓ Corticosteroid treatment
✓ Cytostatics, chemotherapy, radiotherapy
✓ Other, specify

Outcome / death (updateable)

It was recommended that pregnancy associated cases would be reported as one case even if *Listeria* is isolated from both the mother and child (even in the case of twins). Countries will be encouraged to organise their data collection in such a manner that a neonate can be linked to his/her mother.

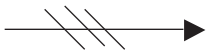
Data can be updated over time (eg the occurrence of death may not be known at the time of data transmission, and can be updated afterwards). Death should be defined as death related to *Listeria* infection according to the physician and occurring within 30 days of the isolation of *Listeria monocytogenes*.

Annex 2 – Country profiles

European surveillance of Listeria infections feasibility study

Abbreviations and symbols:


Single case


Aggregated cases

ST = Serotyping

RT = Ribotyping

BT = Biotyping

PFGE = Pulsed Field Gel Electrophoresis

Phage = Phage typing

Lm = *Listeria monocytogenes*

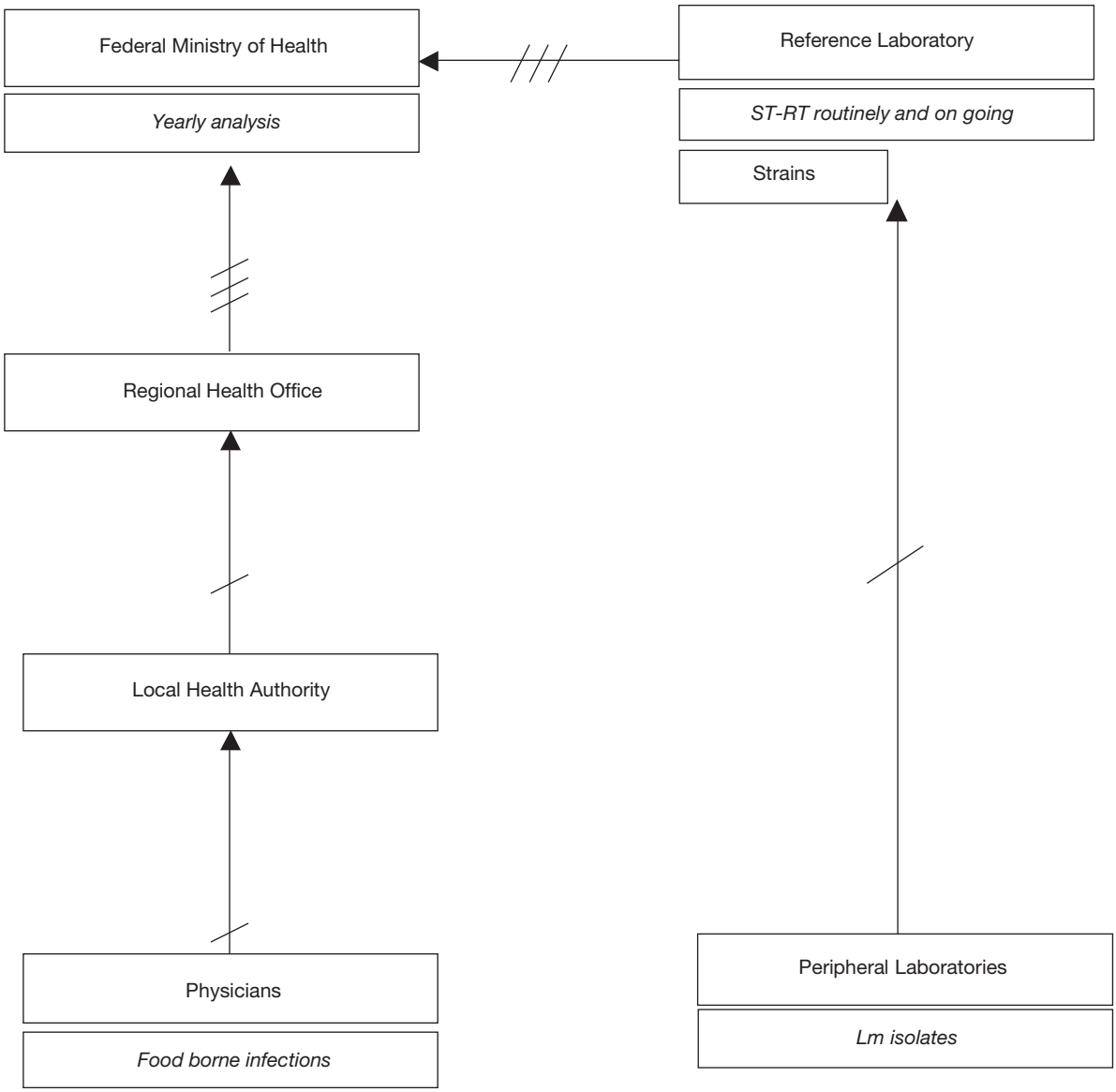
Austria

In Austria, *Listeria* infections do not specifically figure on the list of statutorily notifiable diseases. However, food borne infections are statutorily notifiable and as such, *Listeria* infections are to be notified. Cases are notified to the public health officer (local level) who reports to the regional level. The Federal Ministry receives aggregated data on notified diseases every month. Through this system, few or no cases of listeriosis are actually notified.

According to the will of the laboratory, hospitals throughout the country send their human *Listeria* isolates to the National Reference Laboratory (NRL). The NRL also receives isolates from foods usually from private laboratories. Isolates are characterised by serotyping and ribotyping, routinely and ongoing for human isolates, upon request by the laboratory for food isolates.

Outbreak detection relies mainly on the NRL that informs the Federal Ministry of an increase in the number of cases of infection with a strain of a same serotype and ribotype.

Statutory Notification
National reference Laboratory



Belgium

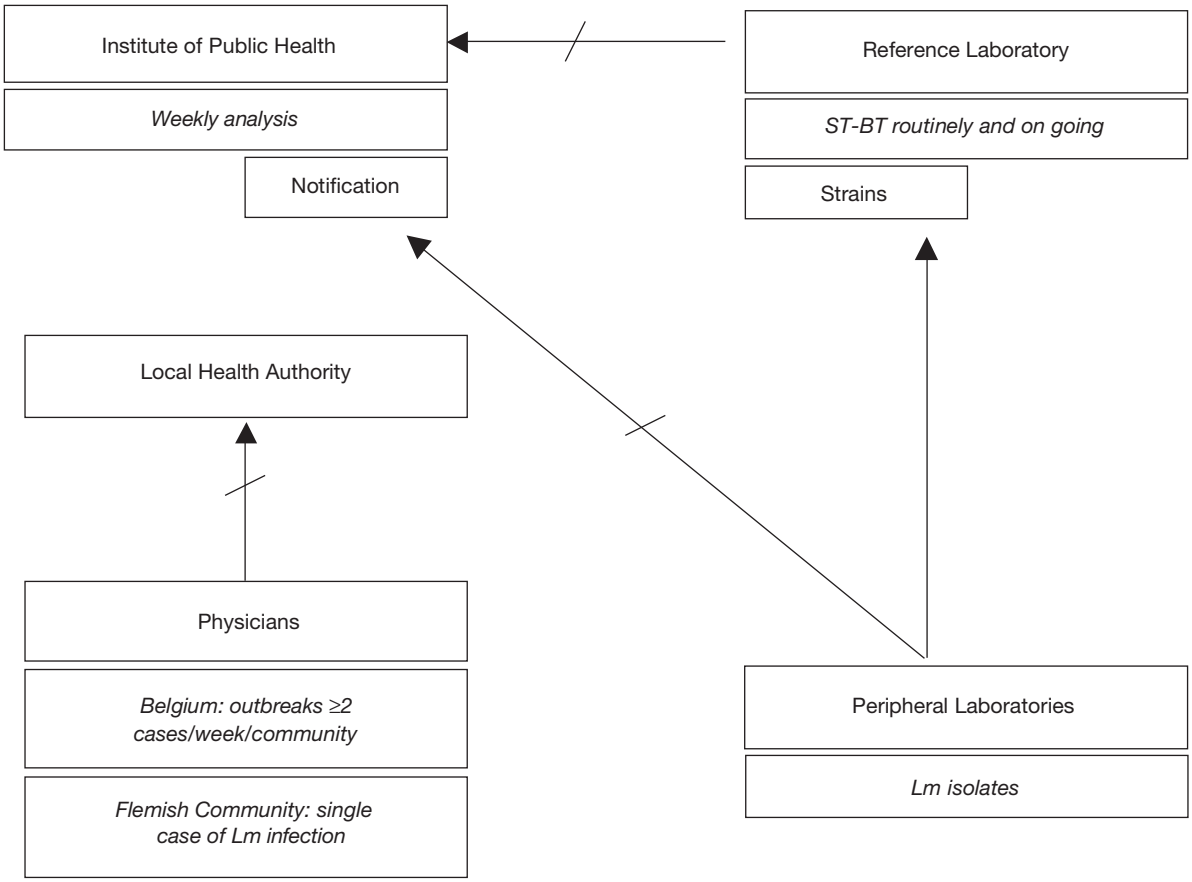
In Belgium *Listeria* infections are statutorily notifiable since 1995 in the Flemish community only. In addition, outbreaks of *Listeria* infection, defined as at least 2 cases per week per community, are also statutorily notifiable for the whole of Belgium. Notifications are sent weekly to the provincial level and are not centralised at the national level.

Peripheral laboratories voluntarily report cases to the National Institute for Public Health. 129 laboratories representing 49% of all officially recognised laboratories and the National Reference laboratory participate in this sentinel system.

The National Reference Laboratory receives human strains from hospital and private laboratories throughout the country. Some hospitals send their strains immediately and systematically, others at irregular intervals or in outbreak situations. Strains received by the NRL are routinely and immediately characterised by serotyping and biotyping, and for specific investigations by PFGE. The NRL also receives isolates from food for serotyping (routinely) and PGFE (in case of special investigations).

Outbreaks are detected by the NRL by measuring an increase in the number of strains by serotype end biotype or by the National Public Health Institute by measuring an increase in the total number of cases reported by peripheral laboratories.

Statutory Notification
Sentinel reporting
National reference Laboratory



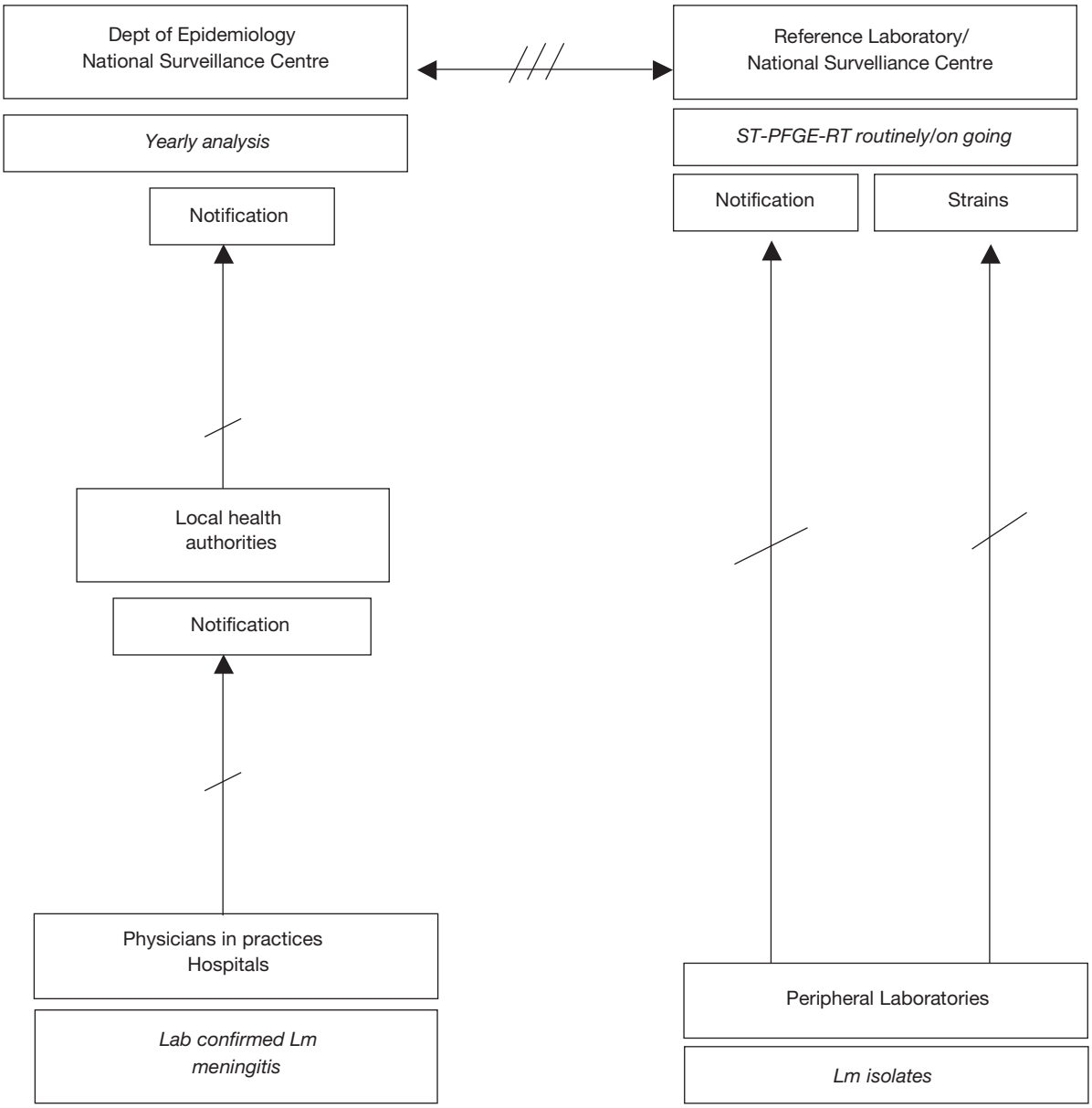
Denmark

In Denmark, laboratories statutorily notify all patients from whom *Listeria* is isolated immediately to the National Surveillance Centre (Staten Serum Institute). The sensitivity of this system for *Listeria* infections is assumed to be almost 100%. In addition, there is a system for the surveillance of bacterial meningitis of all causes. Hospitals and medical practices immediately notify every case of bacterial meningitis to the department of epidemiology of the National Surveillance Centre. The laboratory notification system of *Listeria* infections is more sensitive than the bacterial meningitis surveillance system (in 2000, only 6 of the 8 *Listeria* CNS infections notified through the laboratory system were notified through the bacterial meningitis surveillance system).

On a voluntary basis, the notifying laboratories also send their isolates, systematically and immediately after isolation, to the National Reference Laboratory. Usually the isolates are received for approximately 95-97% of the notified patients. The NRL routinely characterises the strains by serotyping, PFGE analysis and ribotyping, on an on going basis. The NRL also receives and characterises isolates from foods suspected to be linked to human cases.

Outbreaks are detected by the NRL by an increase in the number of cases due to strains of a same serotype, PFGE profile and ribotype.

Syndrome based surveillance
National reference Laboratory



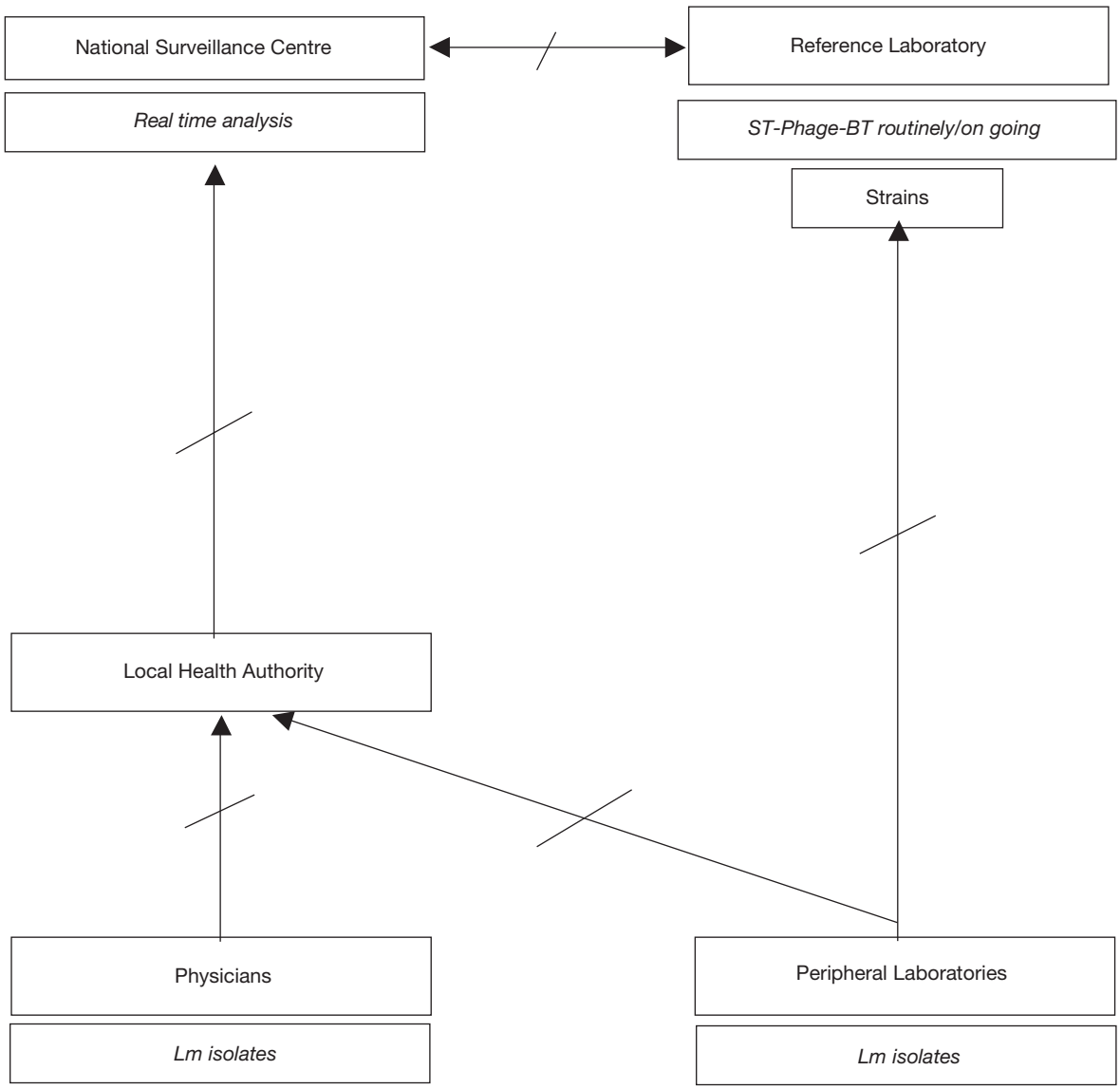
England and Wales

In England and Wales, *Listeria* infections are notified on a universal voluntary basis to the local health office that transmits the notification, in real time, to the National surveillance centre PHLS-CDSC. The sensitivity of this notification is assumed to be high.

According to the will of the laboratory, hospitals throughout the country send their human *Listeria* isolates to The National Reference Laboratory. Isolates are received for approximately 80% of the notified cases. The NRL also receives isolates from foods suspected to be linked to human cases or from foods found to be highly contaminated. Human and food isolates are routinely characterised upon reception by serotyping phagetyping and biotyping. A PCR based method (AFLP) is used for ad hoc studies.

Outbreaks are detected by the NRL by an increase in the number of cases due to strains of a same serotype, phagetype and biotype, or by investigation of cases suspected to have a common source.

Universal Voluntary Reporting
National reference Laboratory



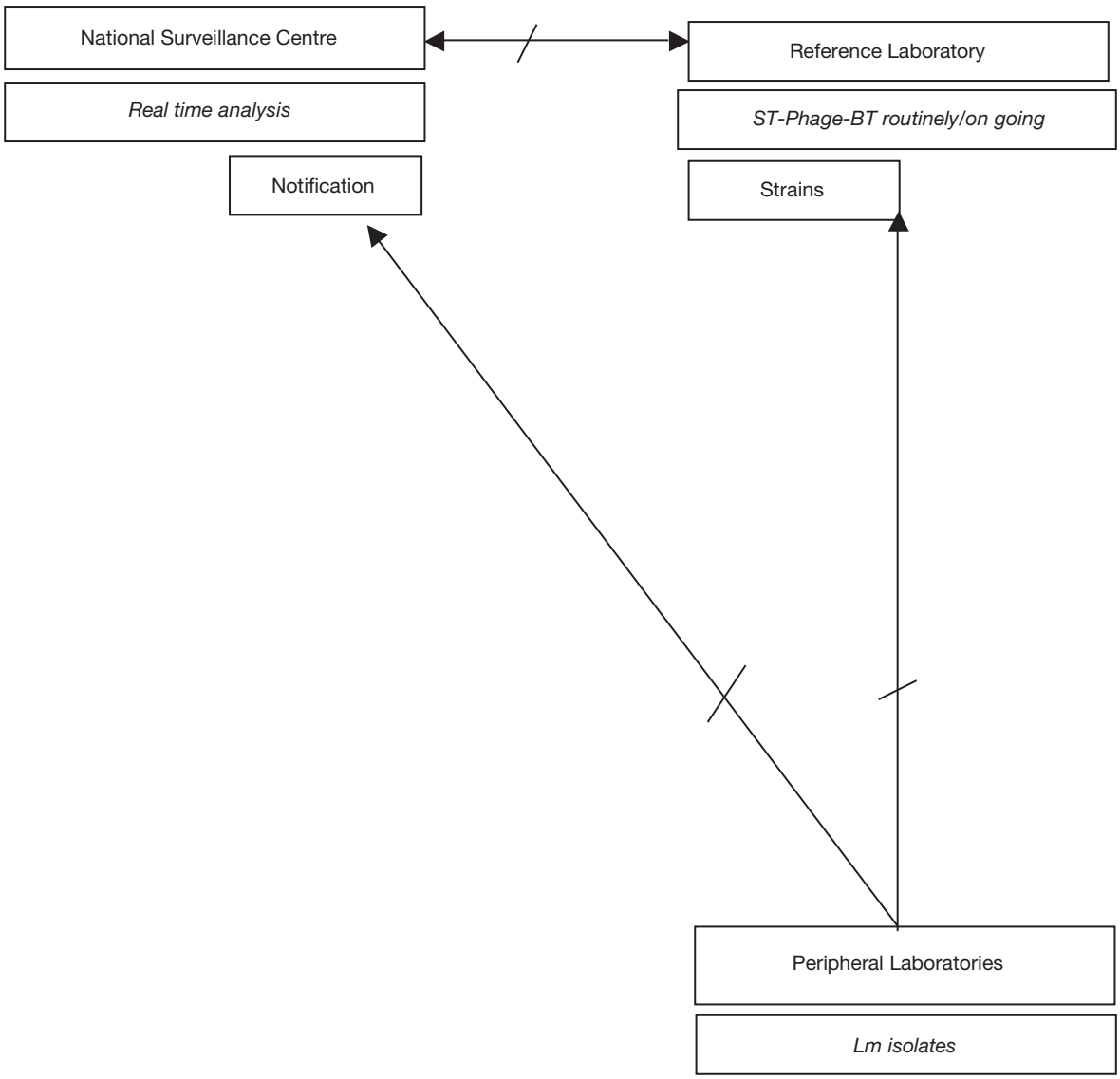
Scotland

In Scotland, *Listeria* infections are notified by the laboratories isolating *Listeria*, in real time, on a universal voluntary basis to the National surveillance centre, the Scottish Centre for Infection and Environmental Health in Glasgow. The sensitivity of this notification is assumed to be high.

According to the will of the laboratory, hospitals send their human *Listeria* isolates to the National Reference Laboratory in England (PHLS). Since isolates are rare it is assumed that all isolates are sent to PHLS. PHLS also receives isolates from foods suspected to be linked to human cases or from foods found to be highly contaminated. Human and food isolates are routinely characterised upon reception by serotyping phagetyping and biotyping.

Outbreaks are detected by the NSC or by PHLS by an increase in the number of cases due to strains of a same serotype, phagetype and biotype.

Universal voluntary reporting
National reference Laboratory (PHLS)



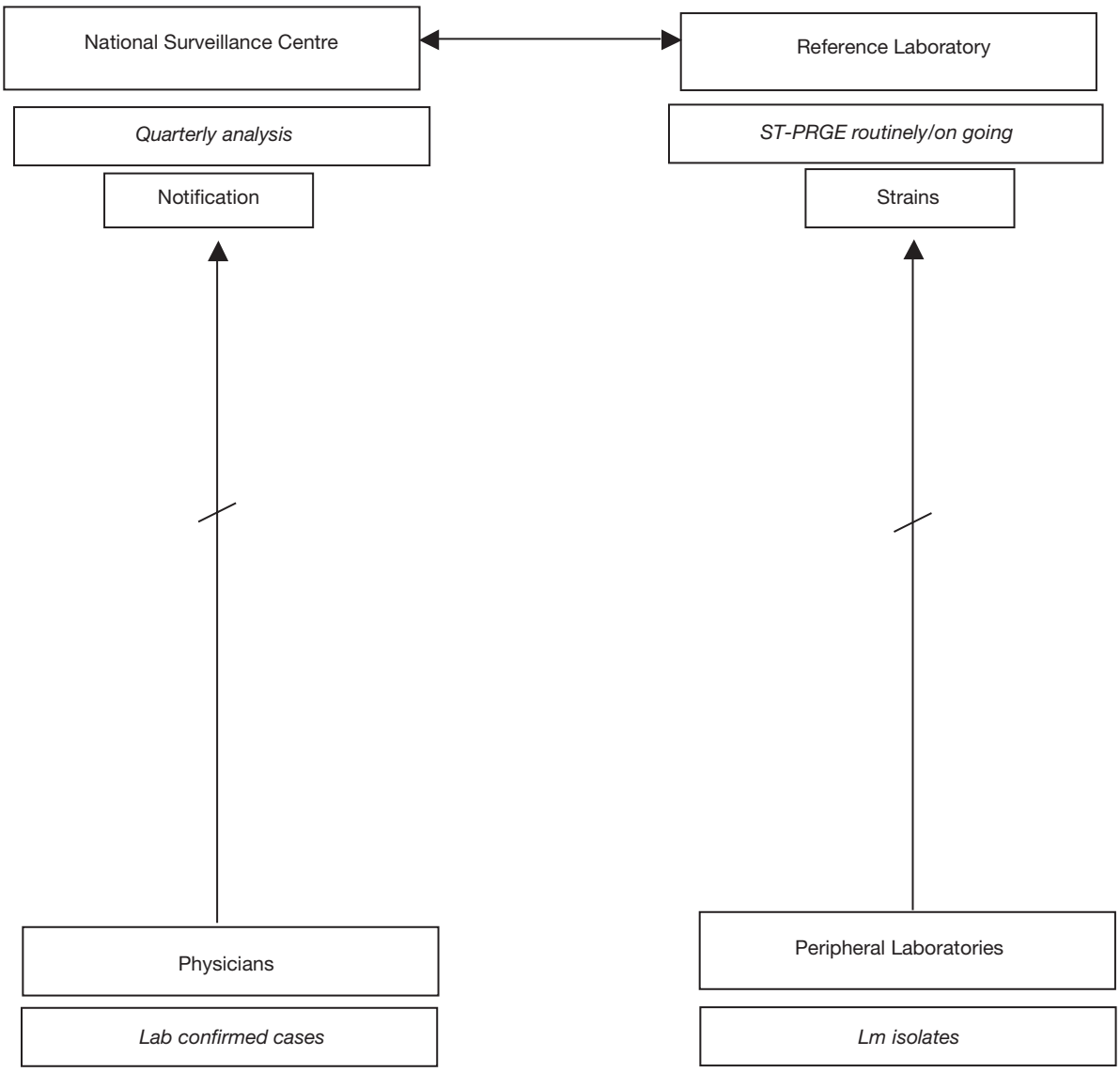
Finland

In Finland, laboratory confirmed *Listeria* infections are statutorily notified by physicians and laboratories directly to the national Surveillance Centre.

Since 1995, hospital and private laboratories systematically send their human *Listeria* isolates to the National Reference Laboratory, immediately after isolation or at regular intervals. Strains received by the NRL are routinely and immediately characterised by serotyping and PFGE analysis. The NRL does not receive food isolates.

Outbreaks are detected by the NRL by an increase in the number of cases due to strains of a same serotype and PFGE profile.

Statutory Notification
National Reference Laboratory



France

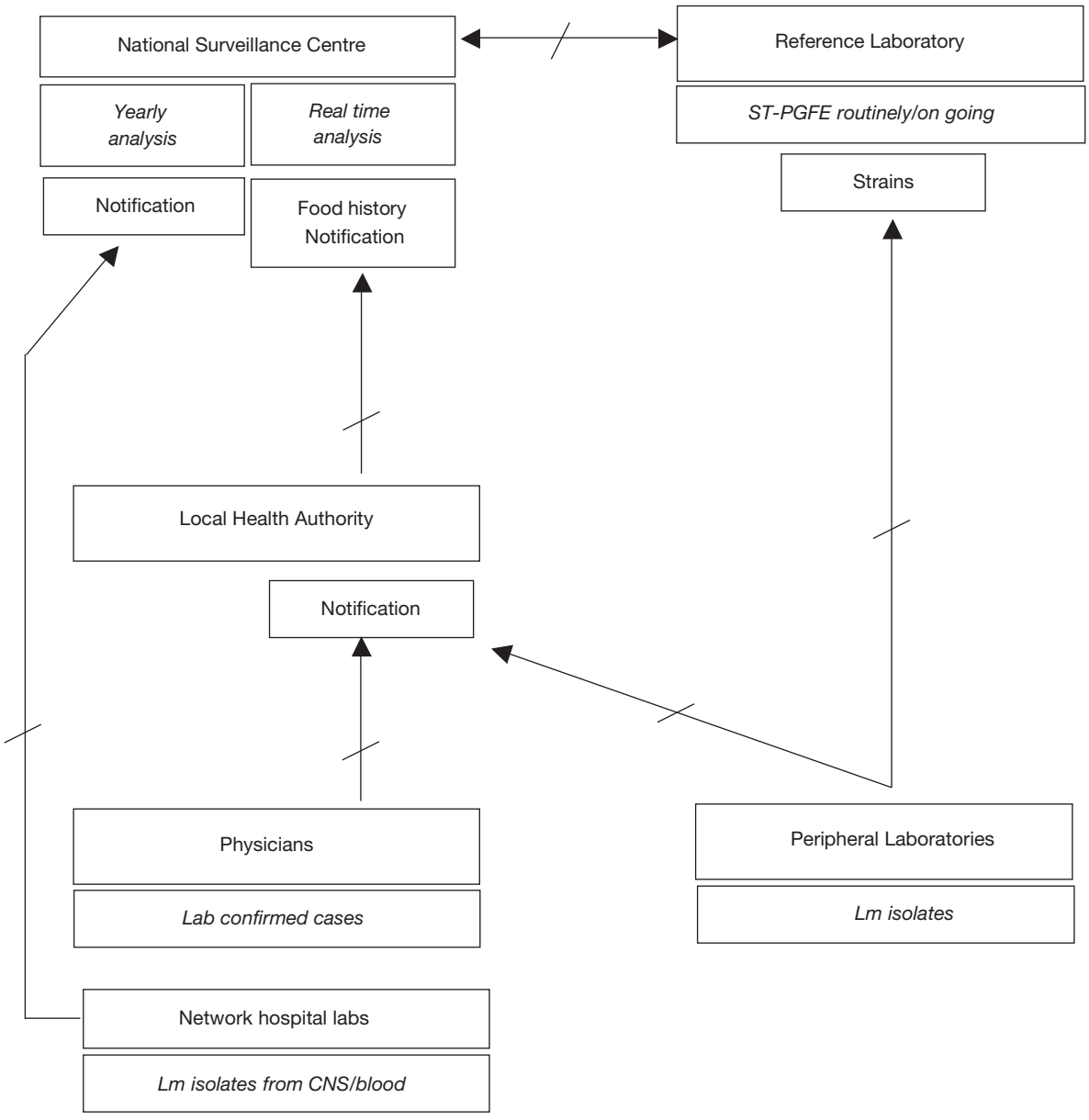
In France, physicians, and from 2003 onwards medical laboratories, statutorily notify all patients from whom *Listeria* is isolated immediately to the district medical officer who completes a food history for each notified case, and transmits all information to the National Surveillance Centre (Institut de Veille Sanitaire InVS).

In addition there exists a voluntary syndrome based surveillance of bacterial bloodstream and CNS infections. Participating hospital laboratories send, on a monthly or quarterly basis, details on all bacterial isolates from blood and CSF to the NSC.

Hospital and private laboratories voluntary send their human *Listeria* isolates to the National Reference Laboratory (Institut Pasteur). The NRL combines their data with those of the NSC to achieve a higher completeness of reporting. The sensitivity of the combined system NRL-NSC is estimated at 87%. The NRL systematically and immediately characterise all human strains by serotyping and PFGE analysis. The NRL also receives and characterises isolates from foods, sent by private laboratories, and in some cases by the Ministry of Agriculture and the Directorate of consumer protection (eg strains isolated from foods withdrawn from the market because of *Listeria* contamination).

Outbreaks are detected by the NRL who informs the NSC of any occurrence of at least 3 or more isolates with a same serotype and PFGE profile over a 14 week period.

Statutory Notification
Syndrome based surveillance
National reference Laboratory

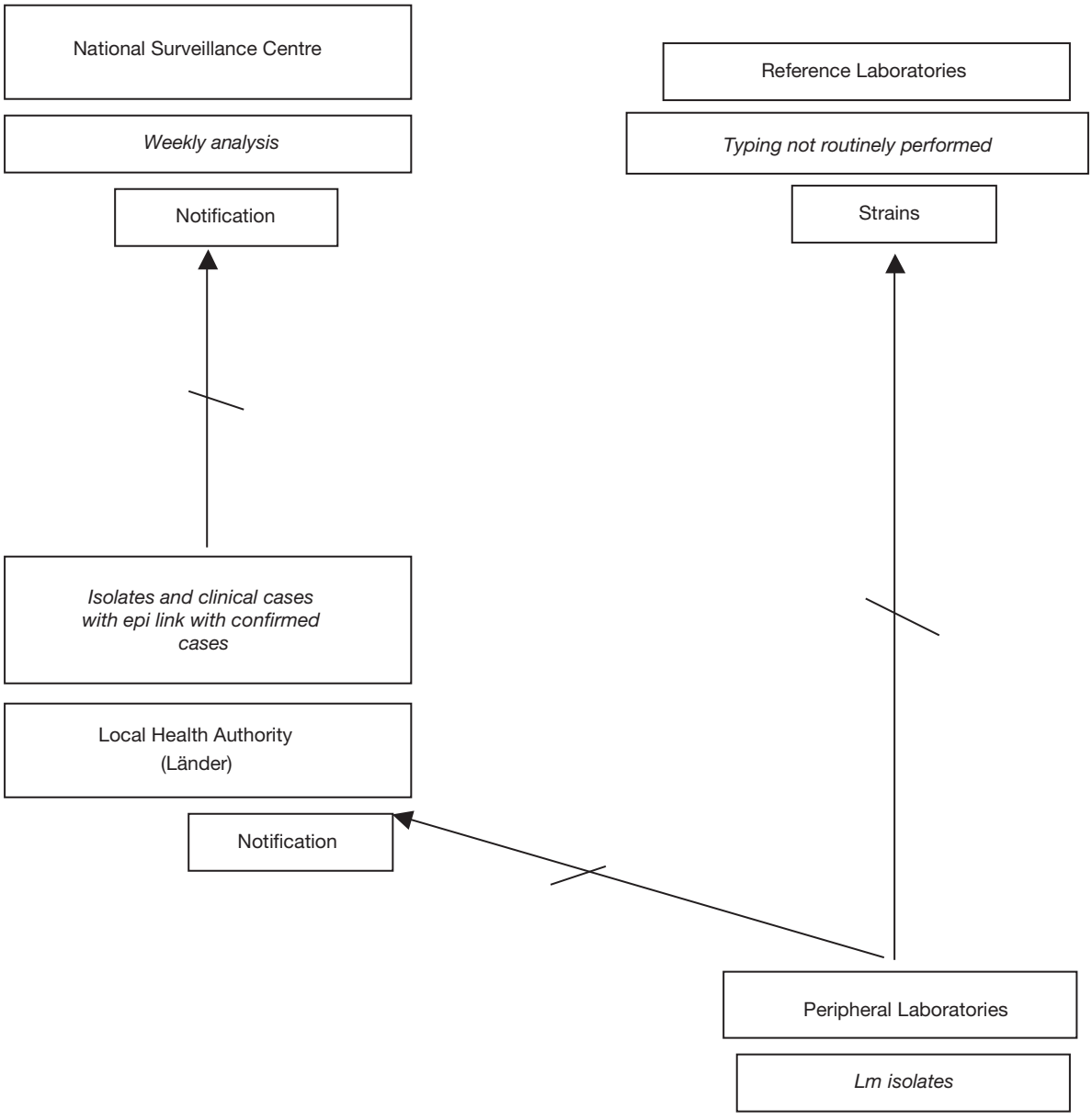


Germany

Since January 2001, *Listeria* infections (laboratory confirmed cases or clinical cases with an epidemiological link to a confirmed case) are statutorily notified to the «local health office» (Länder) that transmits the notification, in real time, to the National surveillance centre (Robert Koch Institute). Before 2001, only pregnancy associated cases were statutorily notifiable.

The National Reference Laboratories are based in Mannheim and Wernigerode. In addition, there is a third laboratory, in Hamburg, that carries out reference tasks for *Listeria*. These 3 laboratories do not play a role in surveillance at the national level. The reference laboratories receive isolates from a number of hospital and private laboratories, according to the will of the laboratory, sometimes with the request to establish a link with a food or with another case. In Mannheim, isolates are characterised by serotyping and PCR based methods, only in cases of specific investigations. The laboratories in Wernigerode and Hamburg carry out serotyping, and the laboratory in Wernigerode performs PFGE and ribotyping on the strains that are sent to them for specific investigations. The laboratory in Hamburg receives essentially food strains.

Statutory Notification

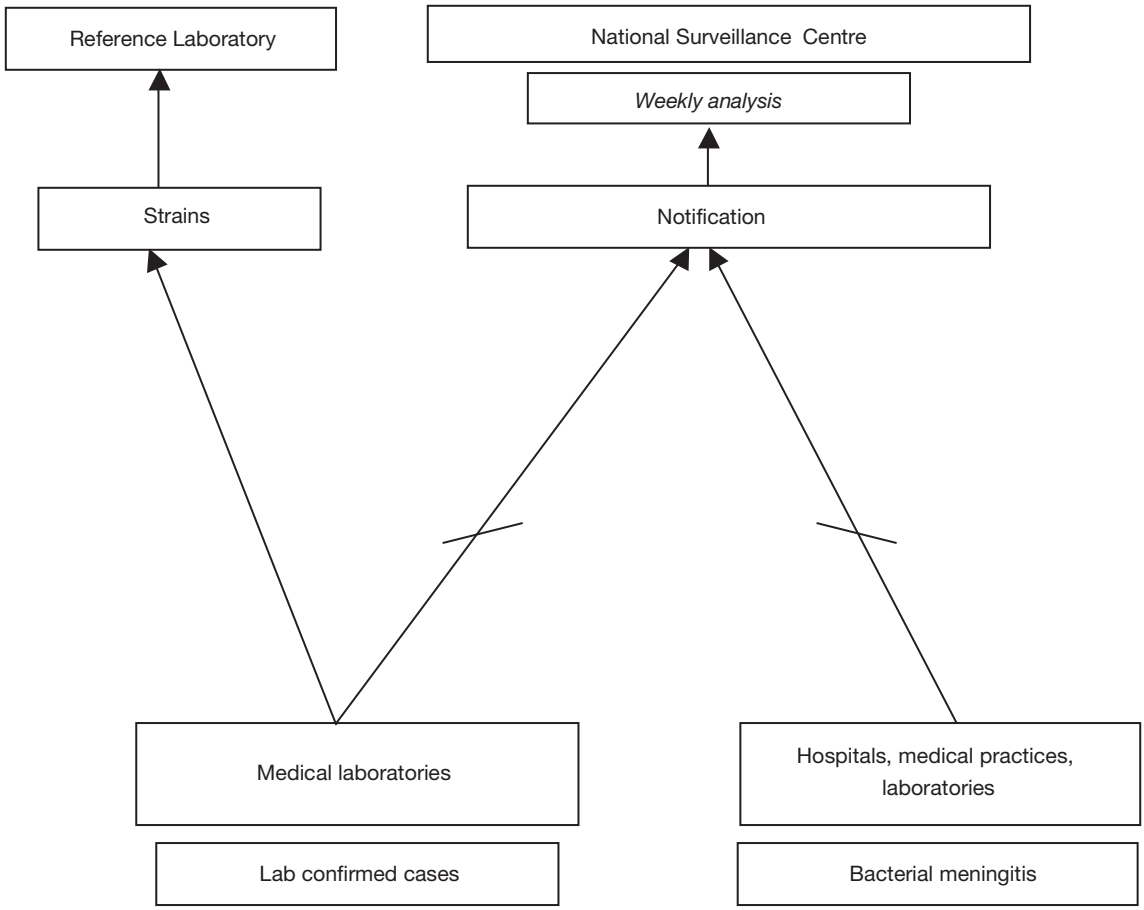


Greece

In Greece, surveillance of *Listeria* infections is based on voluntary reporting by laboratories which notify single cases of listeriosis directly to the National Surveillance Center. In addition, there is a system for the surveillance of bacterial meningitis of all causes. Hospitals, medical practices and laboratories immediately notify every single case of bacterial meningitis to the National Surveillance Centre.

The National Reference Laboratory receives strains sent by hospital laboratories, on an irregular basis. The strains are routinely typed, at intervals, by sequencing. For specific investigations, strains are typed by PFGE or ribotyping.

Universal voluntary reporting
Syndrome based surveillance



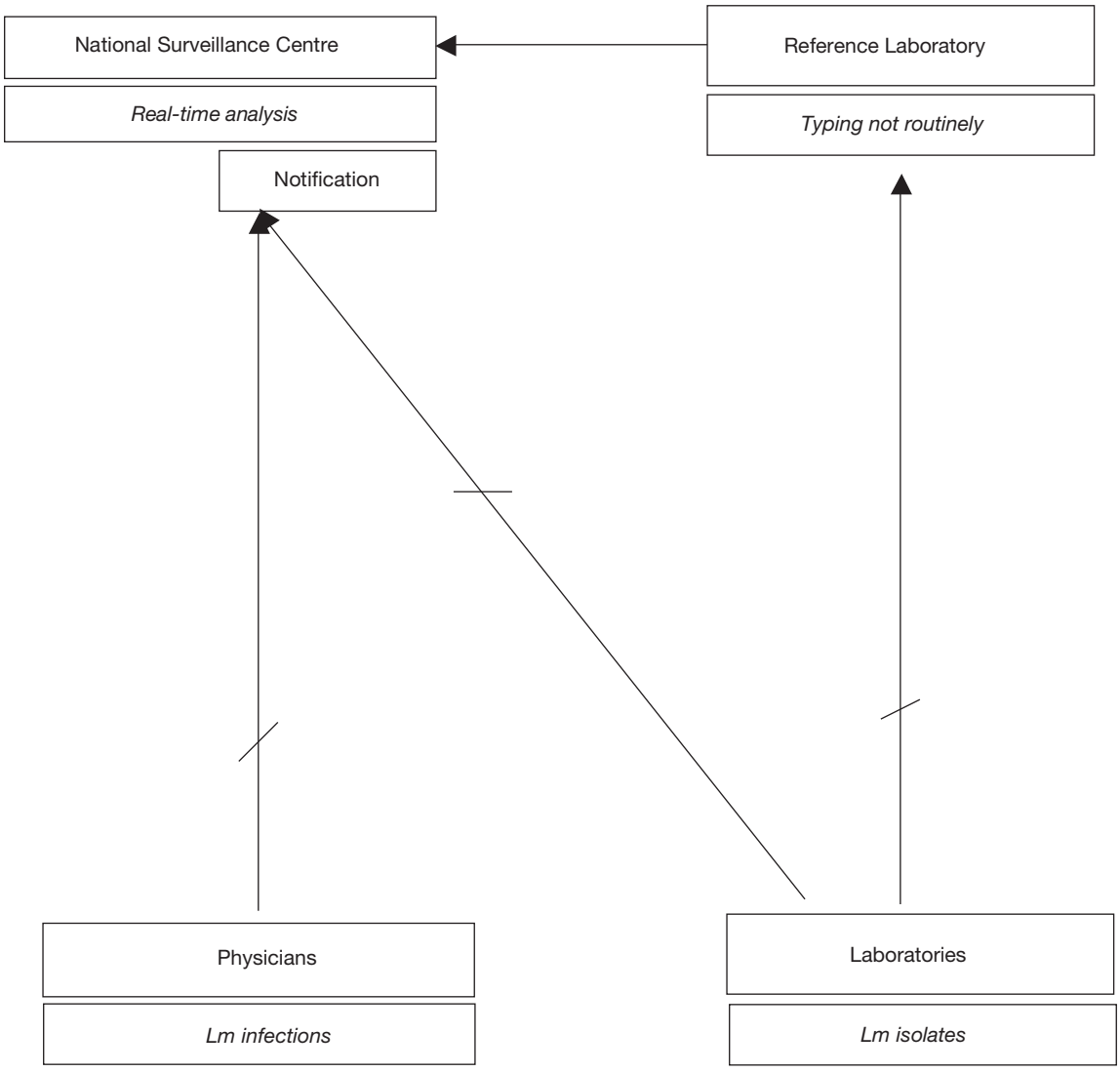
Iceland

In Iceland, since 1999, *Listeria* infections are statutorily notified by physicians and laboratories directly to the National Surveillance Centre.

Hospital and private laboratories voluntarily send their human *Listeria* isolates to the National Reference Laboratory immediately after isolation. The NRL does not type the strains, since only 0-2 strains are isolated yearly. The NRL has the capacity to perform PFGE. The NRL does not receive food isolates.

Outbreaks are detected by the NSC or NRL by an increase in the number of cases.

Statutory Notification
National reference Laboratory

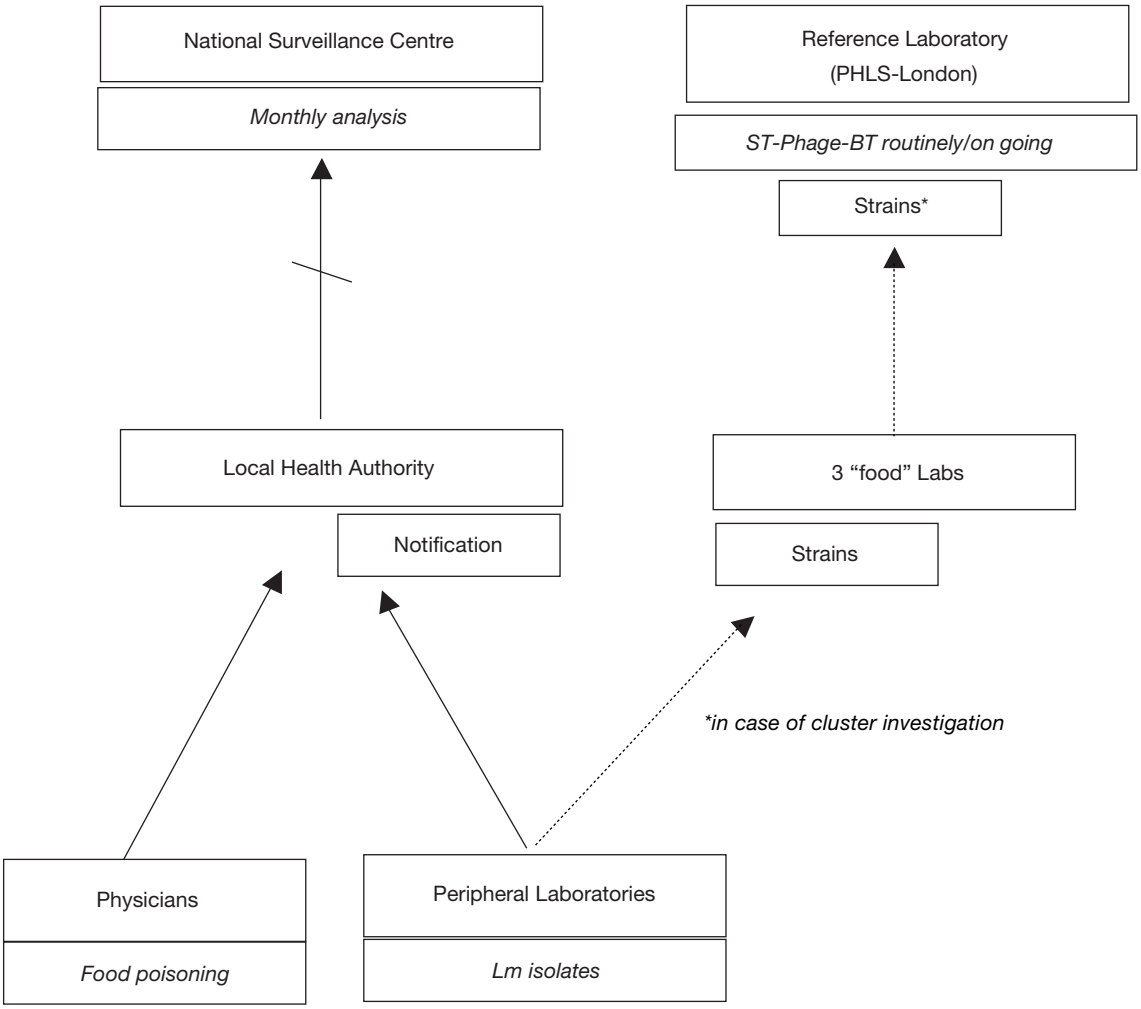


Ireland

In Ireland, food poisoning is statutorily notifiable. In theory, *Listeria* infections should be notified under this category but in reality they never are. However, laboratories voluntary notify *Listeria* infections to the local health office that transmits the notification, in real time, to the National surveillance centre.

Ireland has no National Reference Laboratory. There are 2 hospital laboratories (Galway and Cork) and one Public Health laboratory (Dublin) attached to a hospital that analyse foods for *Listeria*. One of these laboratories (Cork) receives strains from other hospital laboratories for identification. The National Salmonella Reference Laboratory in Galway offers PFGE typing of *Listeria monocytogenes* to clinical laboratories, and also has limited capacity to identify the more common serotypes. In case of clusters, the strains are sent to PHLS in London for typing (sero-, phage- and biotyping).

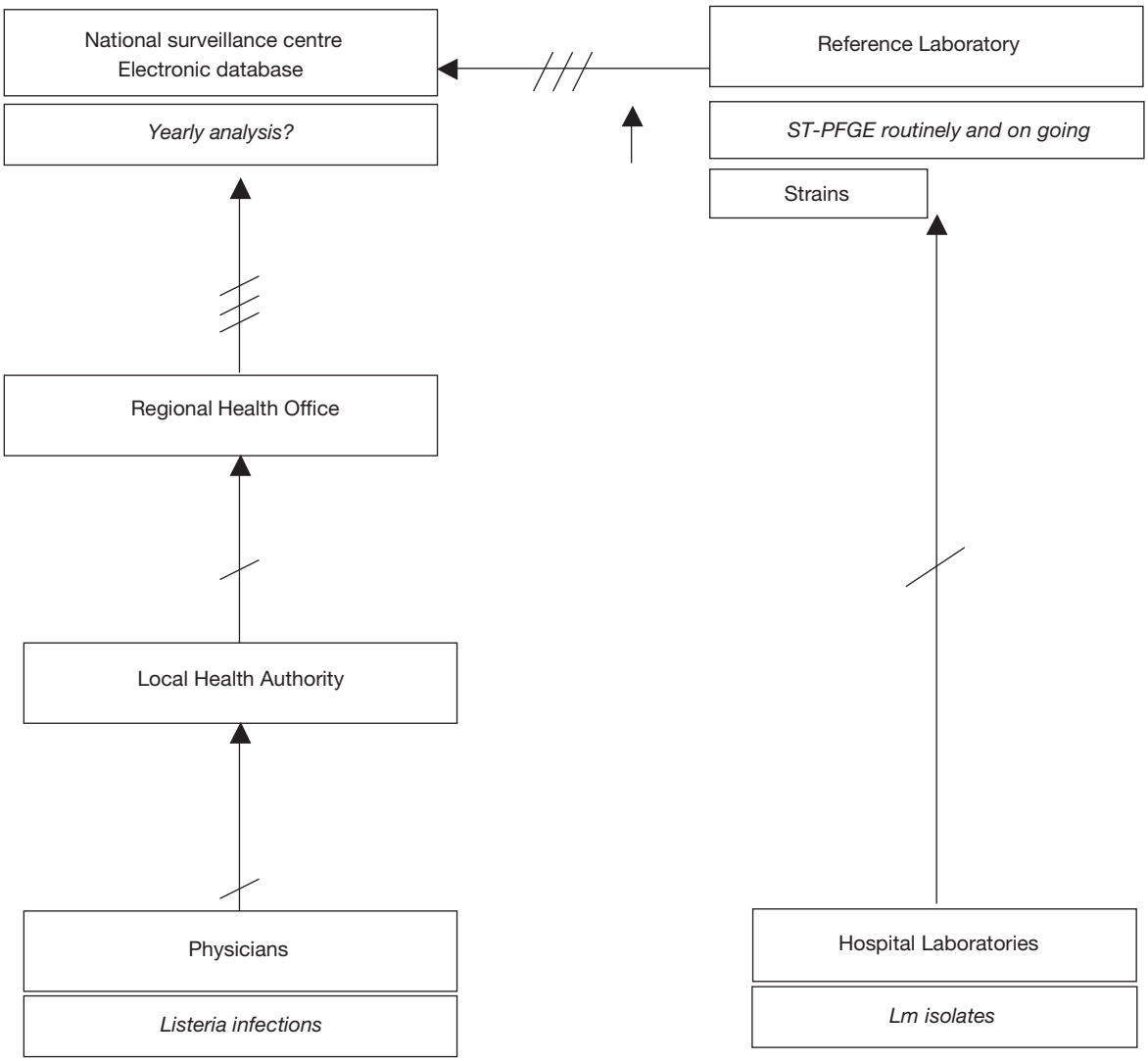
Statutory Notification
Universally Voluntary Reporting



Italy

In Italy, *Listeria* infections are statutorily notified to the local health office that transmits the notification, as single cases and in real time, to the regional level. The regional level transmits monthly aggregated data to an electronic national data base of the National Surveillance Centre and sends single case reports to the Ministry of Health. Hospital laboratories voluntary, but not systematically, send their human *Listeria* isolates to the National Reference Laboratory. Strains received by the NRL are routinely and immediately characterised by serotyping, PCR based methods, PFGE and frequent cutting enzyme (REA).

Statutory Notification
National Reference Laboratory



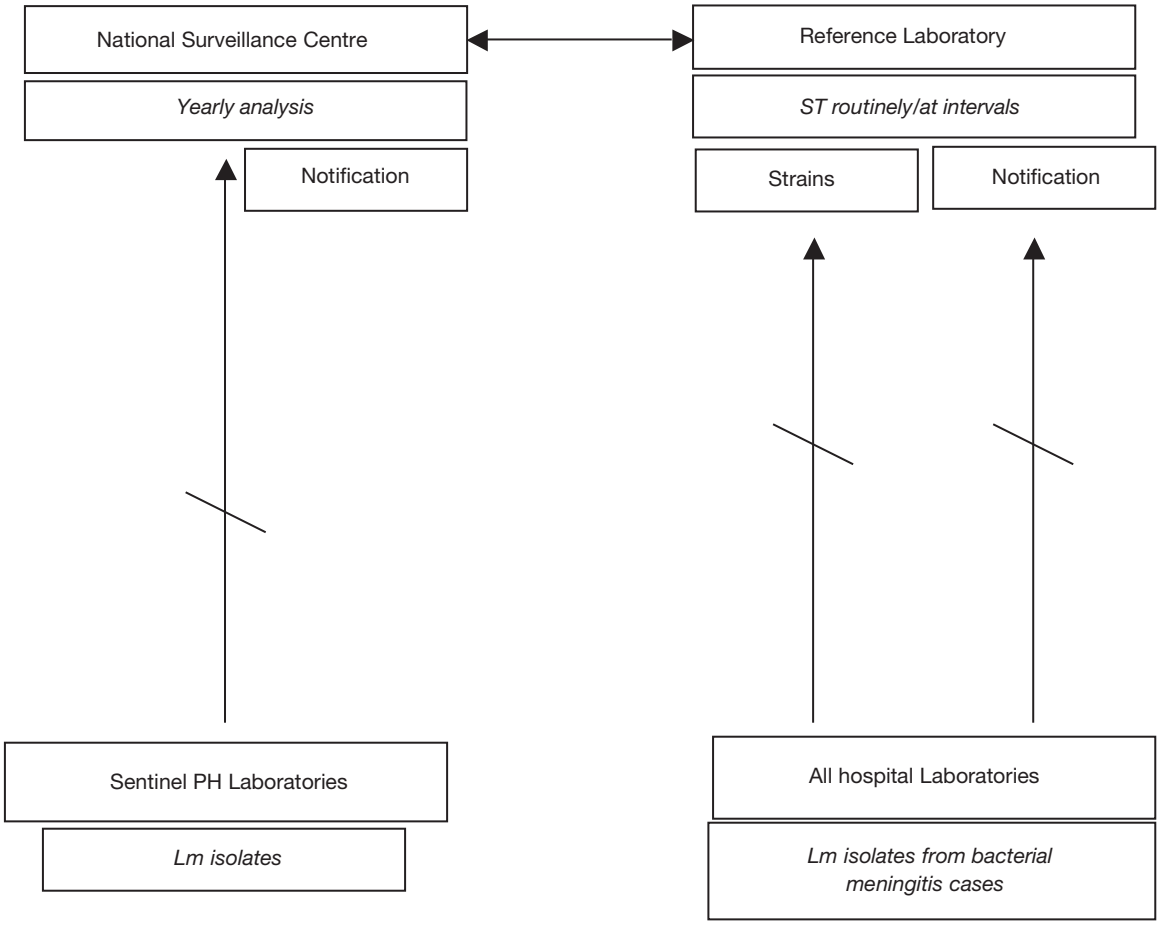
The Netherlands

In the Netherlands, surveillance of *Listeria* infections is based on a sentinel surveillance system. 16 regional public health laboratories that receive samples for analysis from medical practices and small and medium sized hospitals notify *Listeria* isolates to the NSC (RIVM) immediately after diagnosis. It is estimated that this system identifies approximately 35% of all *Listeria* infections. In addition, there is a system for the surveillance of bacterial meningitis of all causes. Hospitals and medical practices immediately notify every case of bacterial meningitis to the National Reference Laboratory (RIVM). The sensitivity of this system is estimated at 70%.

The National Reference Laboratory receives isolates from a number of hospital and private laboratories, according to the will of the laboratory, sometimes with the request to establish a link with a food or with another case. Isolates are characterised by serotype at regular intervals. PCR based methods (RAPD and repetitive element sequence-based PCR) as well as PFGE are used in special investigations.

Outbreak detection relies on an algorithm comparing the number of cases with the average number of cases over the same period during previous years.

Sentinel System
Syndrome Based Surveillance



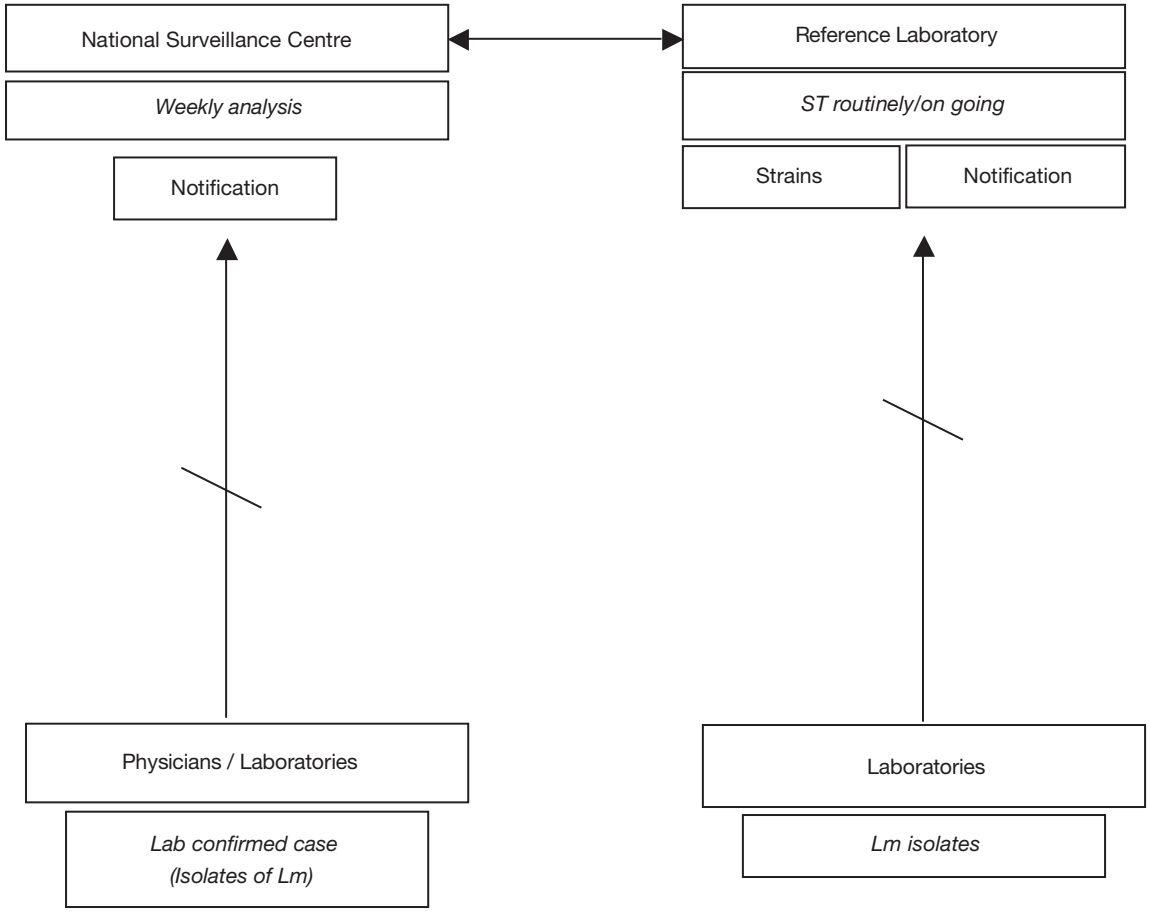
Norway

In Norway, laboratory confirmed (isolate of Lm or serum antibodies) *Listeria* infections are statutorily notified directly to the national Surveillance Center.

Most laboratories send their human *Listeria* isolates, or information on these isolates, to the National Reference Laboratory. Strains received by the NRL are routinely and immediately characterised by serotyping. Sequencing and PFGE are performed for special investigations.The NRL does not receive food isolates but exchanges information, when necessary, with the laboratory concerned with animal and food isolates.

Outbreaks are detected by the NSC by an increase in the number of cases, or by the NRL by an increase in the number of strains received by serotype.

Statutory Notification
National Reference Laboratory



Portugal

In Portugal, there is no surveillance of *Listeria* infections. Also, laboratories do not usually send their *Listeria* isolates to the National Reference Laboratory in the National Health Institute Dr Ricardo Jorge. The National Reference Laboratory mainly receives food isolates. For ad hoc studies, sequencing and PCR based methods are performed.

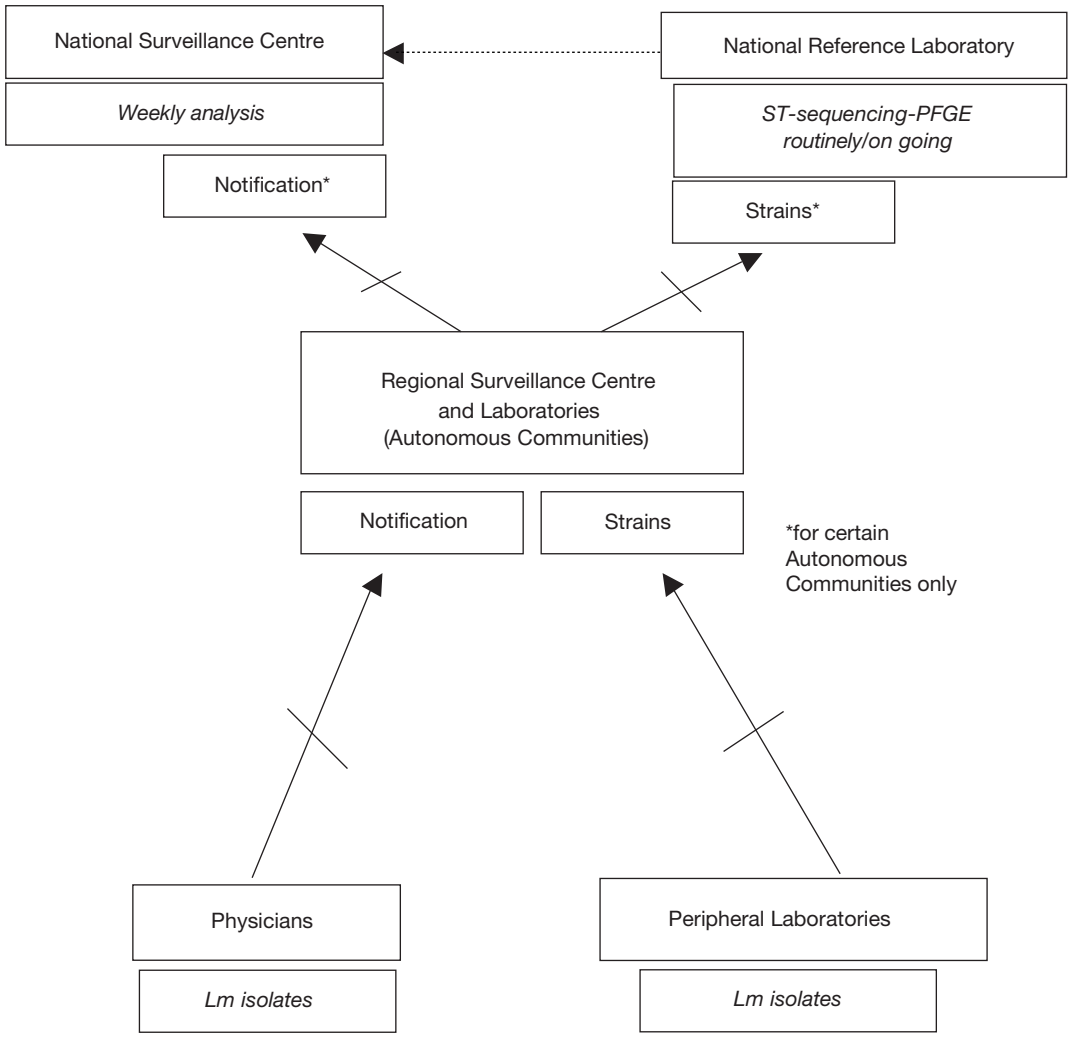
Spain

In Spain, physicians and laboratories voluntary notify *Listeria* infections to the authorities situated at the level of the Autonomous Communities. In addition, isolates are voluntary sent to the Autonomous Community laboratory. In a certain number of Autonomous Communities the notifications and the strains are not transmitted to the central level. Other Autonomous Communities transmit the notifications and the isolates to the National Surveillance Centre and the National Reference Laboratory in Madrid.

The National Reference laboratory routinely characterises the isolates by serotyping, sequencing and PFGE analysis.

Outbreaks are detected either by the AC by antrains of a same serotype and PFGE profile.

Statutory Notification
National Reference Laboratory



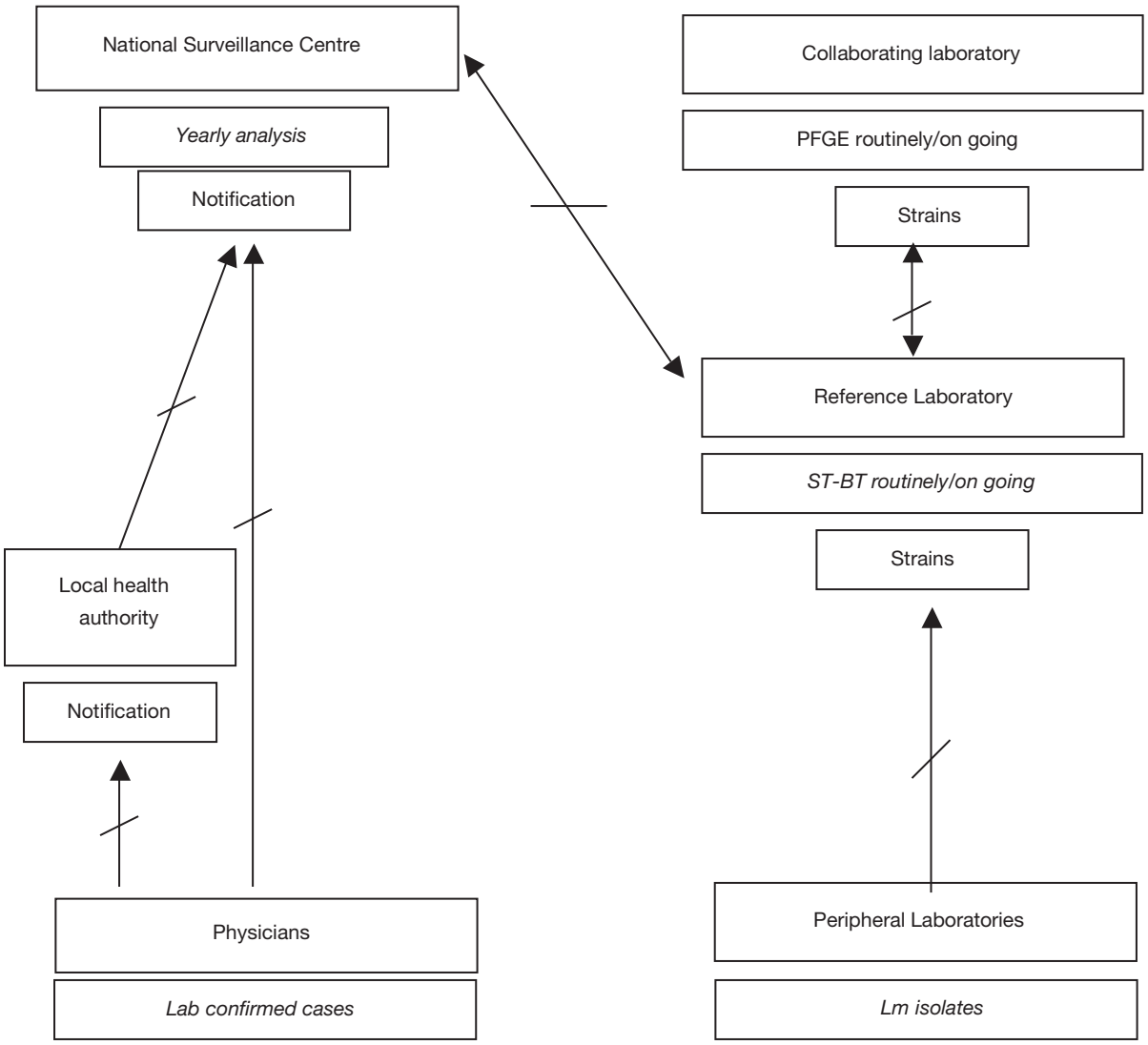
Sweden

In Sweden, laboratory confirmed *Listeria* infections are statutorily notified by physicians, laboratories and pathologists to the local health authority that transmits the notification in real time to the National Surveillance Centre. In addition the cases can be directly notified to the National Surveillance Centre

It is statutory for hospital and private laboratories to send their human *Listeria* isolates to the National Reference Laboratory. Isolates are systematically sent to the NRL either immediately after isolation or at regular or irregular intervals. Strains received by the NRL are routinely and immediately characterised by serotyping and biotyping. The NRL does not carry out PFGE but systematically sends the strains after reception to a collaborating laboratory that routinely carries out PFGE.

Outbreaks are detected by the NRL and the collaborating laboratory by an increase in the number of cases due to strains of a same serotype and PFGE profile.

Statutory Notification
National Reference Laboratory



Switzerland

In Switzerland, laboratory confirmed *Listeria* infections are statutorily notified by the laboratory isolating the strain, immediately and directly to the Ministry of Health.

In addition it is statutory for laboratories to send their human *Listeria* isolates to The National Reference Laboratory in Lausanne. Isolates are systematically sent to the NRL immediately after isolation. Strains received by the NRL are routinely and immediately characterised by serotyping. The NRL also receives food isolates. For specific investigations PFGE is performed, and multilocus enzyme electrophoresis and RAPD for ad hoc studies.

Outbreaks are detected by the NRL by an increase in the number of cases due to strains of a same serotype.

Statutory Notification
National Reference Laboratory