Joint Programming Initiative on Antimicrobial Resistance Mapping Report

"Scale and Scope of Anti- Bacterial Resistance Research 2007-2013"

December 2015

* This report builds on a publication in the Lancet Infectious Disease by Kelly *et al.,* 2015 (DOI: http://dx.doi.org/10.1016/S1473-3099(15)00350-3)

Acknowledgements:

This exercise was led by the Medical Research Council, UK, on behalf of the Joint Programming Initiative on Antimicrobial Resistance (JPIAMR). Responsibilities at the MRC Head Office for the exercise were: project management, analyses, and report writing by Ruth Kelly, oversight of the work by Ghada Zoubiane and Desmond Walsh, and initial stages of the exercise by Rebecca Ward.

We would like to personally thank the National and EU contact points, listed in Annex 2, for all their work in this exercise, particularly throughout the data collection process. We would like to extend our appreciation to all the participating countries and organisations in the mapping exercise, listed in Annex 1, who provided the data for inclusion in the exercise.

The participation and cooperation from a wide range of contributors has enabled the scale and scope of publically funded antibacterial resistant research projects to be determined for the first time across multiple European countries, Canada and Israel, at both national and European level. We would also like to thank the JPIAMR Management Board members and the JPIAMR Scientific Advisory Board for their input in the design and scope of the exercise and their engagement throughout. Without the platform of the JPIAMR and the involvement and commitment of all participants, this report would not have been possible.

"Mapping is not a goal in itself but it is a tool to identify possibilities for joint actions"

Peter Keet, member of the Joint Programming Initiative on Agriculture, Food Security and Climate Change (FACCE-JPI) and the High Level Group for Joint Programming (GPC).

Contents:

List of Abbreviations:

ABR - Antibacterial Resistance

AMR - Antimicrobial Resistance

DG Research - Directorate General for Research and Innovation

DG SANCO - Directorate General for Health and Consumer Affairs

EC - European Commission

ECDC - the European Centre for Disease Prevention and Control

EFPIA - the European Federation of Pharmaceutical Industries & Associations

ERC - European Research Council

EU - European Union

FP - Framework Programme

IMI - Innovative Medicines Initiative

IMI-1 - Innovative Medicines Initiative Programme 1

JPI - Joint Programming Initiative

MRC - Medical Research Council

SRA - Strategic Research Agenda

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1. Background and Purpose:

Antibacterial resistance (ABR) is a global and multifaceted problem demanding comprehensive and creative solutions. It is recognised that no individual sector or nation has the capacity to independently address this major societal challenge. In response, the Joint Programming Initiative on Antimicrobial Resistance (JPIAMR) was established in 2011 to address ABR at national level and to increase the current impact of public research through more effective, efficient, and aligned investments. This growing initiative brings together 19 Member States[1], involving 17 European countries, Canada, and Israel, and 3 observers, Argentina, Estonia, and Japan.

Based on an agreed vision on how ABR should be addressed, the JPIAMR launched its Strategic Research Agenda[2] (SRA) in April 2014. The SRA identifies six broad and encompassing priority topics (*Figure 1*) which incorporate a biomedical, healthcare, veterinary, environmental, economic, and social science agenda. This is a dynamic framework upon which the JPIAMR have, and will continue to launch joint activities to guide and align research activity and investment to reduce the burden of ABR. To harmonise activities, avoid duplication, and maximise efforts, the JPIAMR will continue to engage nationally and internationally with key stakeholders, such as, funding organisations, industry, policy makers, the research community, the European Commission (EC), and the Innovative Medicines Initiative (IMI), among others.

To underpin the implementation of the SRA due consideration of the existing research landscape was necessary. This report presents the findings from a mapping exercise led by the United Kingdom, Medical Research Council, in which the primary aim was to provide an objective insight into the scale and scope of ABR research – including human, veterinary, and environmental research – publically funded over a seven year period (2007-2013) across 21 participating countries[3] and European Union (EU) agencies[4].

[1] Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Israel, Italy, the Netherlands, Norway, Poland, Romania, Spain, Sweden, Switzerland, Turkey, the United Kingdom.
[2] Further details on the JPIAMR Strategic Research Agenda are available through the JPIAMR website: http://www.jpiamr.eu/wp-content/uploads/2014/05/SRA1_JPIAMR.pdf
[3] Countries included: 18 JPIAMR Member States, Estonia (an observer), and Ireland and Portugal
[4] EU agencies included: the Directorate General for Research and Innovation through Framework Programme Six and Seven (including the Innovative Medicines Initiative (IMI-1) and the European Research Council), the Directorate General for Health and Consumer Affairs, and the European Centre for Disease Prevention and Control.

As the JPIAMR is actively working to improve data sharing, the secondary aim of the mapping exercise was to set up a useful, freely accessible, and searchable database of the research data captured. This database is available on the JPIAMR website[5] and is hoped to be a useful resource for funding organisations as well as the scientific community for further networking, information sharing, and collaboration.

The mapping exercise will act as a guide to ensure research is complementary and that no major overlaps exist, while aiming to identify gaps and opportunities to be exploited. It will be used in conjunction with the SRA for the development of the implementation plan and the prioritisation of particular research areas identified in the SRA. The exercise may also identify areas for improved co-ordination which can be used to align research efforts and avoid duplication, both at national and international level. Finally, this exercise forms the baseline for ABR research and associated investment in which the efforts of the JPIAMR and individual countries can be evaluated upon.

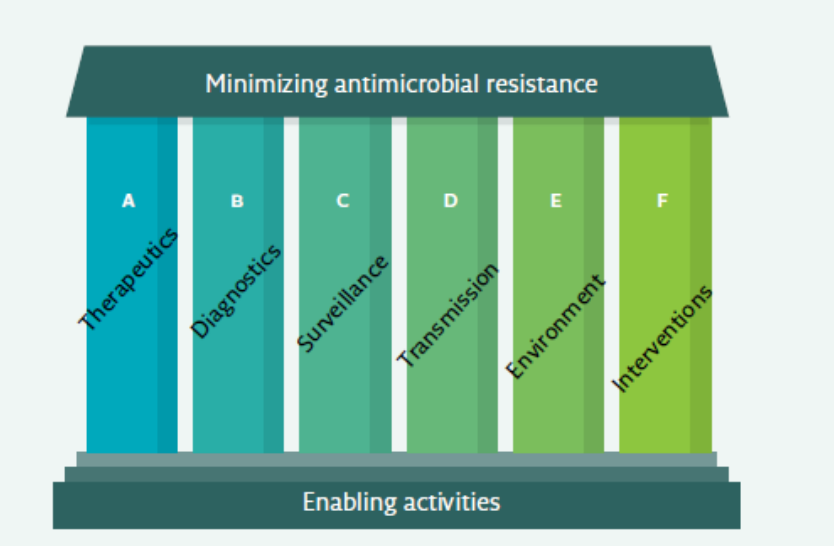


Figure 1: A schematic outline of the priority topics identified in the JPIAMR strategic research agenda.

[5] The database is available on the JPIAMR website: http://www.jpiamr.eu/activities/evaluation-framework/mapping-exercise/

2. Methods:

2.1 Co-ordination:

The JPIAMR member state, the UK, was responsible for the mapping exercise and was led by the Medical Research Council (MRC). The mapping project manager, based at the MRC, was responsible for the co-ordination of different aspects of the mapping exercise including: data collection, data checking and validation, data classification and analyses, and report writing. Progress of the mapping exercise was presented and discussed at JPIAMR Management Board meetings, with any areas of concern addressed.

2.2 Questionnaire Design:

The content of the questionnaire was co-ordinated and developed by the MRC in collaboration with the JPIAMR Scientific Advisory Board to ensure the data gathered would be useful and informative for JPIAMR future activities. The questionnaire ensured the data collected would be sufficient to enable the classification of the research into the six priority topics identified in the SRA (*Figure 1*).

2.3 Participating Countries and European Union Agencies:

In total, 21 countries provided data for the mapping exercise. Eighteen JPIAMR Member States completed the questionnaire, namely: 16 European countries, Belgium, Czech Republic, Denmark, Finland, France, Germany, Italy, the Netherlands, Norway, Poland, Romania, Spain, Sweden, Switzerland, Turkey, and the United Kingdom, and Canada and Israel. Estonia, an observing country of the JPIAMR completed the questionnaire and additional participation from non-JPIAMR countries included Ireland and Portugal. Greece, a JPIAMR Member State, did not participate in the mapping exercise.

EU agencies also provided data, namely: the Directorate General for Research and Innovation (DG Research) through Framework Programme (FP) 6 and FP7 (including the Innovative Medicines Initiative first programme (IMI-1) and the European Research Council (ERC)), the Directorate General for Health and Consumer Affairs (DG SANCO), and the European Centre for Disease Prevention and Control (ECDC), hereby collectively referred to as EU level data.

2.4 Data Collection:

The questionnaire was sent to all JPIAMR national representative(s) responsible for co-ordinating activities and contacting public funding organisations for ABR research information within their respective country. The mapping project manager contacted and sent the questionnaire to individual public funding organisations within the UK, where they were the national contact point, the additional participating countries (Ireland and Portugal) organisations, and the individual EU agencies to obtain their data. Additional desk study was conducted by the mapping project manager using publically available databases to identify further projects funded by national and EU agencies. Any further projects identified in this way were sent to and approved for inclusion by the appropriate national and EU representative. The organisations included are listed in *Annex 1: Public Funding Organisations Included,* and the list of national and EU representatives are available in *Annex 2: National and EU Representatives*.

All national and EU representatives were briefed on the questionnaire and the exercise through presentations and discussions at JPIAMR meetings and/ or through on-to-one communications with the mapping project manager. Follow-up and support by email and phone were on-going throughout the data collection process between the representatives and the mapping project manager. A schematic representation of the data collection process is provided in *Figure 2*.

Only research funded by public funding organisations (which can invest in both public and private organisations) was collected and no private organisations were contacted for their investments, this was due to difficulties in accessing data. The collected information included: funding organisation name, principle investigator/ project leader, host institution, title, summary/ abstract, start and end dates, and the total investment in Euros.

All financial information is as reported by the funders; projects awarded in a currency other than Euros were converted to Euros by the organisations at the time of data collection. No adjustments were made for inflation and no attempt was made to remove any indirect and estate costs included. The data collected were the most comprehensive data available at the time from the national organisations and EU agencies contacted.

2.4.1 Inclusion Criteria:

The data included in the mapping exercise covered:

- Research specifically relevant to antibacterial resistance, within the broad remit of the six priority topics identified in the JPIAMR SRA,
- All on-going and completed research (from basic to translational) invested in projects and large programmes (collectively referred to as projects in the report) committed since January 1, 2007 until December 31, 2013 (note: some projects may not have begun spending until early 2014),
- Projects ≥€100,000 in basic, applied and clinical research, including trials, epidemiological, public health, veterinary and environmental research,
- Public investments, including some charities (such as the Wellcome Trust, UK).

2.4.2 Exclusion Criteria:

The data excluded in the mapping exercise covered:

- Basic bacteriology and infectious disease research with no reference to resistance (note: it is recognised that this supporting basic bacteriology research may contribute to the overall ABR research effort in the long term but was excluded from this mapping exercise),
- Fungal, viral, parasite, and insecticide resistance,
- Grants <€100,000,
- Institutional funding,
- Projects on generic (e.g. buildings) and research infrastructure (e.g. facilities, networks), unless embedded within large grants
- Core programmes, e.g. ECDC in-house programmes and national surveillance programmes,

- Private sector organisations (with the exception of the IMI-1 programme including the European Federation of Pharmaceutical Industries & Associations [EFPIA]).

2.5 Data Validation:

To ensure the data collected met the establish inclusion criteria, that there was no duplication of projects, and that the data provided were complete and accurate, all data was checked and validated using a two stage process. First, this was conducted by the appointed national representative(s) within each participating country and EU agencies, and second, in more detail by the mapping project manager. The title and abstract/ summary were used and any discrepancies were resolved by contacting the appropriate party.

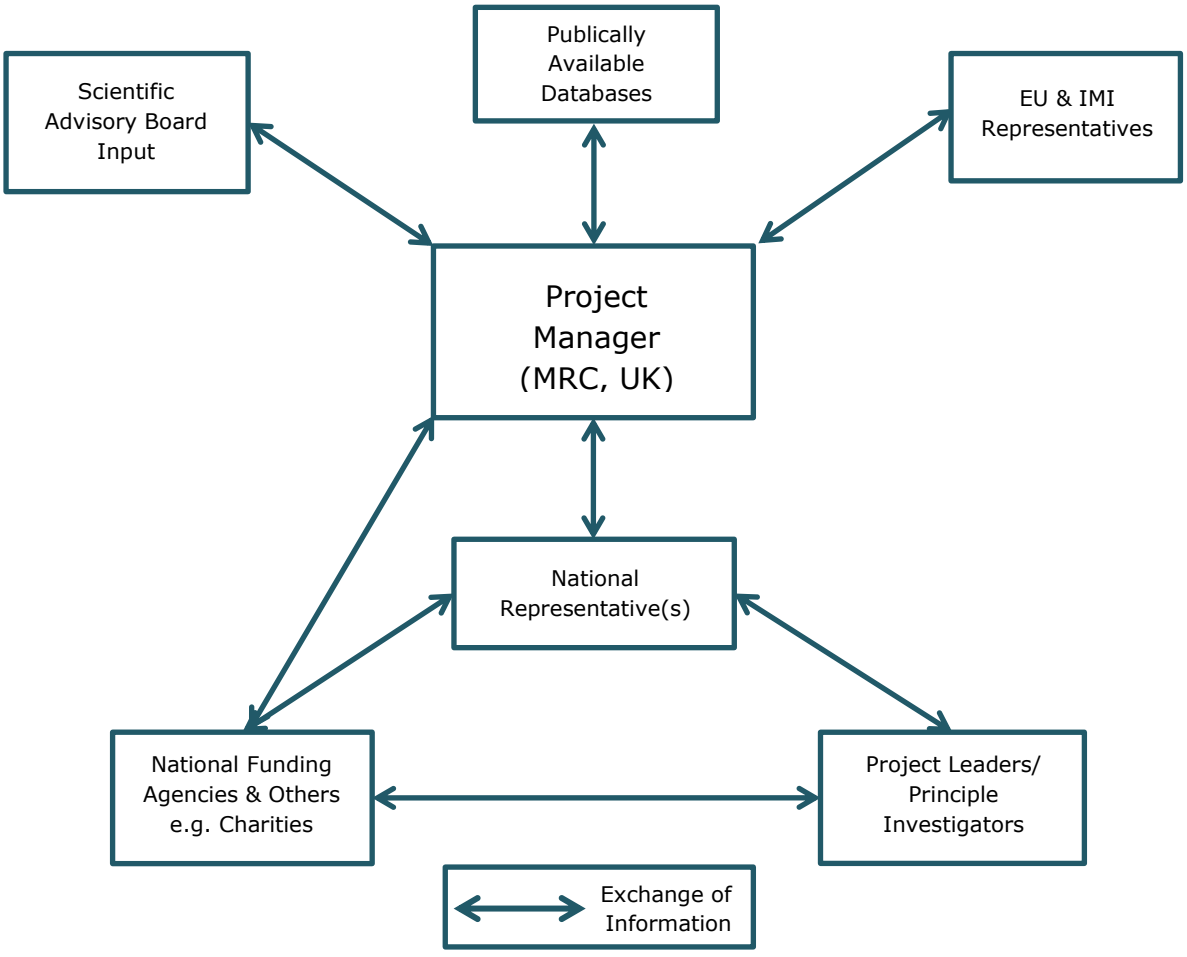


Figure 2: A schematic of the JPIAMR mapping exercise data collection process

2.6 Research Project Classification:

The title and abstract/ summary where available (an abstract/ summary was available for 87% (1,033/1,189) and 98% (112/114) of the national and the EU projects, respectively), were used to determine research specifically relevant to ABR. Projects were then classified based on the SRA six priority topics (*Figure 1*). To ensure consistent classification of projects throughout, the mapping project manager read the title, abstract/ summary, and any further information on each individual project and classified them into one or more of the six priority topics. The JPIAMR Scientific Advisory Board was contacted for any uncertainties.

The SRA priority topics[6] are briefly summarised as:

A. **Therapeutics:** To develop new antibiotics and therapeutic alternatives to antibiotics (from basic research to market), to improve the use of current and new antibiotics and to optimise treatment regimens,

B. **Diagnostics:** To develop new and novel (rapid) diagnostics to effectively distinguish between viral and bacterial infections, to identify antibiotic resistant bacteria and their resistance profile, to stimulate better use of current antibiotics and support the development and use of new antibiotics and alternatives to antibiotics,

C. **Surveillance:** To establish an international, standardised surveillance programme for antibiotic resistance and antibiotic use in human, and agricultural settings; for the mapping exercise any research on surveillance at local, national or international levels were classified within this priority topic,

D. **Transmission:** To have a comprehensive, multi-disciplinary understanding of the transmission mechanisms by which antibiotic resistance can spread between bacterial populations and between different (animal and human) reservoirs, and to translate this knowledge into the development of evidence-based strategies to minimise the spread of resistance,

[6] For further details on the Strategic Research Agenda six priority topics see: www.jpiamr.eu/activities/strategicresearchagenda

E. **Environment:** To assess the contribution of pollution of the environment (e.g. surface water, soil, sewage, air) with antibiotics, antibiotic residues and resistant bacteria on the spread of antibiotic resistance and to develop strategies to minimise environmental contamination by antibiotics and resistant bacteria,

F. **Interventions:** To design and test cost effective interventions to prevent acquisition, transmission, and infection caused by antibiotic-resistant bacteria and to determine and improve their efficacy in different settings (health care, community, agriculture).

Further in-depth analysis on priority topic A. (therapeutics) covering basic research to market was conducted for the mapping exercise. This priority topic was sub-classified into different areas of research for both human and veterinary medicine, briefly described as:

I. **Underpinning:** To understand the underpinning biology of resistance and host pathogen interactions. Some examples include: the molecular mechanisms that lead to resistance and the evolution of resistance, molecular epidemiology, the formation of biofilms, mathematical models to better understand the development of resistance, identifying and understanding the mechanism of actions of potential targets, enzymes, peptides, inhibitors, molecules, etc., in order to develop new antibiotics, and anti-virulence strategies,

II. **Alternatives:** To understand mechanisms of action to develop anti-infective strategies, and to efficiently deliver antibiotic therapy. Examples include: treatment or preventative measures alternative to antibiotic therapy including: potential vaccine targets/ vaccine development, phage therapy, pre- and pro-biotics, potentiators, coatings on e.g. implants, devices, surfaces, catheters, etc.,

III. **Optimisation:** To optimise the use of existing antibiotics when medically required in both human and animals via antibiotic stewardship programmes, randomised control trials based on optimal dose, time, duration, delivery, combination of drugs etc., trials to optimise prophylactic treatments, new economic models for the development and use of new/ existing antibiotics, drug development priorities and associated policies,

IV. **Lead-to-Trial:** Identifying lead compounds, optimisation, pre-clinical studies, and phase I-IV clinical trials of, e.g. new antibiotics, targeted antibody treatment, vaccines, and anti-biofilm coatings, and modifying old/ neglected and current antibiotics to improve clinical efficacy and reduce side effects, etc.,

V. **Multiple Components:** Research projects/ programmes that focus on more than one of the above components, these are likely to be centres e.g. the Dancard centre in Denmark which focuses on many aspects of priority topic A. (Therapeutics).

Research projects were also classified as major projects if the total investment was ≥€500,000 and smaller research projects if ≥€100,000- €499,999, and live if the project was still on-going as of March 01, 2014. If only the year was available i.e. 2014, these projects were not categorised as live.

Many research projects, when classified, covered more than one priority topic. As a breakdown of funding across these priorities within a project was not available, and to avoid duplication of investment and to ensure consistency, the mapping project manager assigned an equal proportion of funding to all priority topics addressed within the project. In addition, for projects where only a proportion of the project met the inclusion criteria, only a proportion of funding was allocated to this project and the remainder of the funding was excluded from the exercise. This was done on a case-by-case basis by the mapping project manager.

The data was analysed as both, number of projects, and investment in projects.

Data were collected, categorised, and analysed from approximately July 1, 2013 to February 1, 2015. Data analyses and generation of figures and graphs were done using Microsoft Excel 2010.

3. Results:

3.1 Total Number of Projects and Investment in ABR Research:

The results presented below detail the total number of projects and total public sector investment in ABR research in all 21 participating countries[7] and EU agencies. This will then be broken down by the investments made at national level only in the participating countries and then separately by the investments made at EU level. Figures are broken down into live projects (on-going projects as of March 01, 2014) and by size of investment (major [≥€500,000] vs. smaller [<€500,000] research grants). Some figures and percentages have been rounded to the nearest decimal point.

3.1.1 Total Number of Projects and Investment of Public Funds:

From 2007-2013, €1·3 billion of public sector funding has been invested through competitive funding mechanisms in 1,303 ABR research projects across participating countries (*Table 1*) and at EU level. Of the total €1·3 billion invested, 68·2% (€913·2m/ €1·3b) of this investment is in live projects indicating investment in this area has increased in recent years, this is in large due to DG Research €345·1m contribution to IMI-1. When only live projects are considered (n=593), an increase in projects receiving major investments are observed with 45·4% (269/593) of all live projects categorised as major investments compared to 35·1% overall (457/1,303). These live major projects are also receiving 90.5% (€826·8m/€913·2m) of the investment compared to major projects overall receiving 84·6% (€1·1b/ €1·3b) of the total investment (*Table 2*).

[7] Belgium, Canada, Czech Republic, Denmark, Estonia, Finland, France, Germany, Ireland, Israel, Italy, the Netherlands, Norway, Poland, Portugal, Romania, Spain, Sweden, Switzerland, Turkey, the United Kingdom.

	Number of Projects	Total Investment
National Level (21 countries)	1,189	€679,557,086
EU Level (excluding DG Research contribution to IMI-1)	105	€314,072,980
Overall (National + EU level)	**1,294**	**€993,630,066**
DG Research contribution to IMI-1	9	€345,128,438
Overall (National + EU level + IMI-1)	**1,303**	**€1,338,758,504**

Table 1: Summary of total number of projects and investment of public funds: *Totals include all committed public funds in ABR research from 2007-2103, including national data from participating countries and EU level data.*

		Number of Projects	% of Total Projects	Total Investment	% of Total Investment
All Projects	Total	1,294 (1,303)		€993·6m (€1·3b)	
	Major investments	448 (457)	34·6% (35·1%)	€788·0m (€1·1b)	79·3% (84·6%)
	Smaller investments	846 (846)	65·4% (64·9%)	€205·6m (€205·6)	20·7% (15·4%)
Live Projects	Total	584 (593)		€568·1m (€913·2m)	
	Major investments	260 (269)	44·5% (45·4%)	€481·7m (€826·8m)	84·8% (90·5%)
	Smaller investments	324 (324)	55·5% (54·6%)	€86·0m (€86·0m)	15·1% (9·4%)

Table 2: Total number of projects and investment of public funds: *Totals include all public funds in ABR research from 2007-2013, including national data from participating countries and EU level data (DG Research, DG SANCO, ECDC, and in brackets including DG Research contribution to IMI-1).*

3.1.2 Total Number of Projects and Investment at National Level:

From 2007-2013, 1,189 projects with a total investment of €679·6 million have been funded in ABR research at national level across participating countries[8] (*Table 1 and Table 3*). Of these, the majority were smaller investments which accounted for 69·5% (826/1,189) of the total number of projects and received 29·3% (€199·0m/ €679·6m) of the total investment, whereas, larger investments accounted for 30·5% (363/1,189) of the total number of projects but received 70·7% (€480·5m/ €679·6m) of the total investment. However, when only currently live projects were considered (n=531), the total number of major grants increased to 41·1% (218/531) and received 79·3% (€319·8/ €403·1m) of the investment (*Table 3*), indicating there has been an increase in major investments in recent years in ABR research. These figures do not include EU level investments in ABR research; this data is presented elsewhere in the report (*Section 3.1.3*)

		Number of Projects	% of Total Projects	Total Investment	% of Total Investment
All Projects	Total	1,189		€679·6m	
	Major investments	363	30·5%	€480·5m	70·7%
	Smaller investments	826	69·5%	€199·0m	29·3%
Live Projects	Total	531		€403·1m	
	Major investments	218	41·1%	€319·8m	79·3%
	Smaller investments	313	58·9%	€83·2m	20·7%

Table 3: Total number of projects and investment at national level by participating countries: *Totals include national data from participating countries in ABR research from 2007-2013 and do not include EU level and IMI-1 data.*

[8] Belgium, Canada, Czech Republic, Denmark, Estonia, Finland, France, Germany, Ireland, Israel, Italy, the Netherlands, Norway, Poland, Portugal, Romania, Spain, Sweden, Switzerland, Turkey, the United Kingdom.

3.1.3 Total Number of Projects and Investment at European Union Level:

From 2007-2013, EU agencies have invested €314·1 million in 105 projects (via DG Research [FP6, FP7, ERC], DG SANCO, and ECDC) in ABR research. An additional nine large programmes funded by DG Research were identified within IMI-1, reaching a total of €659·2 million invested by EU agencies in 114 ABR research projects. When only live projects (n=62) are considered, the majority of projects are receiving major investment 82·3% (51/62) and 99·4% (€507.0m/€510.1m) of the funding (*Table 4*).

		Number of Projects	% of Total Projects	Total Investment	% of Total Investment
All Projects	Total	105 (114)		€314,072,980 (€659,201,418)	
	Major investments	85 (94)	78.7% (82.5%)	€307,460,414 (€652,588,852)	97.9% (99.0%)
	Smaller investments	20 (20)	19.0% (17.5%)	€6,612,566 (€6,612,566)	2.1% (1.0%)
Live Projects	Total	53 (62)		€165,018,838 (€510,147,276)	
	Major investments	42 (51)	79.2% (82.3%)	€161,835,073 (€506,963,511)	98.1% (99.4%)
	Smaller investments	11 (11)	20.8% (17.7%)	€2,779,278 (€2,779,278)	1.7% (0.5%)

Table 4: Total number of projects and investment at EU level: *Totals include EU level data in ABR research from 2007-2013, including DG Research, DG SANCO and ECDC funded research. Included in brackets are the totals plus DG Research's contribution to IMI-1.*

3.2 Breakdown by the Strategic Research Agenda Priority Topics:

3.2.1 Analyses at National Level:

The analyses presented below includes national data from all participating countries and do not include EU level investment in ABR research, this data is presented elsewhere in the report (*Section 3.2.2*). These results are analysed in terms of number of projects and associated investment.

3.2.1.1 Total Number of Projects and Investment by Priority Topic:

Of the 1,189 ABR projects funded from 2007-2013 across all participating countries, the majority of awards (64%) were classified as priority topic A. (therapeutics) (n=806). This was followed by 15% of all ABR research carried out in area D. (transmission) (n=193), 11% in B. (diagnostics) (n=138), 4% in F. (interventions) (n=55), 3% in area E. (environment) (n=41), and finally 3% in area C. (surveillance) (n=39) (*Figure 3*).

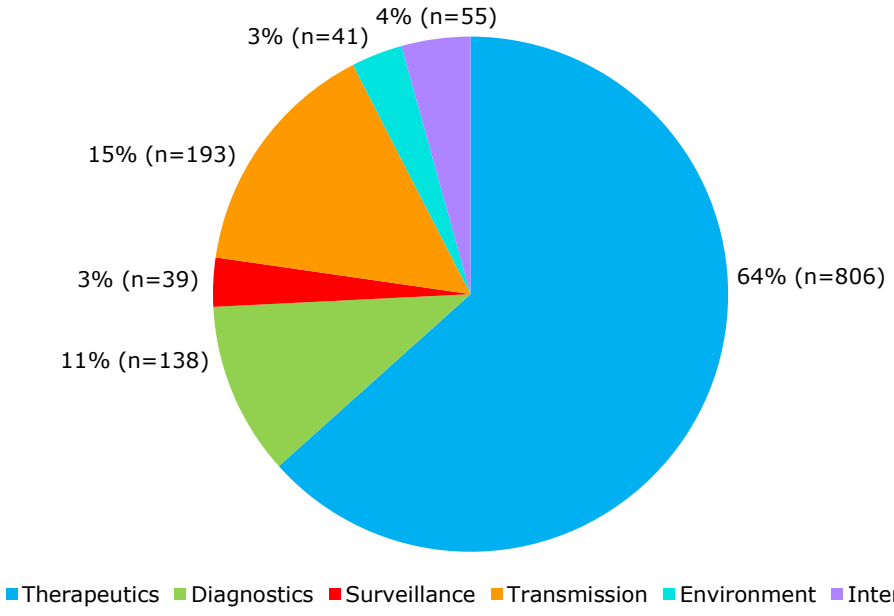


Figure 3: Proportion of total number of projects by priority topic at national level: *Totals include national data from participating countries from 2007-2013 and do not include EU level and IMI-1 data. Some projects are classified under more than one priority topic (hence, the numbers of projects are duplicated and the total sum used= 1,272 projects).*

When looking at the proportion of total investment (€679.6 million) across the SRA priority topics, the majority of investment was in priority topic A. (therapeutics) with 65% (€441.1 million) of all investment allocated here. This was followed by 16% in B. (diagnostics) (€106.5 million), 8% in D. (transmission) (€58.3 million), 5% in F. (interventions) (€35.5 million), 4% in C. (surveillance) (€25.1 million), and finally 2% in E. (environment) (€13.0 million) (*Figure 4*).

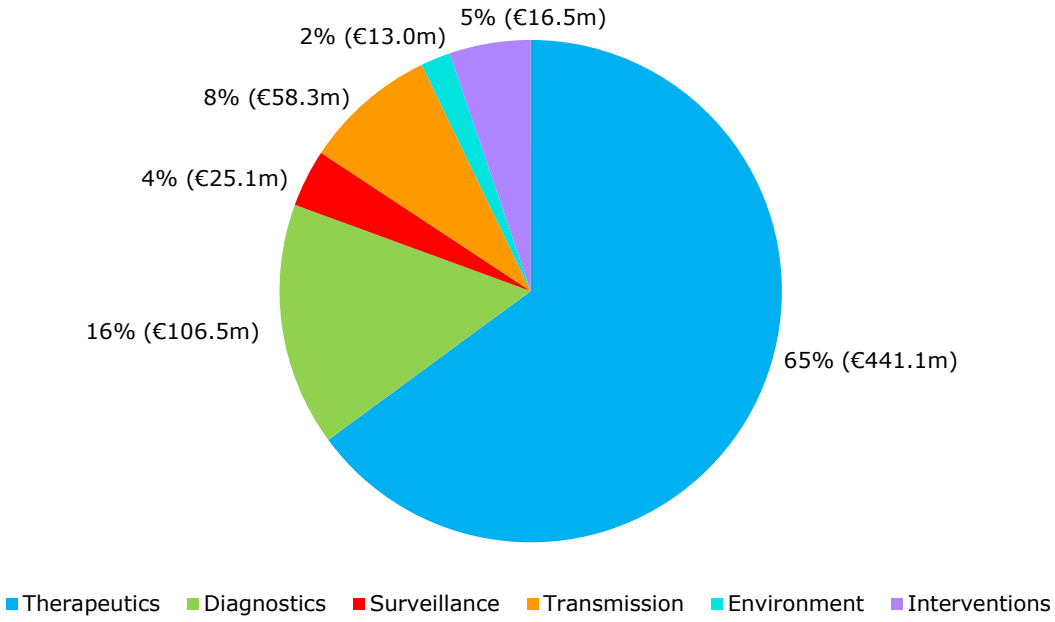


***Figure 4**: **Proportion of investment by priority topic at national level:** Totals include national investment from participating countries from 2007-2013 and do not include EU level and IMI-1 investment. Investment is not duplicated within the priority topics as a percentage of investment has been assigned to each priority topic in projects crossing more than one priority topic.*

3.2.1.2 Distribution across Participating Countries:

A significant variation in national investment in ABR research across participating countries was observed, both in terms of number of projects and investment (*Figures 5 and 7*). Graphs are presented including and excluding the UK for visual purposes, for example *Figure 5* includes the UK and *Figure 6* excludes the UK.

Information on each individual country and the agencies providing data for the mapping exercise are provided in more detail in the *Annex 2: Country Specific Information.*

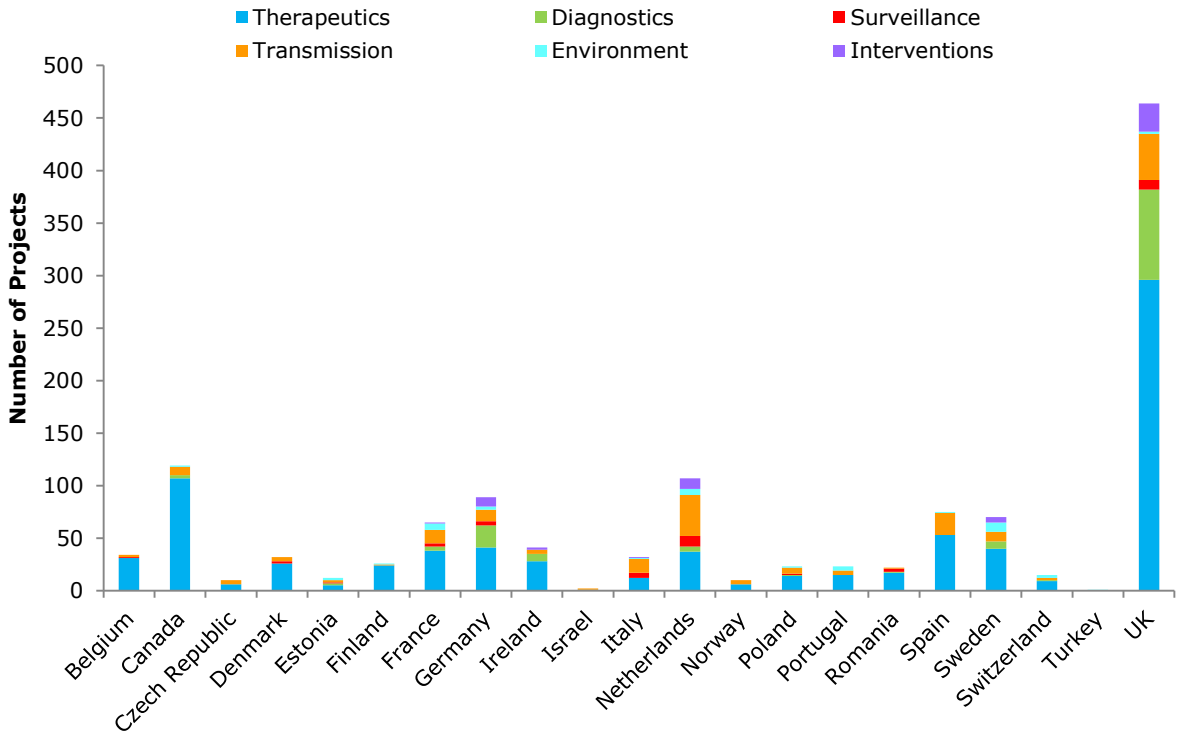


Figure 5*: Total number of national projects per country by priority topic:* *Totals include national data from participating countries from 2007-2013 and do not include EU level and IMI-1 data. Some projects are classified under more than one priority topic (hence, the numbers of projects are duplicated).*

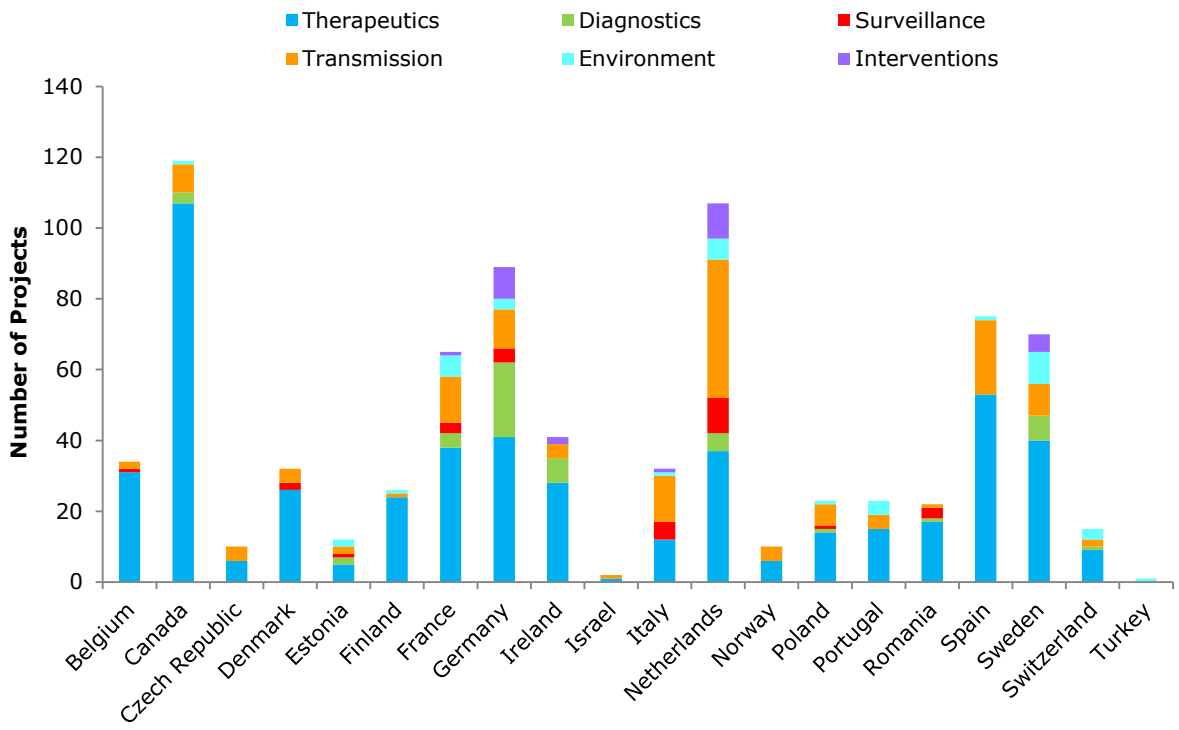


Figure 6: Total number of national projects per country by priority topic (UK removed): *Totals include national data from participating countries from 2007-2013 and do not include EU level and IMI-1 data. Some projects are classified under more than one priority topic (hence, the numbers of projects are duplicated).*

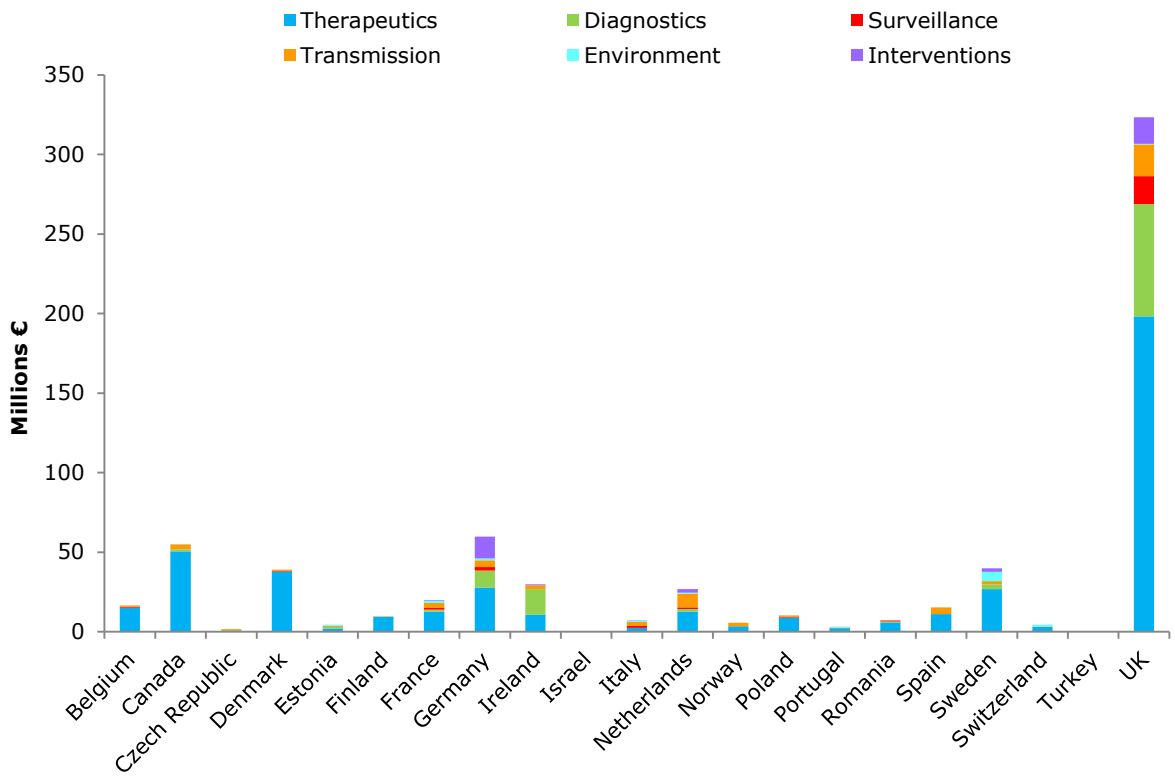


Figure 7: Total national investment per country by priority topic: *Totals include national investment from participating countries from 2007-2013 and do not include EU level and IMI-1 investment. Investment is not duplicated within the priority topics as a percentage of investment has been assigned to each priority topic in projects crossing more than one priority topic.*

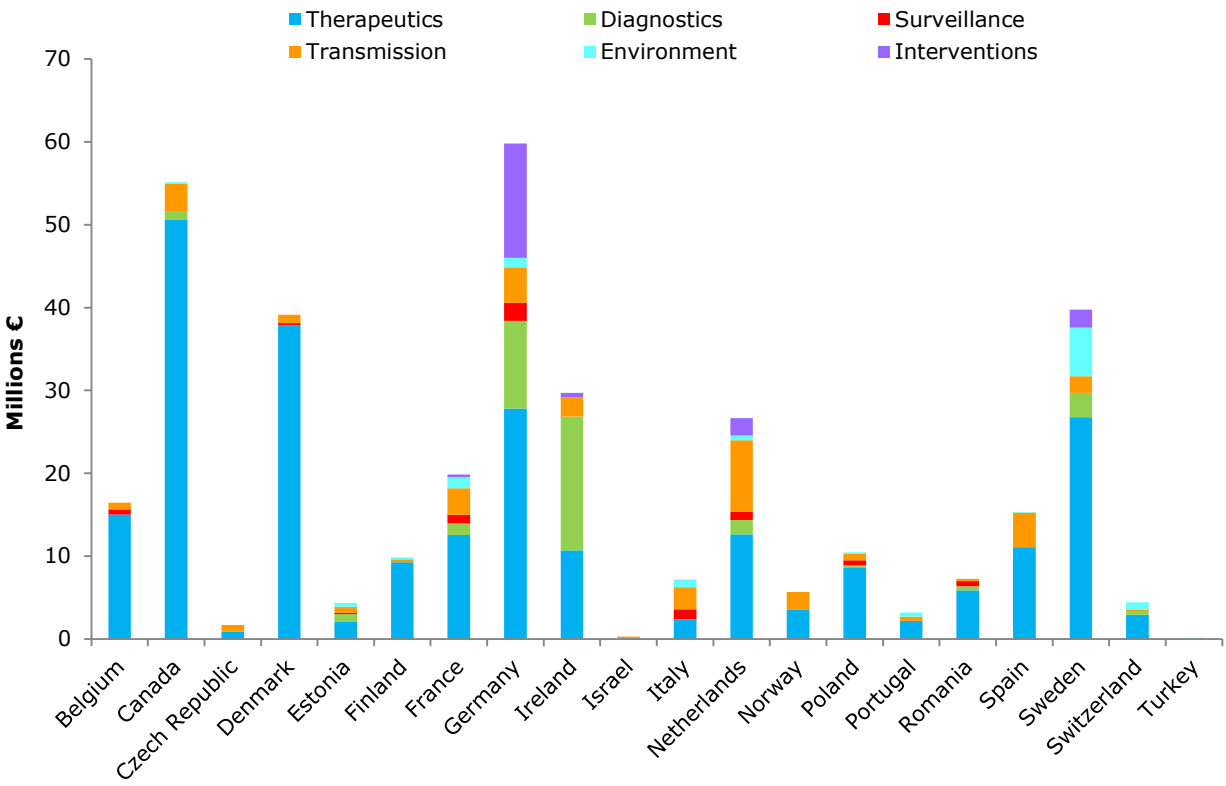


Figure 8: Total national investment per country by priority topic (UK removed): *Totals include national investment from participating countries from 2007-2013 and do not include EU level and IMI-1 investment. Investment is not duplicated within the priority topics as a percentage of investment has been assigned to each priority topic in projects crossing more than one priority topic.*

3.2.1.3 Total Number of Projects and Investment in Priority Topic A. Sub-Classifications:

As reflected in the figures presented above, a large proportion of the projects and associated investment are in priority topic A. (therapeutics). This is in part due to the level of our current scientific understanding of bacteria, resistance, and infection. The outcomes from this underpinning research will provide the basis for the development of therapies and intervention strategies for use in clinical practice. As a result, further in-depth analyses were conducted to sub-classify this priority topic into different areas of research.

In total, 806 projects were classified as priority topic A. (therapeutics) across the participating countries. When these projects were sub-classified and the distribution of these projects were examined, a large proportion was classified as I. (underpinning research) (59.7%, n=481), as this category contains a wide range of projects from understanding the evolution of resistance to identifying and understanding the mechanisms of action of potential antibiotic targets. This was followed by II. (alternatives to antibiotics) (18.7%, n=151), III. (optimising existing antibiotics) (12%, n=97), IV. (lead-to-trial) (9.2%, n=74), and finally V. (projects focusing on more than one component) (0.4%, n=3) (*Figure 9*).

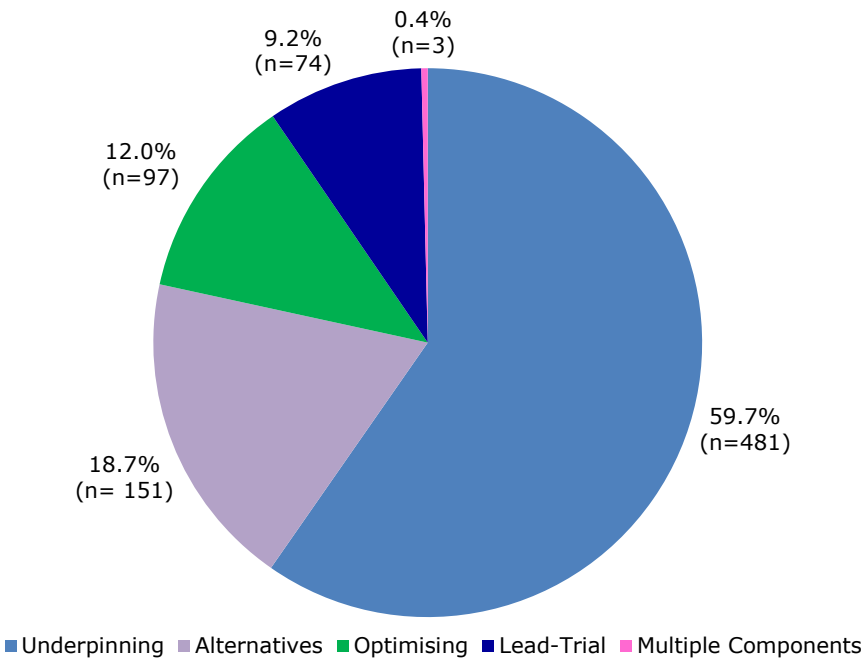


Figure 9: Proportion of total number of national projects in priority topic A. by sub-classification: *Totals include national data from participating countries from 2007-2013 and do not include EU level and IMI-1 data. The numbers of projects are not duplicated as projects are only classified under one sub-classification.*

When looking at the proportion of total investment (€441.1 million) across priority topic A. sub-classifications a similar trend was observed in *Figure 10* as seen above in *Figure 9* when the number of projects were analysed. A large proportion of investment, 49% was classified as I. (underpinning) (€216.0 million). This was followed by 21% invested in II. (alternatives) (€91.5 million), 16% in III. (optimising) (€71.9 million), 10% in IV. (lead-to-trial) (€43.2 million), and finally, 4% in V. (multiple components) (€18.5 million) (*Figure 10*).

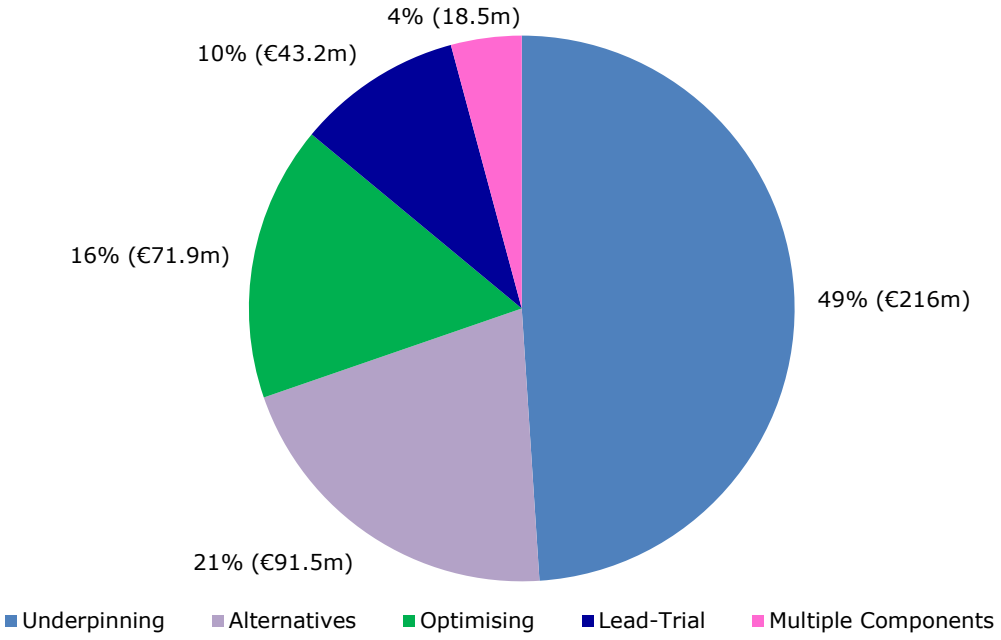


Figure 10*: Proportion of national investment in priority topic A. by sub-classification*: *Totals include national investment from participating countries from 2007-2013 and do not include EU level and IMI-1 investment. Investment is not duplicated as projects can only be classified under one sub-classification.*

3.2.1.4 Distribution of Priority Topic A. Sub- Classifications across Participating Countries:

As noted above, significant variation in national investments were observed across countries. Yet it is clear, with some exceptions, the majority of projects and associated investment within participating countries are within priority topic A. (therapeutics) and are sub-classified as I. (underpinning) (*Figure 11 and Figure 13*).

Graphs are presented including and excluding the UK for visual purposes, example *Figure 11* includes UK and *Figure 12 excludes UK*.

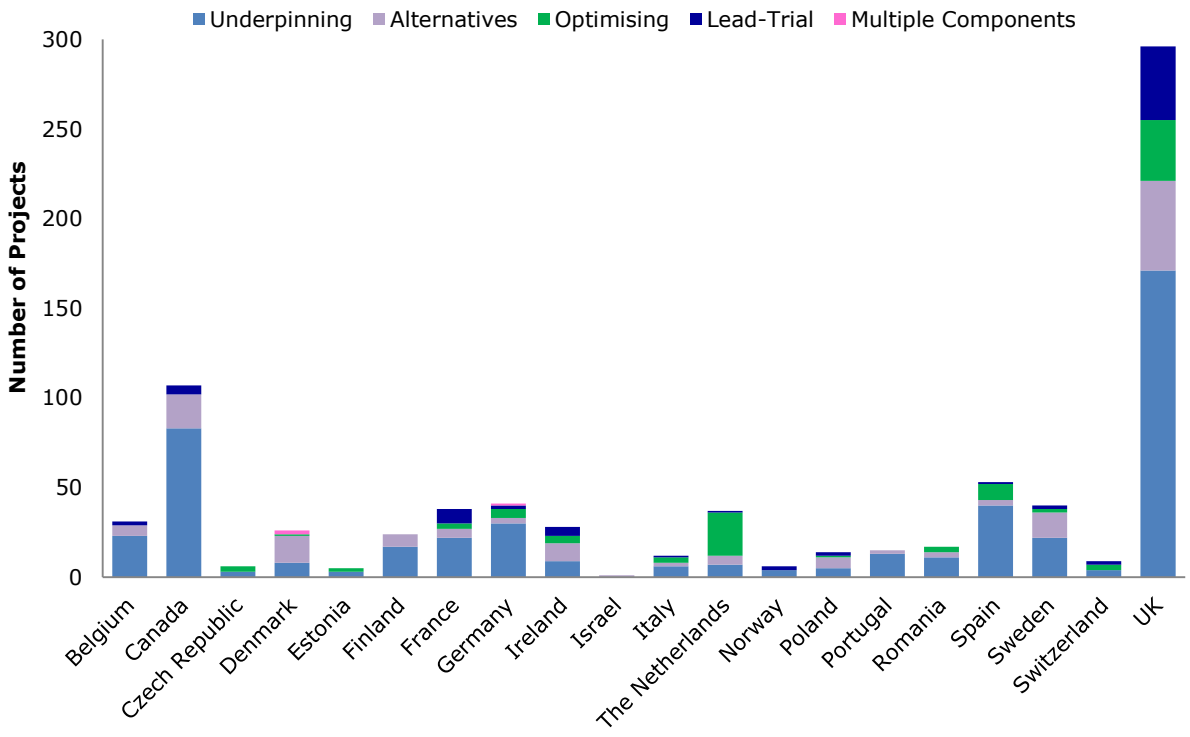


***Figure 11**: **Total number of national projects per country by priority topic A. sub-classifications:** Totals include national data from participating countries from 2007-2013 and do not include EU level and IMI-1 data. The numbers of projects are not duplicated as projects are only classified under one sub-classification.*

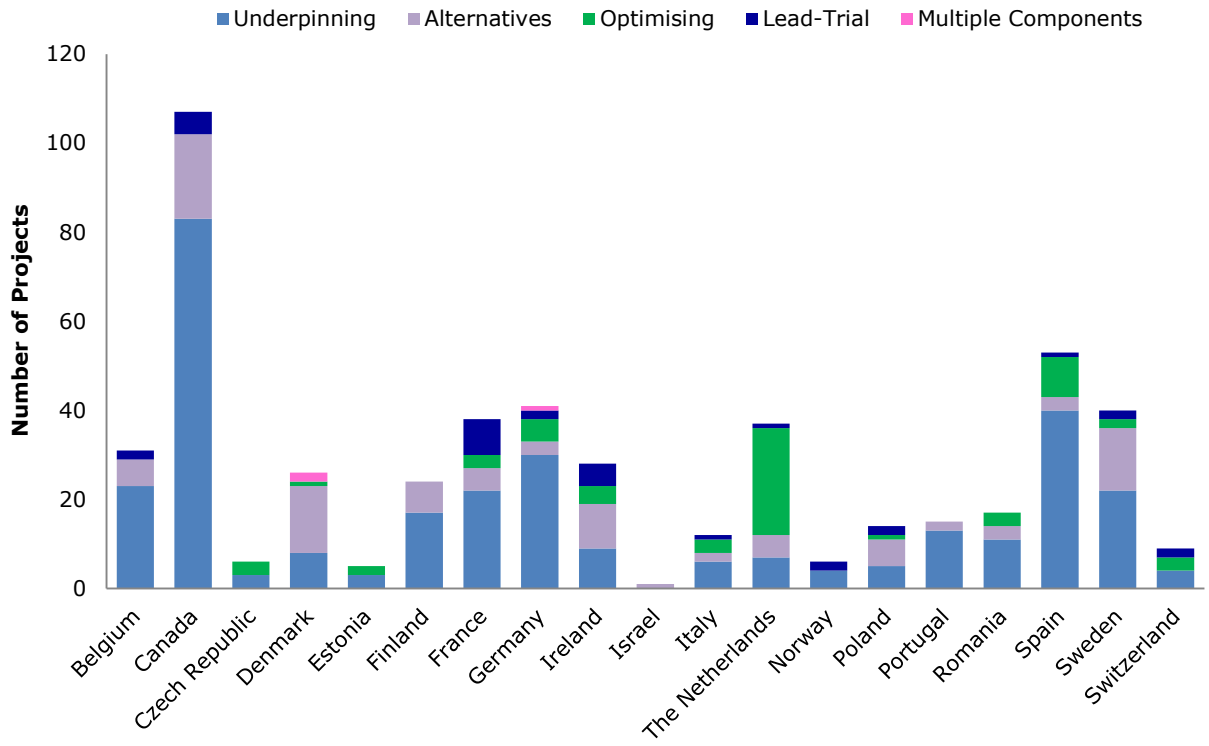


***Figure 12**: **Total number of national projects per country by priority topic A. sub-classifications (UK removed):** Totals include national data from participating countries from 2007-2013 and do not include EU level and IMI-1 data. The numbers of projects are not duplicated as projects are only classified under one sub-classification.*

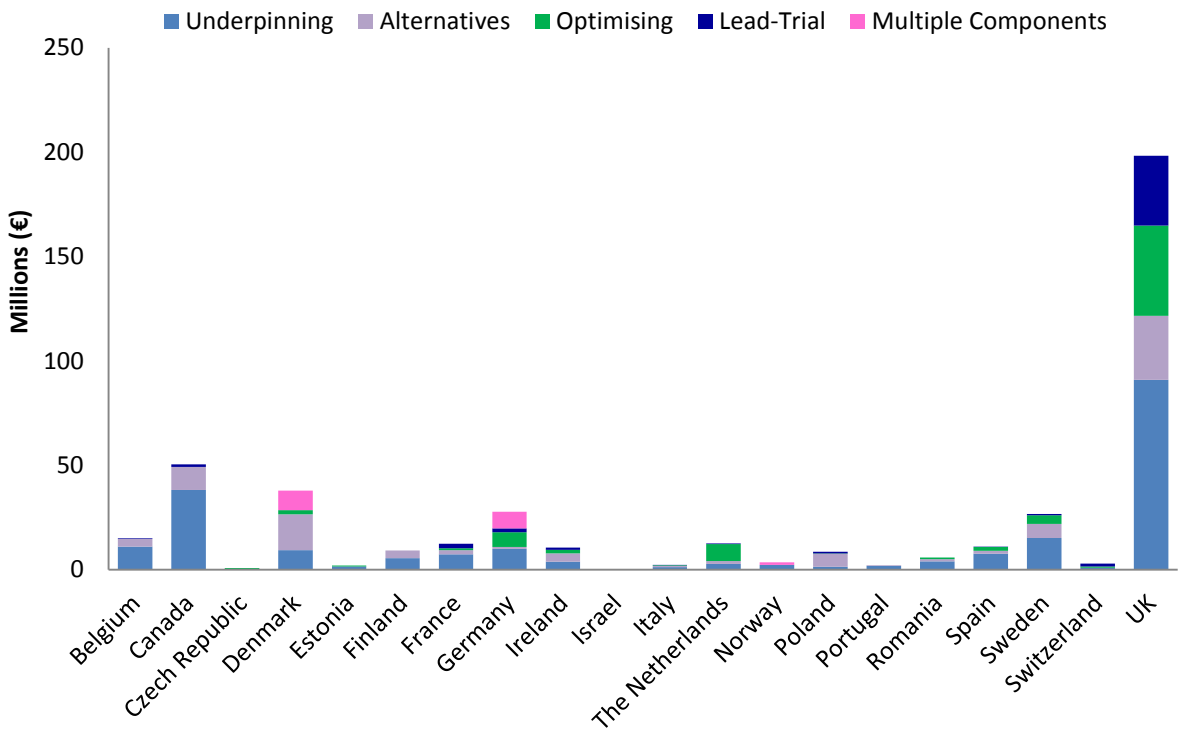


Figure 13: Total national investment per country by priority topic A. sub-classifications: *Totals include national investment from participating countries from 2007-2013 and do not include EU level and IMI-1 investment. Investment is not duplicated as projects can only be classified under one sub-classification.*

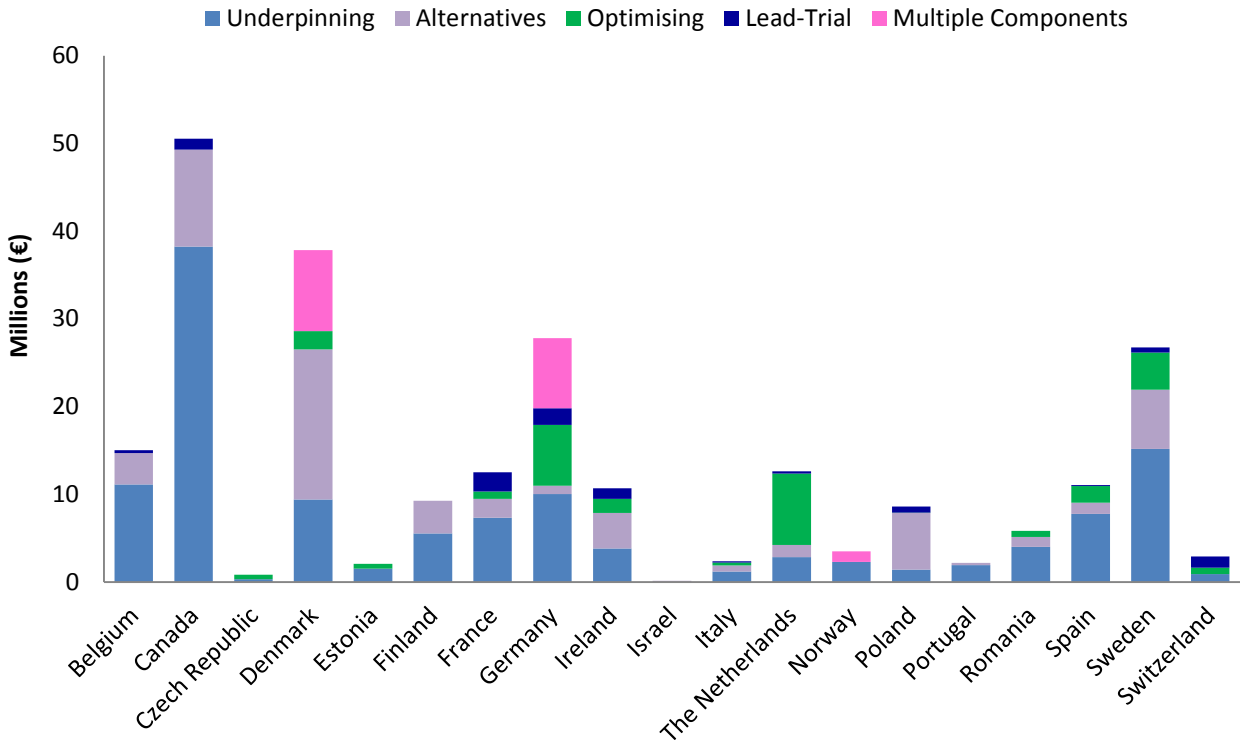


Figure 14: Total national investment per country by priority topic A. sub-classifications (UK removed): *Totals include national investment from participating countries from 2007-2013 and do not include EU level and IMI-1 investment. Investment is not duplicated as projects can only be classified under one sub-classification.*

3.2.2 Analyses at European Union Level:

As the analyses above does not include EU level investment, an additional analyses was undertaken to address this. This section describes the scale and scope of ABR research by EU Agencies via DG Research (FP 6, FP 7, and ERC), DG SANCO, and ECDC since 2007 to the end of 2013.

In addition, the DG Research funds ABR research through IMI-1. This is a public-private partnership between the EC and the European Federation of Pharmaceutical Industries & Associations (EFPIA). This analysis is detailed separately in the final section (*Section 3.2.3*).

3.2.2.1 Total Number of Projects and Investment by Priority Topic:

As seen in *Figure 15*, the trends observed for EU level funded projects (n=105) are similar to those observed at a national level within participating countries (*Figure 3*), with the majority of projects classified as A. (therapeutics) (53%, n=71), followed by D. (transmission) (14% n=18), then C. (surveillance) (12%, n=16), B. (diagnostics) (10%, n=13), F. (interventions) (8%, n=8), and finally E. (environment) (3%, n=4).

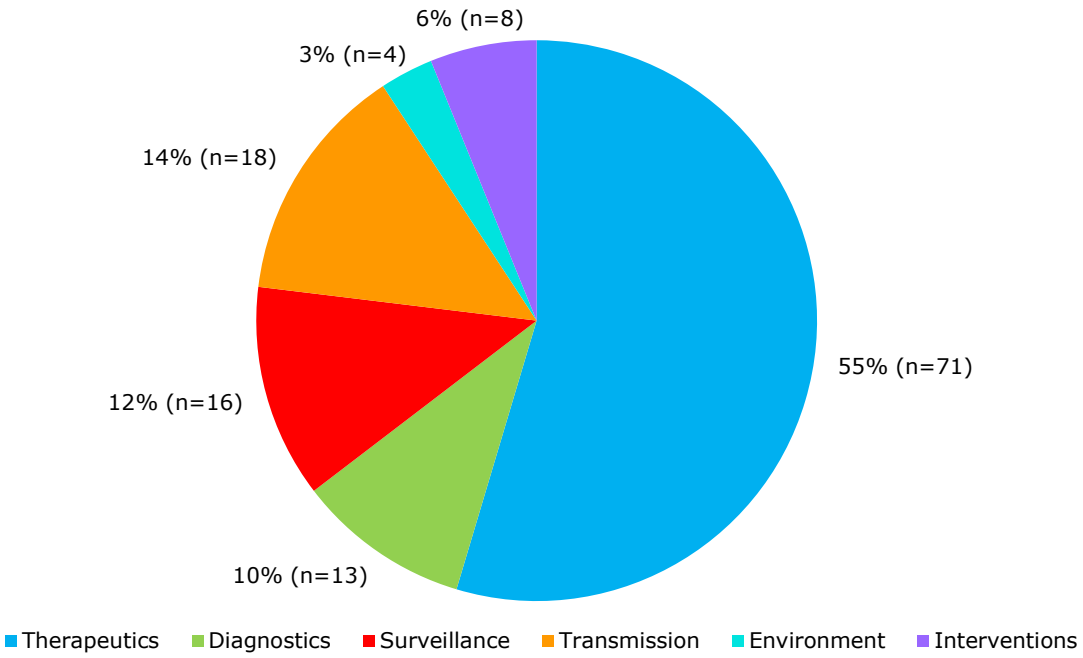


Figure 15: Proportion of total number of EU level projects by priority topic: *Totals include EU level data from 2007-2013 from DG Research, DG SANCO, and ECDC. As significant funds are invested some projects are classified under more than one priority topic (hence, the numbers of projects are duplicated and the total sum used= 130 projects).*

The proportion of total investment in EU level funded research (€314.1m) follows the trend observed throughout the report, with 63% (€197.4 million) of all funding invested in priority topic A. (therapeutics). This was followed by 13% (€42.7 million) in D. (transmission) and 12% (€38.3 million) in B. (diagnostics), 7% (€21.2 million) in F. (interventions), 3% (€8.5 million) in C. (surveillance), and 2% (€5.9 million) in E. (environment) (*Figure 16*).

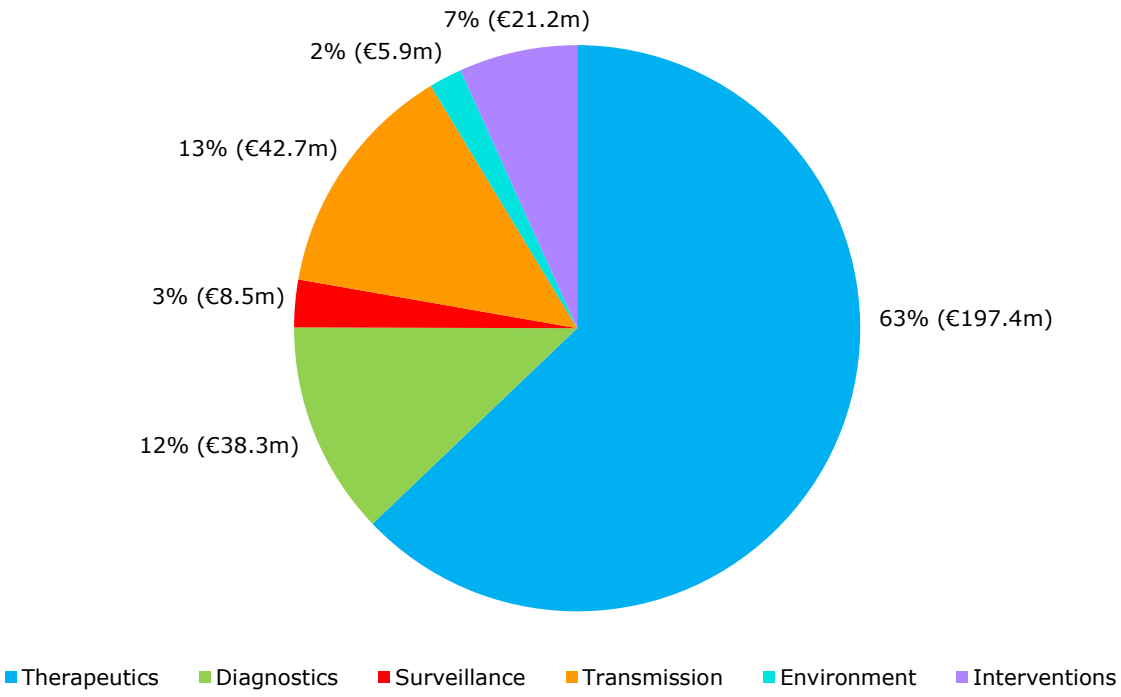


Figure 16: Proportion of EU level investment by priority topic: *Totals include EU level data from 2007-2013 from DG Research, DG SANCO, and ECDC. Investment is not duplicated within the priority topics as a percentage of investment has been assigned to each priority topic in projects crossing more than one priority topic.*

3.2.2.2 Total Number of Projects and Investment in Priority Topic A. Sub-Classifications:

Of the total number of ABR research projects identified (n=105), the EU Agencies invested €314.1 million via DG Research, DG SANCO, ECDC, of this, 63% (€197.4 million) was in priority topic A. (therapeutics). Therefore, further in-depth analyses of priority topic A. (therapeutics) was also conducted for EU level data. Although 38% (27/71) of all projects classified as priority topic A. (therapeutics) focus on I. (underpinning), there was a similar distribution of projects across the other research areas as 22% (16/71) were in II. (alternative), 20% (14/71) in III. (optimisation), and 17% (12/71) in IV. (lead-trial) (*Figure 17)*. Only 3% (2/71) were focusing on multiple areas within this topic.

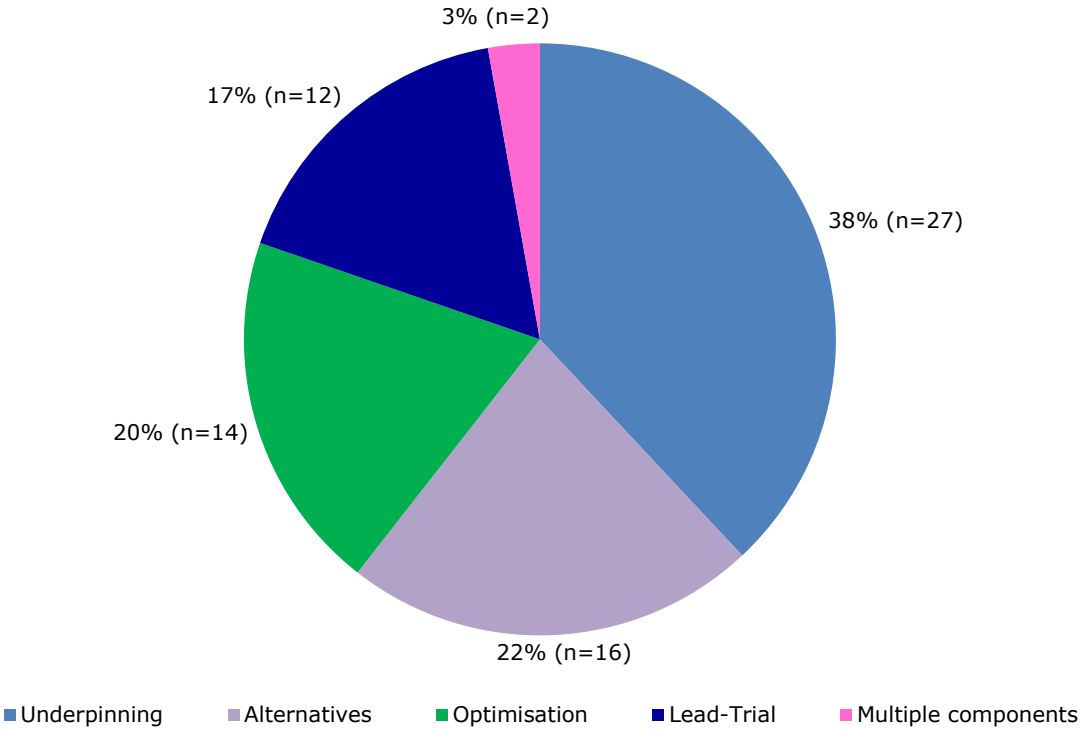


Figure 17: Proportion of total number of EU level projects by priority topic A. sub-classification: *Totals include EU level data from 2007-2013 from DG Research, DG SANCO, and ECDC and the numbers of projects are not duplicated as projects can only classified under one sub-classification.*

There was also a similar distribution of investment observed across the research areas, with 28% (€54.2m) invested in III. (optimisation), 26% (€52.1m) in I. (underpinning), 23% (€45.6m) in II. (alternatives), and 19% (€37.5m) in IV. (lead-trial) (*Figure 18*). Only 4% (€8.0m) were focusing on multiple areas within this topic.

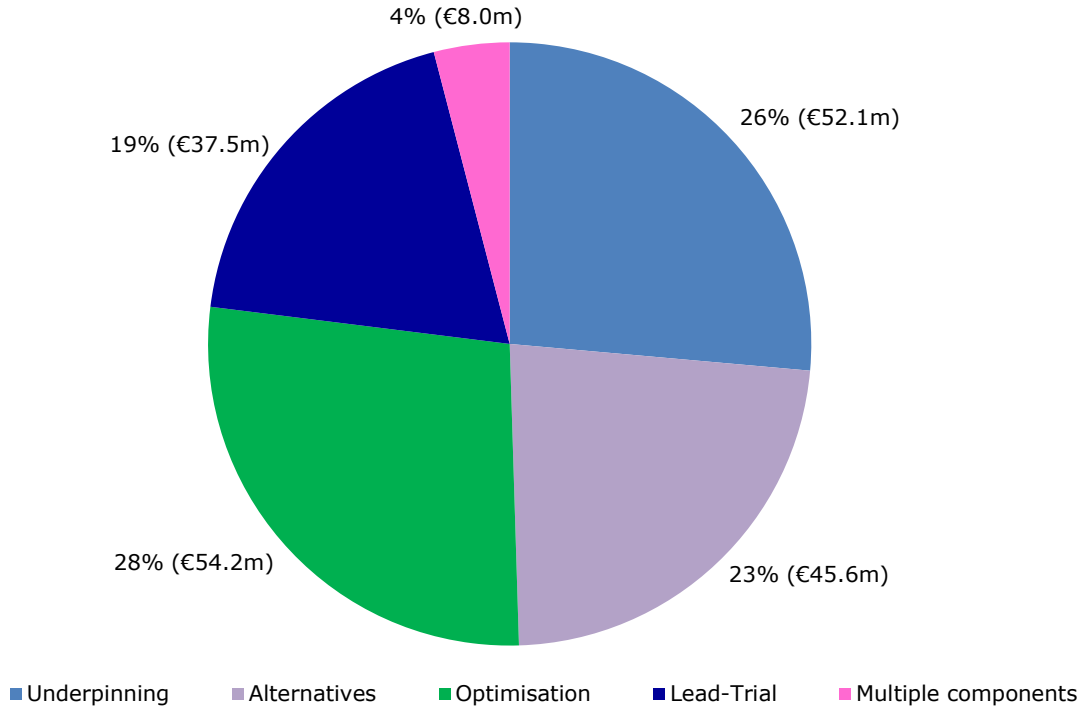


Figure 18: Proportion of EU level investment in priority topic A by sub-classification: *Projects include EU level data from 2007-2013 from DG Research, DG SANCO, and ECDC and investment is not duplicated as projects can only classified under one sub-classification.*

3.2.3 Analyses of the Innovative Medicines Initiative Data:

DG Research also invests in ABR research within the IMI-1 framework which was not included in the above EU level analyses. IMI[9] is an initiative between DG Research/ the EC and EFPIA. IMI is Europe's largest public-private partnership aiming to accelerate the development of better and safer medicines for patients, including antibiotics and alternatives to antibiotics, highlighting its importance for inclusion in the mapping exercise.

In total, we identified nine projects in IMI-1 focusing on ABR research, with a total investment of €739·5 million. The EC has committed €345·1 million to these nine projects via FP7, eight have a clear focus on priority topic A. (therapeutics), with two slightly overlapping into other priority topics, and one specifically focusing on priority topic B. (diagnostics). Beyond pre-clinical and clinical research, IMI-1 projects are also creating and building on research infrastructures through the development of a drug discovery platform and pan-European clinical trials and laboratory networks.

Name	Total €	JPIAMR Priority Areas
COMBACTE	€250.5m	A (& B)
TRANSLOCATION	€29.3m	A
ENABLE	€100.9m	A
DRIVE-AB	€10.8m	A
COMBACTE-CARE	€85.5m	A
COMBACTE-MAGNET	€168.8m	A (& C)
iABC	€50.7m	A
PreDiCT-TB	€28.6m	A
RAPP-ID	€14.4m	B
Total	**€739.5m**	

Table 5: Projects and investment breakdown in IMI-1 by priority topic:
Totals include investment from the EC, EFPIA, and other investments in ABR research in the IMI-1 programme. Totals are rounded up to the nearest decimal point.

[9] Further information on IMI is available at: http://www.imi.europa.eu/

4. Limitations:

Noteworthy, as with similar exercises, there are limitations to the data presented. To ensure the information captured was comparable and consistent, only funding of research projects were captured, therefore, institutional funding, in-house activities, and national surveillance programmes were not included.

We relied on the accuracy of the data provided by funding organisations, although all data was verified by each organisation representative and any apparent discrepancies or duplication of projects were dealt with by the data analyst. All projects were determined for inclusion firstly, by each organisations representative, and secondly, by the data analyst. Some projects may have been missed due to the search terms used or due to the difficulties in obtaining data in certain countries.

It is recognised that countries have different rules regarding what a research grant will cover, e.g. if it includes the salary of investigators or not; this exercise made no attempt to remove any indirect and estate costs included in the funding amounts. Currency conversions to Euros will not be precise due to variations in the exchange rates across the data collection process and no adjustments were made for inflation. In order to deal with these confounding financial issues, the number of projects were analysed and compared across countries rather than only focusing on investment. As the data analyst classified each project into one or more of the priority topics, disagreement in the classification of these cross-disciplinary projects could exist as this was subjective. In addition, for projects classified under more than one priority topic we could not ascertain what proportion of grant funding should be allocated to each of the topics, hence, to ensure consistency an equal proportion of funding was assigned to each.

This study did not include private sector funding, with the exception of the IMI-1 portfolio; this was due to difficulties in openly accessing funding and project information.

Missing data and variability in funding mechanisms across countries may in part explain the large variations in ABR research observed between the countries analysed. However, from the report it is clear that improvements in data sharing and communication need to be achieved at a national level in several countries to enable a clear and accurate picture of ABR research across Europe and beyond to be determined.

5. Conclusions:

For the first time, due to the JPIAMR partnership, an objective overview into the scale and scope of the ABR research landscape was determined across Europe, Israel, and Canada by national and EU-level agencies. This report will enable individual countries to determine what they fund across different areas of ABR research and identify their strengths and weaknesses. Moving forward, it is hoped that it will support participating countries in making informed future investments in this area in order to close the gap between the health research needs and the actual research funded, particularly at national level. The mapping exercise will also support funders, even with modest budgets, to determine where they can make a significant and valuable impact through supporting ABR research and working together and across disciplines to tackle the global threat of resistant bacteria.

For the JPIAMR, this report will act as a framework of ABR research to highlight gaps and opportunities within the portfolio to be exploited. It will be used alongside the SRA for the development of the implementation plan and the prioritisation of particular research areas identified within the JPIAMR SRA. The concept behind Joint Programming, and reinforced by this exercise, is that resources are limited, countries now need to work together to harmonise research activities and collectively pool resources to increase the effectiveness of research and to tackle ABR. Finally, this mapping exercise forms the baseline of ABR research and associated investment which can be used in the future to evaluate the efforts of the JPIAMR.

This rapid assessment including the ABR research portfolios of 21 countries, EU Agencies, and the IMI-1 can now be used as a valuable resource in moving forward with future ABR research activities at both national and international level.

Annex 1: Public Funding Organisations Included:

Country	Public Funding Organisation
Belgium	Agency for Innovation by Science and Technology (IWT), Research Foundation Flanders (FWO), and Fonds de la Recherche Scientifique (FNRS)
Canada	Canadian Institutes of Health Research (CIHR), Natural Sciences and Engineering Research Council (NSERC). Other funding agencies were contacted but had no data meeting the inclusion criteria.
Czech Republic	Internal Grant Agency of Ministry of Health (IGA) and Czech Science Foundation (GAČR)
Denmark	The Danish Council for Strategic Research and the Danish Council for Independent Research
DG SANCO	Directorate General for Health and Consumer Affairs
DG Research	Directorate General for Research and Innovation
ECDC	European Centre for Disease Prevention and Control
ERC	European Research Council
Estonia	Archimedes Foundation, Enterprise Estonia, Estonian Research Council, Ministry of Agriculture, Ministry of Education & Research
Finland	Academy of Finland
France	National Agency for Research (ANR), National Institute for Agricultural Research (INRA), Agency for Food, Environment and Occupational Health and Safety (ANSES), National Institute of Health and Medical Research (INSERM), the Medical Research Foundation (FRM), Hospital Clinical Research Program (PHRC), the Public Hospitals of Paris (AP-HP), the Ministry of Higher Education and Research, Ministry of Health, Single Inter-ministerial Fund, National Institution of Agriculture and Sea Products, the French Alternative Energies and Atomic Energy Commission, Carnot Institute for Animal Health (ICSA), Principality of Monaco, Association Raoul Follereau, and the Infectiopole-sud Foundation.
Germany	Projektträger Jülich (PtJ), Projektträger DLR (PT-DLR), and Deutsche Forschungsgemeinschaft (DFG)
IMI	Innovative Medicines Initiative (IMI) (EFPIA & EC- FP 7)

Ireland	Science Foundation Ireland (SFI), Health Research Board (HRB), Department of Agriculture, Food and the Marine
Israel	Ministry of Health
Italy	Chief Scientists Office, Ministry of Health (CSO-MOH)
The Netherlands	The Netherlands Organisation for Health Research and Development (ZonMw), plus additional desk study to identify publically available funded projects by other organisations
Norway	The Research Council of Norway (RCN)
Poland	National Science Centre (NCN) and National Centre for Research and Development (NCBR)
Portugal	Health and Life Sciences Scientific Council (FCT)
Romania	Ministry of National Education, the National Authority for Research, Technological Development and Innovation
Spain	Instituto de Salud Carlos III, Ministry of Economy and Competitiveness (MINECO), and Spanish Network for Research in Infectious Diseases (REIPI)
Sweden	Swedish Research Council (SRC), Vinnova, Forte, Formas, and the Swedish Foundation for Strategic Research (SSF)
Switzerland	Swiss National Science Foundation
Turkey	The Scientific and Technological Research Council of Turkey (TUBITAK)
UK	Department of Health (DH)/ National Institute of Health Research (NIHR), Medical Research Council (MRC), Biotechnology and Biological Sciences Research Council (BBSRC), Engineering and Physical Sciences Research Council (EPSRC), Natural Environment Research Council (NERC), Innovate UK, Department for Environment, Food and Rural Affairs (DEFRA), the Wellcome Trust, and the Food Standard Agency (FSA). The Economic and Social Research Council (ESRC), the Science and Technology Facilities Council (STFC) and the Arts and Humanities Research Council (AHRC) were contacted but did not have any projects meeting the study inclusion criteria.

Annex 2: National and EU Representatives:

Country	Organisation	Name
Belgium	Dept. Economy, Science and Innovation, Flemish Government (EWI)	Tine Bekaert
Belgium	Research Foundation Flanders (FWO)	Olivier Boehme
Belgium	Fonds de la Recherche Scientifique (FNRS)	Arnaud Goolaerts
Canada	Canadian Institutes of Health Research (CIHR)	Judith Bray, Serge Desnoyers, and Isabelle Létourneau
Czech Republic	National Institute on Public Health (NIPH)	Helena Zemlickova
Denmark	The Danish Council for Strategic Research	Lene Cividanes and Peder Fode
DG Research	Directorate General for Research and Innovation (including FP 6 & FP 7, ERC, and IMI)	Arjon Van Hengel
DG SANCO	Directorate General for Health and Consumer Affairs	Nicole Heine
ECDC	European Centre for Disease Prevention and Control (ECDC)	Liselotte Diaz Högberg, Ole Heuer, Pete Kinross, Gianfranco Spiteri, Marc Struelens, Carl Suetens, Csaba Ködmön, Johanna Takkinen, Marieke van der Werf, Klaus Weist, Therese Westrell, and Dominique L. Monnet
Estonia	Research Coordinator Ministry of Social Affairs	Kerstin Mahlapuu
Finland	National Institute for Health and Welfare	Jaana Vuopio
France	National Agency for Research (ANR)	Serawit Bruck-Landais
France	INSERM	Imène Tabbi
Germany	Forschungszentrum Jülich GmbH	Bülent Genc and Henrike Knizia

Greece	General Secretariat for Research and Technology	Suzanne Kolyva
IMI	Innovative Medicines Initiative (IMI)	Angela Wittelsberger
Ireland	Science Foundation Ireland (SFI)	Manus Ward
Ireland	Health Research Board (HRB)	Maura Hiney
Ireland	Department of Agriculture, Food and the Marine	James Conway and Ciara Daly
Ireland	Teagasc	Raymond Kelly
Israel	Ministry of Health	Irit Allon
Italy	Institute of Health	Alessandra Carattoli
The Netherlands	The Netherlands Organisation for Health Research and Development (ZonMw)	Dunja Dreesens
Norway	The Research Council of Norway	Sonja Prehn
Poland	Ministry of Science and Higher Education	Joanna Misiewicz
Portugal	Health and Life Sciences Scientific Council (FCT)	Anjos Macedo and Luis Valente
Romania	Carol Davila University of Medicine and Pharmacy	Irina Codita
Romania	National Authority for Scientific Research	Ioana Ispas
Spain	Instituto de Salud Carlos III	Gloria Villar
Spain	Ministry of Economy and Competitiveness (MINECO)	Rosa Rodríguez Bernabe
Spain	Spanish Network for Research in Infectious Diseases (REIPI)	Jesús Rodríguez Baño
Sweden	Swedish Research Council (SRC)	Pontus Holm
Switzerland	Agroscope, Institute of Food Sciences IFS, Research Division Food Technology	Andreas Aeschlimann
Turkey	The Scientific and Technological Research Council of Turkey (TUBITAK)	Özge Gözay
UK	Medical Research Council (MRC)	Ruth Kelly

Annex 3: Country Specific Information:

Belgium:

	Total	A	B	C	D	E	F
Number	34	31	0	1	2	0	0
Investment	€16,454,574	€15,033,781	0	€594,600	€826,193	0	0

Table 1: Total number of projects and investment by priority topic in Belgium: *Totals include national data from Belgium from 2007-2013 and do not include EU and IMI data. Number of projects and investment is not duplicated.*

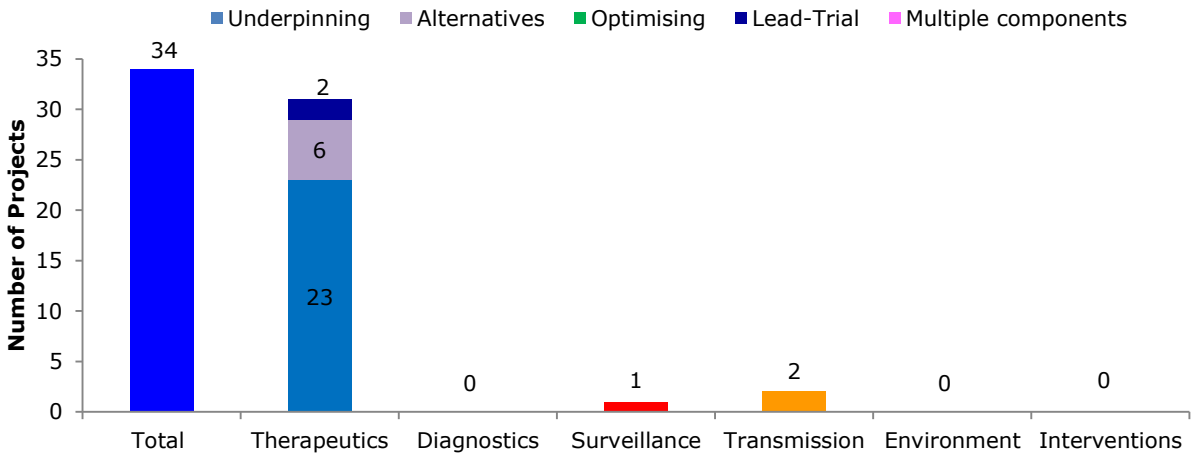


Figure 1: Total number of projects by priority topic: *Totals include national data from Belgium from 2007-2013 and do not include EU and IMI data. Number of projects is not duplicated. Priority topic A. therapeutics is sub-classified.*

Commentary:

Organisations providing funding data for the mapping exercise:

- Agency for Innovation by Science and Technology (IWT)
- Research Foundation Flanders (FWO)
- Fund for Scientific Research (FNRS)

The science policy in Belgium is according to the bottom up principle and selection of funded projects according to excellence and/or valorisation criteria.

Projects on ABR are funded through three funding agencies:

- IWT (Agentschap voor Innovatie door Wetenschap en Technologie) is the organisation for all industrial R&D and innovation support in Flanders. The agency assists companies, research centres and knowledge centres in realising their research and development projects, by offering funding, advice, and a network of potential partners in Flanders and abroad. www.iwt.be

- FWO (Fonds voor Wetenschappelijk Onderzoek Vlaanderen) stimulates and supports ground-breaking fundamental research in all areas of science at the universities in the Flemish Community, including collaboration agreements between Flemish universities and other research institutes. FWO funds excellent and promising researchers as well as research projects following an interuniversity competition and an evaluation by national and international experts. The only criterion is the outstanding quality of researcher and research proposal. Researchers can apply for support from the FWO through a broad range of funding instruments, providing they are affiliated to a university of the Flemish Community. www.fwo.be

- F.R.S.-FNRS (Fonds de la Recherche Scientifique –FNRS) funds fundamental research in all areas of science for the French-speaking Community of Belgium. The three funding instruments of the F.R.S.-FNRS support fellowships (both temporary and tenure track positions), research projects (including equipment, human resources and working budget) by an annual call and networking/transnational projects all year round. www.fnrs.be

In Flanders additional funding is governed by the universities, including BOF (Special research fund) and IOF (Industrial research fund) funding.

Organisations in Belgium working in the area of ABR (including those responsible for creating guidelines, advice etc.) but not included in the mapping exercise:

- BAPCOC (Belgian antibiotic policy coordination committee) (www.bapcoc.be). This committee has the following objectives:

- Prudent use of antibiotics through campaigns, surveillance and hand hygiene campaigns, and cooperation with veterinary sector, the collection and classification of all the available information concerning the use of antibiotics in antibiotic resistance,
- The publication of reports on the evolution of antibiotic resistance and antibiotic consumption in the various ecosystems of Belgium,
- Information and awareness in relation to the evolution of antibiotic resistance and potential improper use of antibiotics dangers,
- Issuing recommendations on: (a) the detection and monitoring of antibiotic resistance among pathogenic microorganisms to humans and animals and bacteria belonging to their normal flora, (b) use of antibiotics with an operating mechanism and / or of similar strength, and in the various ecosystems, (c) the details of prophylactic and therapeutic use of antibiotics in both human and veterinary medicine, (d) evaluation and monitoring of the use of antibiotics in humans and animals, (e) the application of international guidelines on the use of antibiotics in humans and animals,
- Issuing recommendations for depth on the evolution of antibiotic resistance and transmission of resistance between bacteria and between diff, and
- The organization of national awareness campaigns.

  The scientific research that enables BAPCOC to obtain their objectives is carried out by the Scientific Institute of Public Health ("WIV-ISP"). www.wiv-isp.be

- AMCRA (www.amcra.be) is the Center of Expertise on Antimicrobial Consumption and Resistance in Animals. The mission of AMCRA is to collect and analyse all data related to antimicrobial use and resistance in animals in Belgium and to communicate the outcomes in a neutral and objective manner, in order to safeguard both public and animal health and welfare, and to achieve a durable policy of veterinary antimicrobial use in Belgium. AMCRA has become operational from the 2nd of January 2012 and proposes guidelines to direct the whole animal industry (pigs, poultry, beef cattle and dairy cattle) towards a rational reduction of antimicrobial use. The organisation sensitises veterinarians and farmers to

using antimicrobial products in a well-considered way and to respecting the chapters of the antibiotic guides that are applicable to them,

- Belgian Infection Control Society (www.belgianinfectioncontrolsociety.be)
- Scientific Institute of Public Health (www.wiv-isp.be, focal contact point ECDC)
- Scientific Institute of Public Health, Operational Directorate Public Health & Surveillance, Healthcare Associated Infections Programme (NSIH) (www.nsih.be)
- Superior Health Council (Hoge gezondheidsraad HGR)(www.hgr-css.be)
- Scientific committee of the Federal agency for the safety of the food chain (FASFC/FAVV) http://www.fasfc.be/
- VIP2 (Flemish Indicator Project; quality of Flemish Hospitals) https://www.zorg-en-gezondheid.be/kwaliteitsindicatorenziekenhuizen/
- FAGG (federal agency for medicines and medicinal products) http://www.fagg-afmps.be
- DGZ Vlaanderen (animal healthcare Flanders) (www.dgz.be)
- ARSIA (animal healthcare Wallonia) (www.arsia.be)
- KCE (knowledge Centre of excellence in public health) http://kce.fgov.be
- Federal public service: Health, food chain safety and environment http://www.health.belgium.be/eportal/index.htm?fodnlang=en

Canada:

	Total	A	B	C	D	E	F
Number	117	107	3	0	8	1	0
Investment	€55,120,364	€50,550,161	€1,098,533	0	€3,334,712	€136,958	0

Table 2: Total number of projects and investment by priority topic: *Totals include national data from Canada from 2007-2013. Some projects are classified under more than one priority topic, hence, the number of projects is duplicated. Investment is not duplicated as a percentage of investment has been assigned to each priority topic in projects crossing more than one priority topic.*

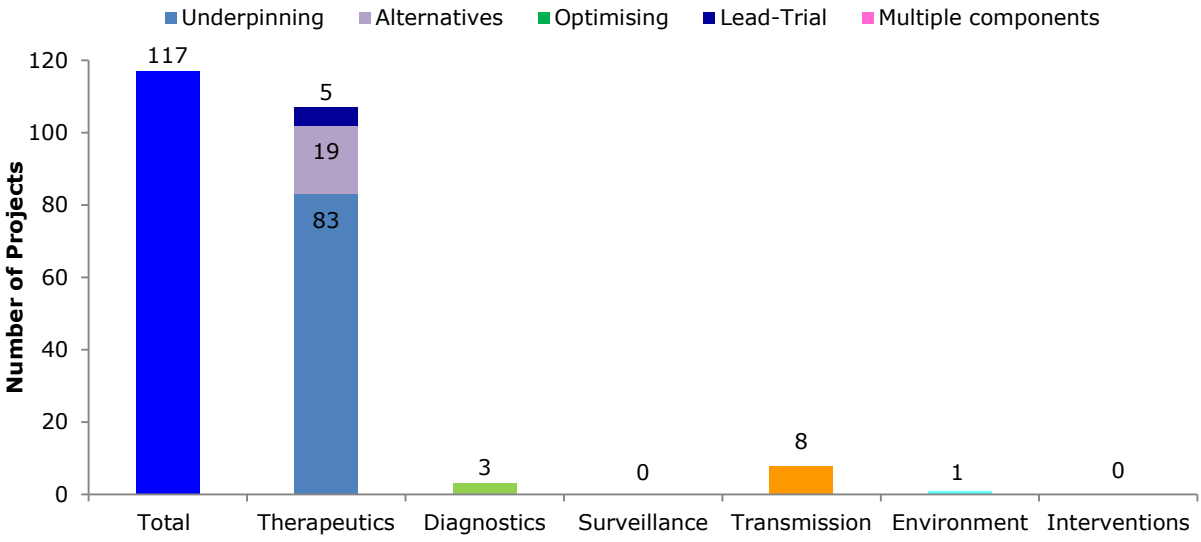


Figure 2: Total number of projects by priority topic: *Totals include national data from Canada from 2007-2013. Some projects are classified under more than one priority topic, hence, the number of projects is duplicated. Priority topic A. therapeutics is sub-classified.*

Commentary:

Organisations providing funding data for the mapping exercise:

- Canadian Institutes of Health Research (CIHR)
- Natural Sciences and Engineering Research Council of Canada (NSERC)

Organisations contacted and did not have data meeting the inclusion criteria:

- Agriculture and Agri-Food Canada
- Health Canada
- Canadian Food Inspection Agency
- The Public Health Agency of Canada
- National Research Council of Canada
- Environment Canada
- Industry Canada
- Genome Canada
- Fonds de recherche du Quebec-Santé (FRQS)

Antimicrobial resistance is complex and cuts across many jurisdictions—federal, provincial, territorial and municipal governments, industry and other stakeholders. Under the Minister of Health, the Government of Canada works to protect Canadians from the risks of increasing antimicrobial resistance. The federal government is leading activities to prevent, limit and control the emergence and spread of antimicrobial resistance in humans, animals and food.

The Canadian Institutes for Health Research, the Public Health Agency of Canada, Health Canada, and the Canadian Food Inspection Agency are the key federal institutions working on antimicrobial resistance from a public health perspective, however there is a significant contribution made by other departments both at the federal and provincial level, as well as substantial support from the industrial and non-governmental sectors.

Provincial and territorial governments are responsible for how antimicrobials are used in healthcare, animal production, the environment, agriculture and veterinary medicine within their jurisdictions. They are involved in public awareness activities, such as education, that support the control of antimicrobial resistance. These governments are also responsible for setting standards and guidelines. Such tasks are often done by working closely with municipalities, professional associations, industry and non-governmental organizations.

Other Canadian organisations not contacted for the mapping exercise:

Provincial:

- BC Centre for Disease Control
- New Brunswick Health Research Foundation
- Alberta Innovates – Health Solutions
- Alberta Department of Health
- British Columbia Department of Health
- Manitoba Department of Health
- New Brunswick Department of Health
- Newfoundland and Labrador Department of Health
- Northwest Territories Department of Health
- Nova Scotia Department of Health
- Nunavut Department of Health
- Ontario Department of Health
- Prince Edward Island Department of Health
- Québec Santé et Services Sociaux
- Saskatchewan Department of Health
- Yukon Department of Health

Industry/NGO/Other:

- Rx&D Health Research Foundation (HRF)
- Association of Medical Microbiology and Infectious Disease Canada
- Canadian Foundation for Infectious Diseases
- Community and Hospital Infection Control Association
- Infection Prevention and Control Canada (IPAC)
- Canadian Association for Clinical Microbiology and Infectious Diseases
- Canadian Patient Safety Institute

Czech Republic:

	Total	A	B	C	D	E	F
Number	10	6	0	0	4	0	0
Investment	€1,690,000	€862,000	0	0	€828,000	0	0

Table 3: Total number of projects and investment by priority topic: *Totals include national data from Czech Republic from 2007-2013 and do not include EU and IMI investment. Number of projects and investment is not duplicated.*

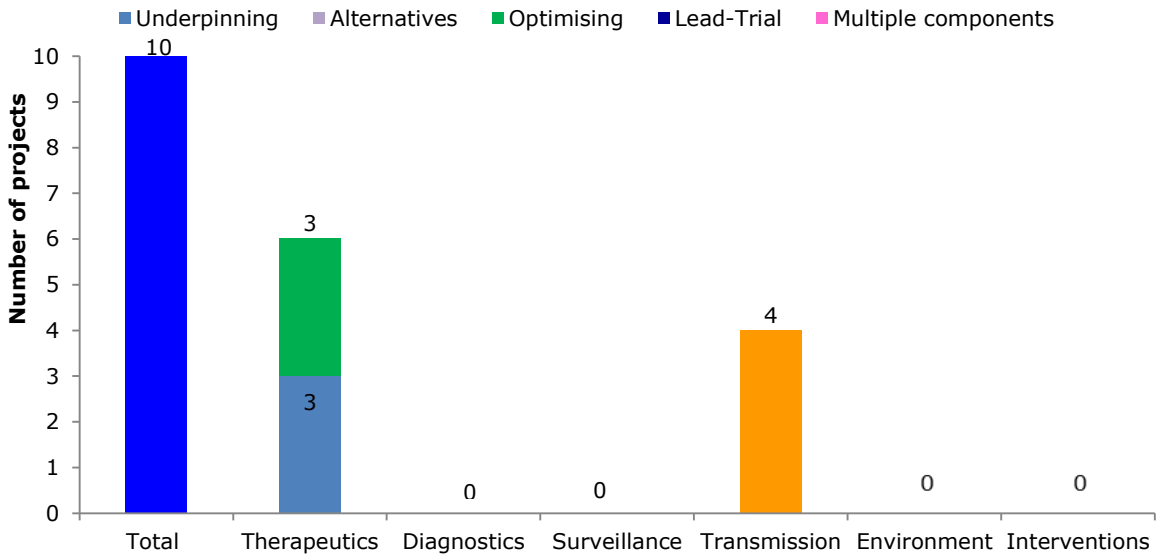


Figure 3: Total number of projects by priority topic: *Totals include national data from the Czech Republic from 2007-2013 and do not include EU and IMI data. Number of projects is not duplicated. Priority topic A. therapeutics is sub-classified.*

Commentary:

Organisations providing funding data for the mapping exercise:

- Internal Grant Agency of Ministry of Health (IGA)
- Czech Science Foundation (GAČR)

Denmark:

	Total	A	B	C	D	E	F
Number	31	26	0	2	4	0	0
Investment	€39,112,774	€37,862,774	0	€273,333	€976,667	0	0

Table 4: Total number of projects and investment by priority topic: *Totals include national data from Denmark from 2007-2013 and do not include EU and IMI investment. Some projects are classified under more than one priority topic, hence, the numbers of projects are duplicated. Investment is not duplicated as a percentage of investment has been assigned to each priority topic in projects crossing more than one priority topic. Some projects were unable to provide funding data, the projects were confirmed as >€100,000 and assigned the baseline amount and hence, the figures are likely to be underestimated.*

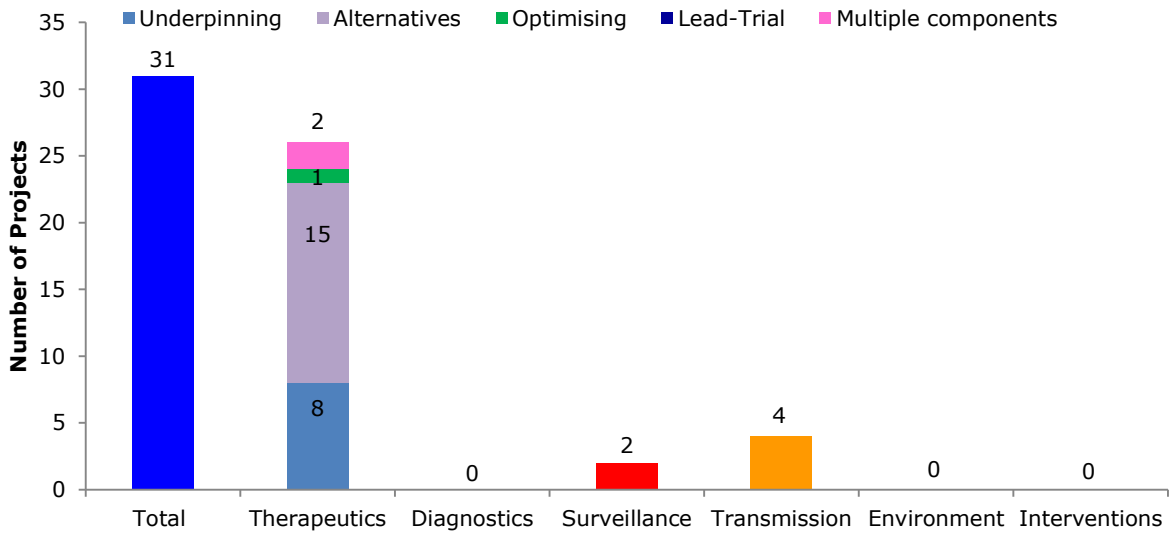


Figure 4: Total number of projects by priority topic: *Totals include national data from Denmark from 2007-2013 and do not include EU and IMI data. Some projects are classified under more than one priority topic, hence, the number of projects is duplicated. Priority topic A. therapeutics is sub-classified.*

Commentary:

Organisations providing funding data for the mapping exercise:

- The Danish Council for Strategic Research
- The Danish Council for Independent Research | Medical Sciences (DFF)

Other sources of ABR funding not included in the mapping exercise:

- Danish Universities and Danish hospitals

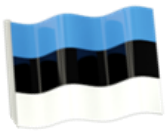
The Danish Council for Strategic Research (from April 01, 2014) seeks to ensure that strategic research in Denmark is organized to meet the challenges facing Danish society. The aim is to ensure Denmark's position as a global frontrunner regarding welfare, wealth and science in the short and long term. "The Programme Commission on Individuals, Disease and Society" is a program under The Danish Council for Strategic Research and is addressing challenges that the Danish healthcare system is facing today and in the future. The commission's field of activity is clinical research and health, prevention and environmental factors – including research on antimicrobial resistance.

The Danish Council for Independent Research | Medical Sciences supports specific research activities based on the initiatives of researchers, and gives scientific advice within the scientific areas of the Council. The Council covers all aspects of both basic scientific-, clinical- and socio-medical research in relation to human health and disease - including research on antimicrobial resistance.

Danish Universities and Danish hospitals also allocate an amount of their annual financing to research on antimicrobial resistance. However, it hasn't been possible to include the research conducted at hospitals and universities in the JPI AMR mapping exercise because there aren't any numbers available for only AMR research in these institutions.

Research councils, Universities and hospitals get their funding directly from the annual budget, which is decided every year in November by the parliament.

The overview provided for the JPIAMR mapping exercise is most likely incomplete for Denmark.



Estonia:

Estonia is currently an observer of the JPIAMR in preparation to become a member.

	Total	A	B	C	D	E	F
Number	11	5	2	1	2	2	0
Investment	€4,366,573	€2,098,984	€894,791	€159,779	€726,177	€486,842	0

Table 5: Total number of projects and investment by priority topic: *Totals include national data from Estonia from 2007-2013 and do not include EU and IMI investment. Some projects are classified under more than one priority topic, hence, the number of projects is duplicated. Investment is not duplicated as a percentage of investment has been assigned to each priority topic in projects crossing more than one priority topic.*

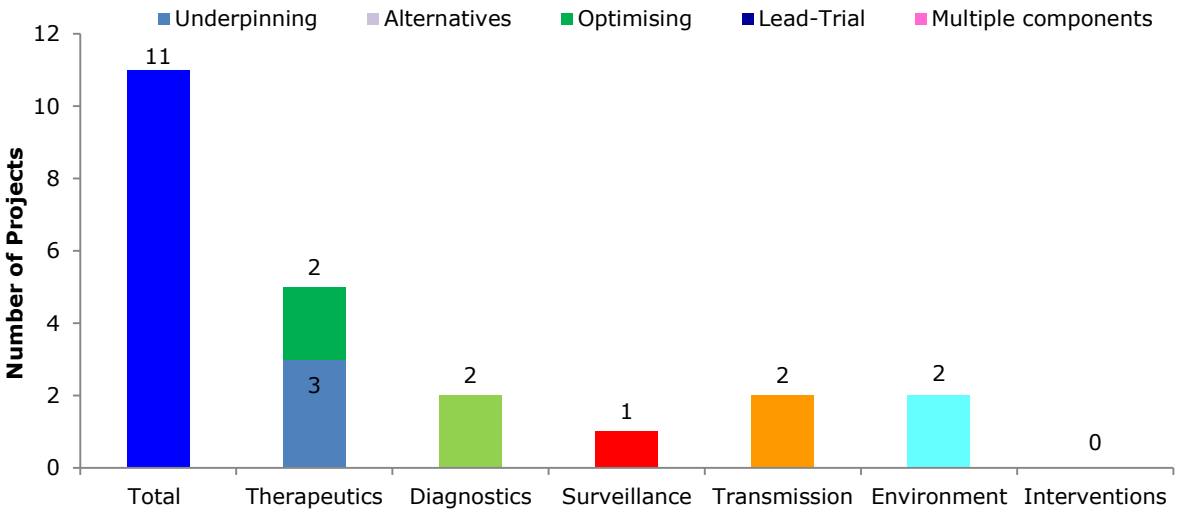


Figure 5: Total number of projects by priority topic: *Totals include national data from Estonia from 2007-2013 and do not include EU and IMI data. Some projects are classified under more than one priority topic, hence, the number of projects is duplicated. Priority topic A. therapeutics is sub-classified.*

Commentary:

ABR related research in Estonia has been mostly funded through the Estonian Research Council (former Estonian Science Foundation) grants and the national research and development programmes.

The relevant Estonian national R&D programmes include:

- *Health promotion research programme TerVE (Estonian Research Council)*
- *Environmental protection and technology programme KESTA (Estonian Research Council)*
- *Biotechnology Programme (Enterprise Estonia)*

ABR research has also been funded through the *Centres of Excellence programme* (Ministry of Education and Research)

However, just to note that certain changes to the funding system are being developed in accordance with the new Estonian Research and Development and Innovation Strategy 2014-2020. Also, in the preparation process for joining JPIAMR, a website has been set up by the University of Tartu to provide an overview of ABR related information and research in Estonia: *https://sisu.ut.ee/amr*

Finland:

	Total	A	B	C	D	E	F
Number	25	24	0	0	1	1	0
Investment	€9,833,724	€9,273,554	0	0	€321,206	€238,964	0

Table 6: Total number of projects and investment by priority topic: *Totals include national data from Finland from 2007-2013 and do not include EU and IMI investment. Some projects are classified under more than one priority topic, hence, the number of projects is duplicated. Investment is not duplicated as a percentage of investment has been assigned to each priority topic in projects crossing more than one priority topic.*

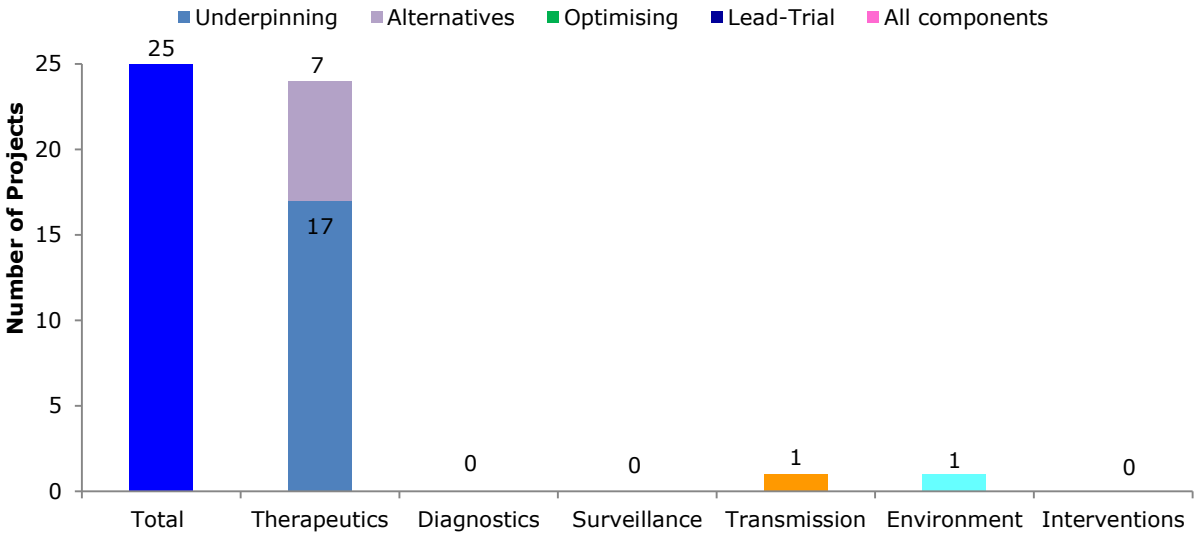


Figure 6: Total number of projects by priority topic: *Totals include national data from Finland from 2007-2013 and do not include EC and IMI data. Some projects are classified under more than one priority topic, hence, the numbers of projects are duplicated. Priority topic A. therapeutics is sub-classified.*

Commentary:

The source for the ABR funding presented is the Academy of Finland, which is a public funding agency for scientific research. A keyword based search was used to list funding that has been directed to ABR research. To date, the Academy has not had any specific research programs or calls directed to ABR research.

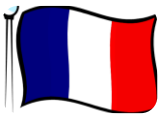
Organisations providing funding data for the mapping exercise:

- Academy of Finland

Other sources of ABR funding (including basic institutional funding) not included in the mapping exercise:

- Tekes, the Finnish Funding Agency for Innovation
- National Institute for Health and Welfare (THL)
- Finnish Food Safety Authority Evira
- Finnish Study Group for Antimicrobial Resistance (FiRe)
- Turku University Medical School

Funding is directed to ABR research also to some degree through private funding organisations, universities, hospitals and health districts. Training of PhDs and post-doctoral fellows also contribute to the field.



France:

	Total	A	B	C	D	E	F
Number	62	38	4	3	13	6	1
Investment	€19,831,032	€12,524,614	€1,417,000	€1,053,000	€3,177,201	€1,359,217	€300,000

Table 7: Total number of projects and investment by priority topic: *Totals include national data from France from 2007-2013 and do not include EU and IMI investment. Some projects are classified under more than one priority topic, hence, the number of projects is duplicated. Investment is not duplicated as a percentage of investment has been assigned to each priority topic in projects crossing more than one priority topic.*

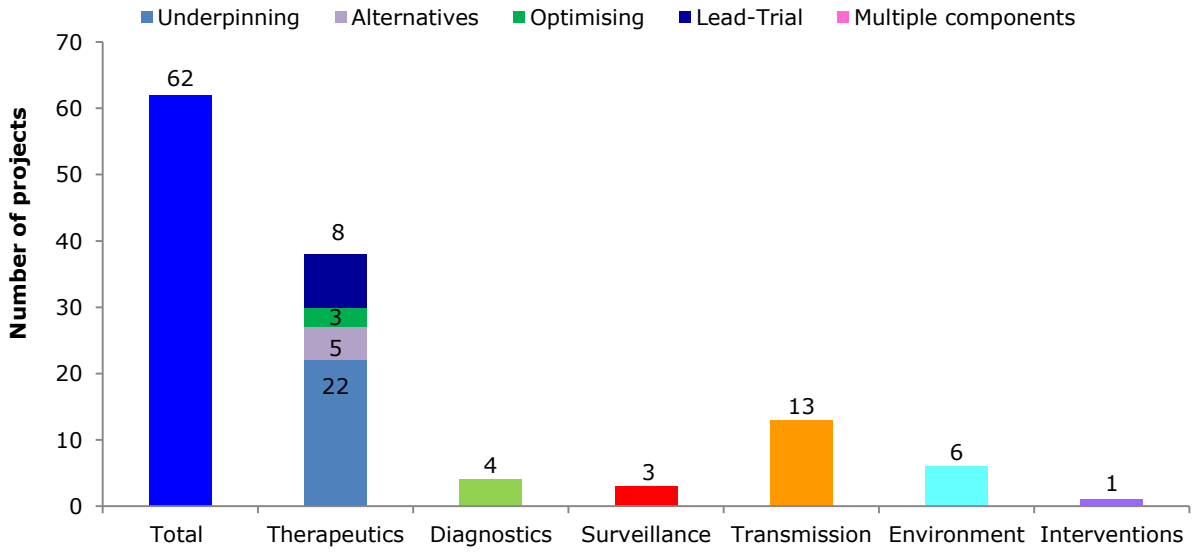


Figure 7: Total number of projects by priority topic: *Totals include national data from France from 2007-2013 and do not include EU and IMI data. Some projects are classified under more than one priority topic, hence, the number of projects is duplicated. Priority topic A. therapeutics is sub-classified.*

Commentary:

French research projects in the area of ABR are funded through the academic sector and research organisations (e.g. INSERM, INRA, ANSES), but also through the French National Research Agency (ANR), the government, regional councils and through associations/foundations.

Organisations providing funding data for the mapping exercise:

- The French National Institute for Agricultural Research (INRA),
- The French Agency for Food, Environmental and Occupational Health and Safety (ANSES),
- The French National Institute of Health and Medical Research (INSERM),
- The French National Research Agency (ANR),
- The Medical Research Foundation (FRM),
- Hospital Clinical Research Program (PHRC),
- The Public Hospitals of Paris (AP-HP),
- The French Ministry of Higher Education and Research,
- The French Ministry of Health,
- Single Inter-ministerial Fund (FUI),
- National Institution of Agricultural and Sea Products (FranceAgrimer),
- The French Alternative Energies and Atomic Energy Commission, Transversal Program, "Security and Non-Proliferation" (CEA)
- Carnot Institute for Animal Health (ICSA),
- Principality of Monaco,
- Association Raoul Follereau,
- Infectiopôle-sud foundation,

Other sources of ABR funding not included in the mapping exercise:

- The French Agriculture Ministry
- Association pour l'Amélioration des Soins en Réanimation Infectieuse (Association for Improving Care in Infectious Resuscitation).
- Vaincre la mucoviscidose (cystic fibrosis association)
  UPMC (Convergence): Pierre and Marie-Curie University

	Total	A	B	C	D	E	F
Number	78	41	21	4	11	3	9
Investment	€59,818,343	€27,814,785	€10,569,595	€2,175,808	€4,279,422	€1,163,675	€13,815,058

Table 8: Total number of projects and investment by priority topic: *Totals include national data from Germany from 2007-2013 and do not include EU and IMI investment. Some projects are classified under more than one priority topic, hence, the number of projects is duplicated. Investment is not duplicated as a percentage of investment has been assigned to each priority topic in projects crossing more than one priority topic.*

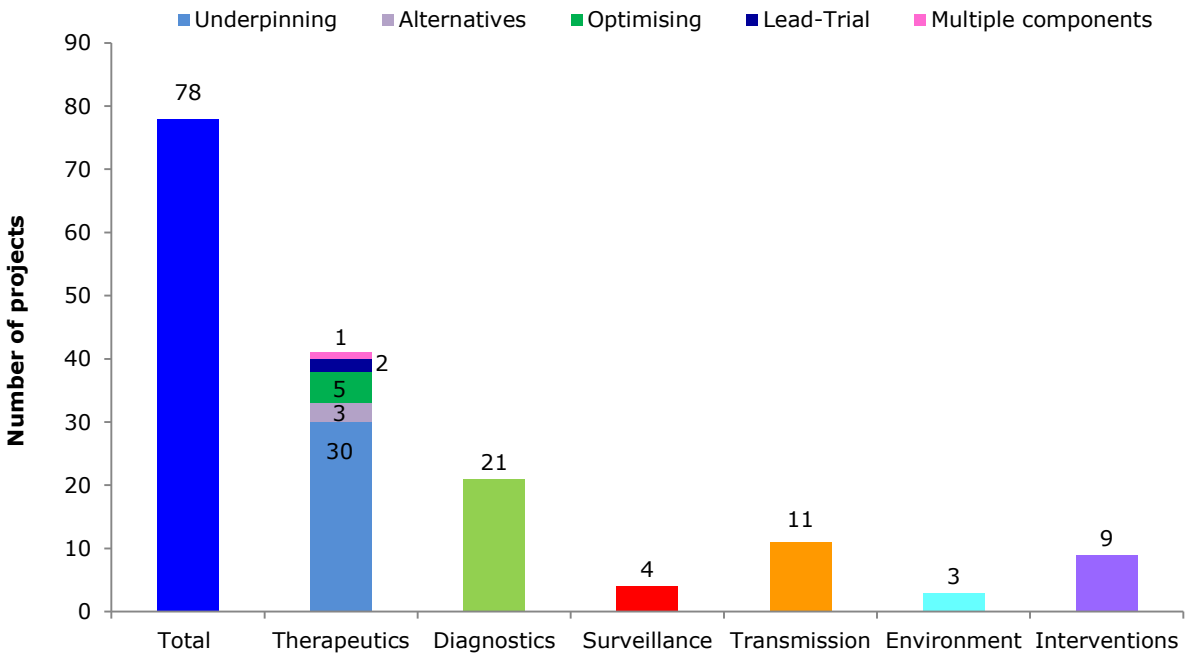


Figure 8: Total number of projects by priority topic: *Totals include national data from Germany from 2007-2013 and do not include EU and IMI data. Some projects are classified under more than one priority topic, hence, the number of projects is duplicated. Priority topic A. therapeutics is sub-classified.*

Commentary:

Organisations providing funding data for the mapping exercise:

- Projektträger Jülich (PtJ)
- Projektträger DLR (PT-DLR)
- Deutsche Forschungsgemeinschaft (DFG)

Due to the high variability and diversity of the German funding structure and policy, not all funded AMR projects could be identified and included in the mapping exercise, in particular DFG funded research. Therefore, investments listed for Germany are underestimated. Germany has an Antimicrobial Resistance Strategy known as DART. The central goal of DART is to reduce and control the spread of antibiotic resistance and nosocomial infections.

Greece:

Greece did not provide any research projects in the area of ABR meeting the JPIAMR mapping exercise inclusion criteria.

Ireland:

	Total	A	B	C	D	E	F
Number	38	28	7	0	4	0	2
Investment	€29,720,670	€10,694,333	€16,161,268	0	€2,296,247	0	€568,824

Table 9: Total number of projects and investment by priority topic: *Totals include national data from Ireland from 2007-2013 and do not include EU and IMI investment. Some projects are classified under more than one priority topic, hence, the number of projects is duplicated. Investment is not duplicated as a percentage of investment has been assigned to each priority topic in projects crossing more than one priority topic.*

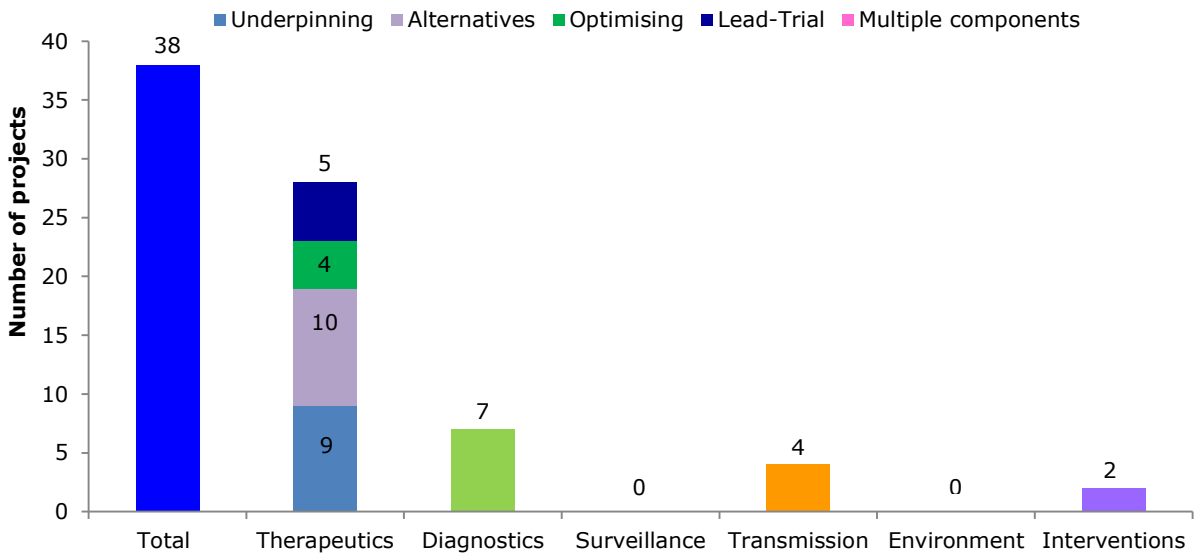


Figure 9: Total number of projects by priority topic: *Totals include national data from Ireland from 2007-2013 and do not include EU and IMI data. Some projects are classified under more than one priority topic, hence, the number of projects is duplicated. Priority topic A. therapeutics is sub-classified.*

Commentary:

Organisations providing funding data for the mapping exercise:

- Science Foundation Ireland (SFI)
- Health Research Board (HRB)
- Department of Agriculture, Food and the Marine
- Teagasc – Due role agency: researcher & funder. No projects from Teagasc have been included in the mapping report. The Teagasc funded components (<€100,000) tend to be parts of projects, co-funded by other Irish and European funding agencies. Recent research in Teagasc has been focused in the area of priority topic A- understanding.

Other agencies funding AMR related research not included in the mapping exercise:

- Irish Research Council
- The Marine Institute
- Environmental Protection Agency (EPA)
- The Irish College for General Practitioners (ICGP)

Therefore, investments listed for Ireland in ABR research could potentially be underestimated.

Israel:

	Total	A	B	C	D	E	F
Number	2	1	0	0	1	0	0
Investment	€307,990	€160,000	0	0	€147,990	0	0

Table 10: Total number of projects and investment by priority topic: *Totals include national data from Israel from 2007-2013 and do not include EU and IMI investment. Number of projects is not duplicated. Investment is not duplicated as a percentage of investment has been assigned to each priority topic in projects crossing more than one priority topic.*

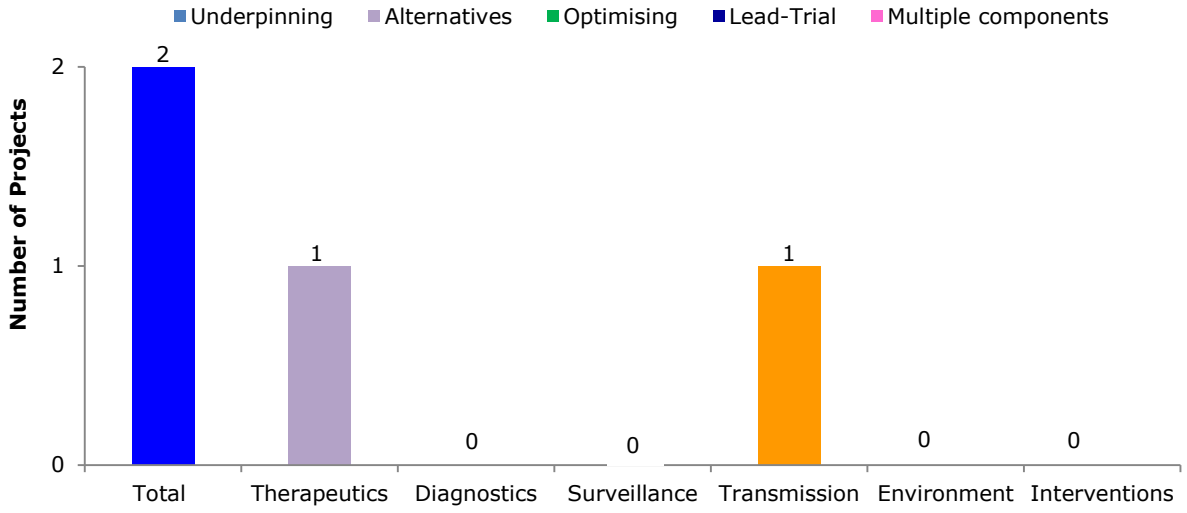


Figure 10: Total number of projects by priority topic: *Totals include national data from Israel from 2007-2013 and do not include EU and IMI data. Number of projects is not duplicated. Priority topic A. therapeutics is sub-classified.*

Commentary:

Funding of ABR research in Israel is mainly under €100,000 per project and most of the funding comes from the EU: therefore, Israel's research portfolio is captured in the EU portfolio.

Organisations providing funding data for the mapping exercise:

- Ministry of Health

Italy:

	Total	A	B	C	D	E	F
Number	27	12	0	5	13	1	1
Investment	€7,140,381	€2,384,911	0	€1,199,500	€2,659,422	€840,000	€56,549

Table 11: Total number of projects and investment by priority topic: *Totals include national data from Italy from 2007-2013 and do not include EU and IMI investment. Some projects are classified under more than one priority topic, hence, the number of projects is duplicated. Investment is not duplicated as a percentage of investment has been assigned to each priority topic in projects crossing more than one priority topic.*

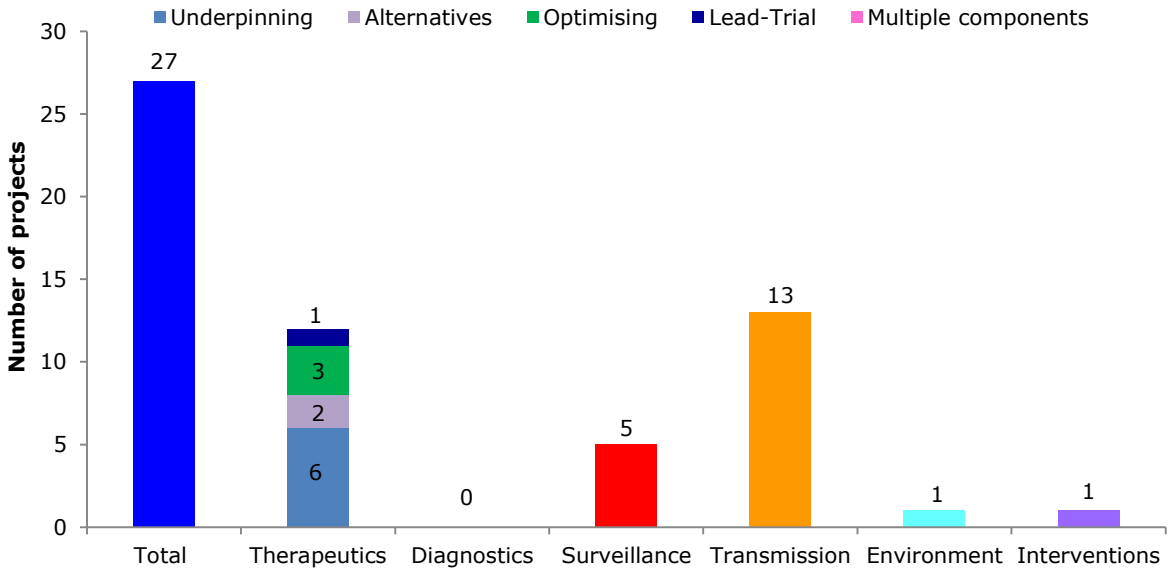


Figure 11: Total number of projects by priority topic: *Totals include national data from Italy from 2007-2013 and do not include EU and IMI data. Some projects are classified under more than one priority topic, hence, the number of projects is duplicated. Priority topic A. therapeutics is sub-classified.*

Commentary:

Organisations providing funding data for the mapping exercise:

- Chief Scientists Office, Ministry of Health (CSO-MOH)

Italian research on antimicrobial resistance is funded for the most part by the Ministry of Health and Ministry of Research and University. The Ministry of Health finances the "AR-ISS" (antibiotic resistance- Instituto Superiore di Sanità), which is the national project of surveillance of antimicrobial resistance, originally the European Antimicrobial Resistance Surveillance System). The study makes use of a network of hospital laboratories distributed throughout the country (including hospitals representative of the national situation) and a central coordination epidemiological and microbiological testing at the National Institute of Health. Annual funding to sustain the networks of surveillance of infectious diseases in the country is provided through the Centro Controllo Malattie, Center for Disease Control of the Ministry of Health.

The "Finalised Research National programme" calls for proposals and projects designed to implement the priorities, biomedical and health services, identified by the National Health Plan. The health research projects are approved by the Minister of Health in consultation with the Ministry of Research and Universities, in order to facilitate their coordination. The proposals are carried out by the Regions, the Institute of Health, the Institute for Prevention and Safety at Work, the Agency for Regional Health Services, Institutes for Research, Hospitalization and Care, both public and private, and the Institutes of Zooprophylactic. It also supports the ERA-NET projects.

The National Research Programme (NRP) is developed by the Government to ensure Italy can be a leader of knowledge in Europe and to promote the coordinated development of research activities. The NRP is the framework for all government departments and bodies in the field of research and innovation and it considers the themes that characterise national search such as ERA- NET, platforms for European technology, the joint technology initiatives, the research driven cluster, public-private partnerships, the JPIAMR, the European innovation platform, and the development of large research infrastructures (ESFRI Roadmap). In the previous years the Ministry of Research and Universities financed AMR projects through basic research and research projects of national interest schemes.

The Netherlands:

	Total	A	B	C	D	E	F
Number	101	37	5	10	39	6	10
Investment	€26,666,006	€12,636,822	€1,714,320	€1,000,000	€8,618,453	€600,000	€2,096,411

Table 12: Total number of projects and investment by priority topic: *Totals include national data from The Netherlands from 2007-2013 and do not include EU and IMI investment. Some projects are classified under more than one priority topic, hence, the number of projects is duplicated. Investment is not duplicated as a percentage of investment has been assigned to each priority topic in projects crossing more than one priority topic. Some projects were unable to provide funding data, the projects were confirmed as >€100,000 and were assigned the baseline amount, hence, the figures are likely to be underestimated.*

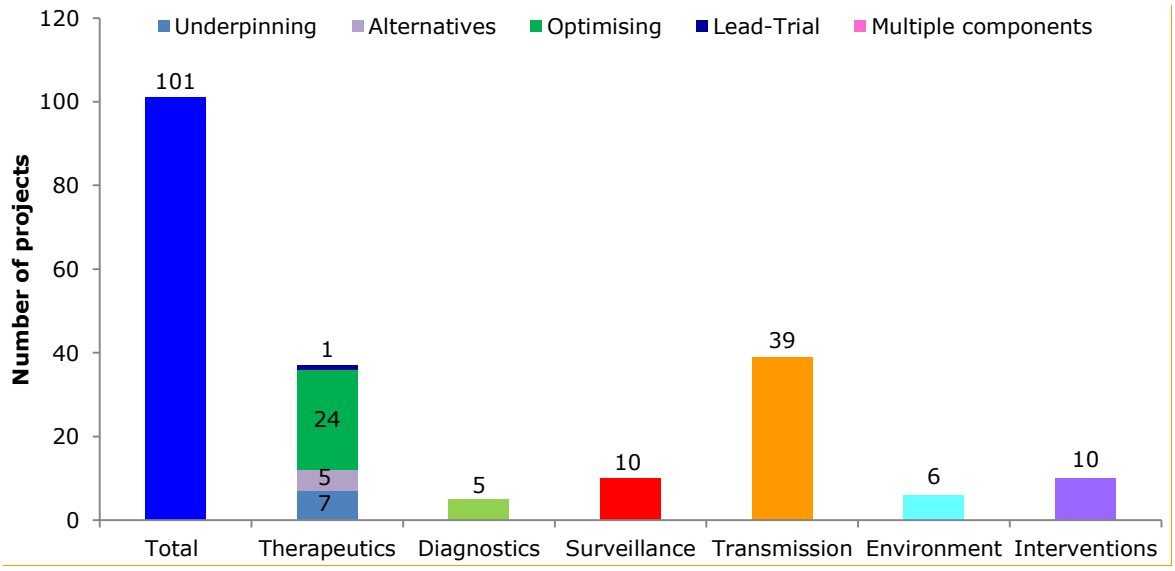


Figure 12: Total number of projects by priority topic: *Totals include national data from the Netherlands from 2007-2013 and do not include EU and IMI data. Some projects are classified under more than one priority topic, hence, the numbers of projects are duplicated. Priority topic A. therapeutics is sub-classified.*

Commentary:

Organisations providing funding data for the mapping exercise:

- The Netherlands Organisation for Health Research and Development (ZonMw)
- Additional desk study conducted (identifying some projects funded via the 3rd mechanism by public organisations)

In the Netherlands funding can be divided in three main mechanisms. In the first mechanism, ('eerste geldstroom') the universities, including the university hospitals, receive funding for research directly from the Ministry of Education, Culture and Science. The funds are allocated through internal procedures and could not be captured in the mapping exercise.

The second mechanism ('tweede geldstroom'), including the NWO (The Netherlands Organisation for Scientific Research) and ZonMw (The Netherlands Organisation for Health Research and Development) divide their funding in a competitive way, mostly via programming. The Priority Medicines Antimicrobial Resistance programme within ZonMw is an example thereof.

The third mechanism ('derde geldstroom') is mainly project driven funding, in which the funding is provided by public and/or private organizations. This means that ministries, provinces, municipalities, research councils, governmental/public bodies like the Healthcare Insurance Board, charity organizations, industry/commercial organizations, healthcare insurers, medical and allied healthcare associations, etc., fund research projects. Sometimes funding is made available via public-private-partnerships. Some examples of funding parties and funding initiatives are the Lung Foundation (charity; Longfonds), the Scientific Programme Indonesia - Netherlands (SPIN) by the Royal Netherlands Academy of Arts and Sciences (KNAW), and the Health Insurers' Innovation Fund (Innovatiefonds Zorgverzekeraars).

Besides funding research by universities and higher education, several ministries fund non-departmental public bodies, such as the National Institute for Public Health and the Environment (RIVM).

Other agencies funding ABR related research not included in the mapping exercise:

- The Netherlands Organisation for Scientific Research (NWO)
- Amongst others, including charities
- An underreporting of projects and initiatives in the 'eerste' and 'derde geldstroom' is suspected, as well as for the domains veterinary and environmental research.

The overview provided for the JPIAMR mapping exercise is most likely incomplete for the Netherlands.

Norway:

	Total	A	B	C	D	E	F
Number	9	6	0	0	4	0	0
Investment	€5,676,000	€3,514,000	0	0	€2,162,000	0	0

Table 13: Total number of projects and investment by priority topic: *Totals include national data from Norway from 2007-2013 and do not include EU and IMI investment. Some projects are classified under more than one priority topic, hence, the number of projects is duplicated. Investment is not duplicated as a percentage of investment has been assigned to each priority topic in projects crossing more than one priority topic.*

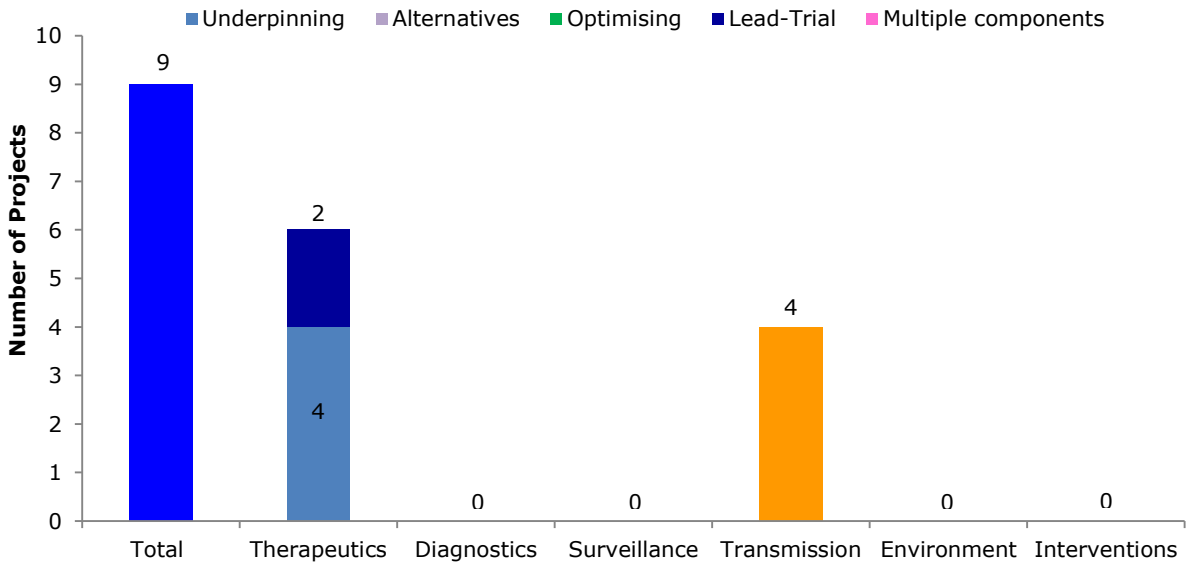


Figure 13: Total number of projects by priority topic: *Totals include national data from Norway from 2007-2013 and do not include EU and IMI data. Some projects are classified under more than one priority topic, hence, the numbers of projects are duplicated. Priority topic A. therapeutics is sub-classified.*

Commentary:

The information presented in the report and the resources currently accessible via the Norwegian database do not give the complete picture for ABR research in Norway and needs to be seen as examples of Norwegian research relevant to JPIAMR only.

Organisations providing funding data for the mapping exercise:

- The Research Council of Norway

Other agencies funding AMR related research not included in the mapping exercise:

- South-eastern Norway Regional Health Authority
- Western Norway Regional Health Authority
- Central Norway Regional Health Authority
- Northern Norway Regional Health Authority

Poland:

	Total	A	B	C	D	E	F
Number	22	14	1	1	6	1	0
Investment	€10,468,610	€8,624,463	€246,425	€635,897	€811,825	€150,000	0

Table 14: Total number of projects and investment by priority topic: *Totals include national data from Poland from 2007-2013 and do not include EU and IMI investment. Some projects are classified under more than one priority topic, hence, the number of projects is duplicated. Investment is not duplicated as a percentage of investment has been assigned to each priority topic in projects crossing more than one priority topic.*

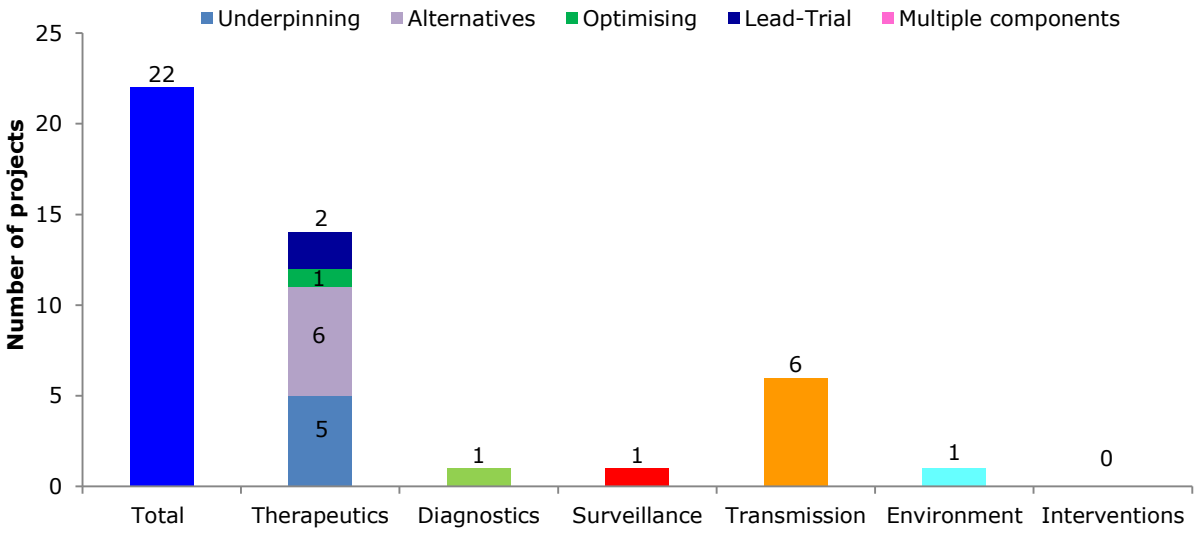


Figure 14: Total number of projects by priority topic: *Totals include national data from Poland from 2007-2013 and do not include EU and IMI data. Some projects are classified under more than one priority topic, hence, the number of projects is duplicated. Priority topic A. therapeutics is sub-classified.*

Commentary:

Organisations providing funding data for the mapping exercise:

- National Centre for Research and Development (NCBR)
- National Science Centre (NCN)

The Ministry of Science and Higher Education is responsible for policy-making and coordinating research activities in Poland, and two executive agencies are responsible for funding research – NCBR for applied research and NCN for basic science.

Public funds are distributed by the funding agencies in a competitive procedure, mostly with top-down approach in NCBR and bottom-up approach in NCN.

ABR research is supported by funding bodies mentioned above, within research programmes or funding schemes offered by the agency, however there is no research programme dedicated to antimicrobial resistance, including antibacterial resistance.

Portugal:

	Total	A	B	C	D	E	F
Number	22	15	0	0	4	4	0
Investment	€3,189,875	€2,200,826	0	0	€484,627	€504,422	0

Table 15: Total number of projects and investment by priority topic: *Totals include national data from Portugal from 2007-2013 and do not include EU and IMI investment. Some projects are classified under more than one priority topic, hence, the number of projects is duplicated. Investment is not duplicated as a percentage of investment has been assigned to each priority topic in projects crossing more than one priority topic.*

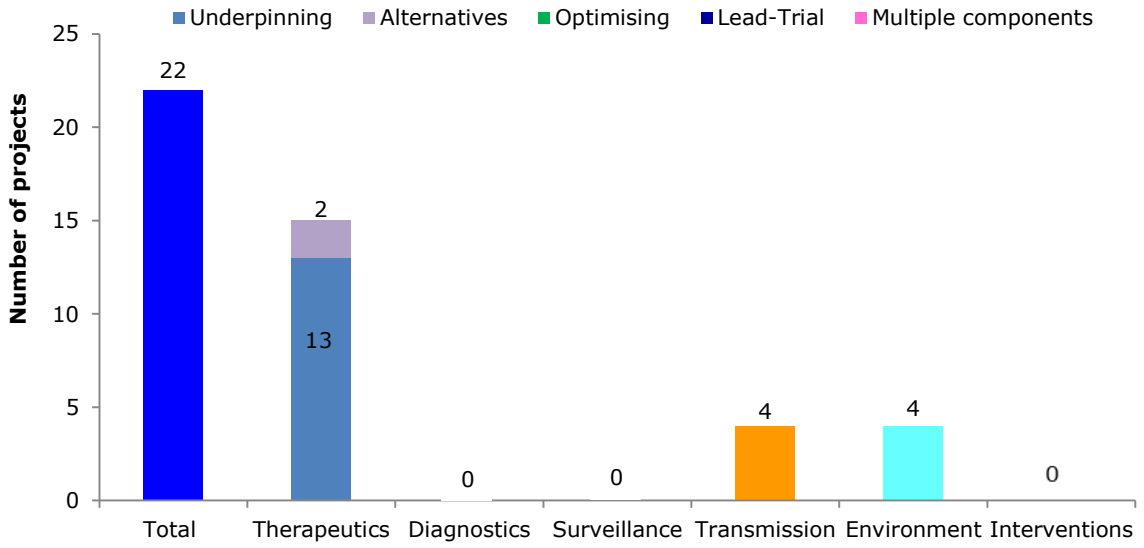


Figure 15: Total number of projects by priority topic: *Totals include national data from Portugal from 2007-2013 and do not include EU and IMI data. Some projects are classified under more than one priority topic, hence, the number of projects is duplicated. Priority topic A. therapeutics is sub-classified.*

Commentary:

Organisations providing funding data for the mapping exercise:

- the Portuguese Foundation for Science and Technology (FCT)

Fundação para a Ciência e a Tecnologia (FCT) is Portugal's main funding agency for research and it is responsible for following the bilateral and multilateral international agreements in science and technology. It is a public autonomous agency under the aegis of the Ministry of Education and Science, covering all scientific domains, in a responsive mode, aiming at capability enhancement and research excellence.

Funding is structured around the following schemes: promotion of training and career development, support of centres of excellence and research centres, support to infrastructure, promotion and development of scientific activity (research projects) and diffusion of scientific culture.

Romania:

	Total	A	B	C	D	E	F
Number	21	17	1	3	1	0	0
Investment	€7,234,254	€ 5,859,254	€500,000	€625,000	€250,000	0	0

Table 16: Total number of projects and investment by priority topic: *Totals include national data from Romania from 2007-2013 and do not include EU and IMI investment. Number of projects is not duplicated. Investment is not duplicated as a percentage of investment has been assigned to each priority topic in projects crossing more than one priority topic.*

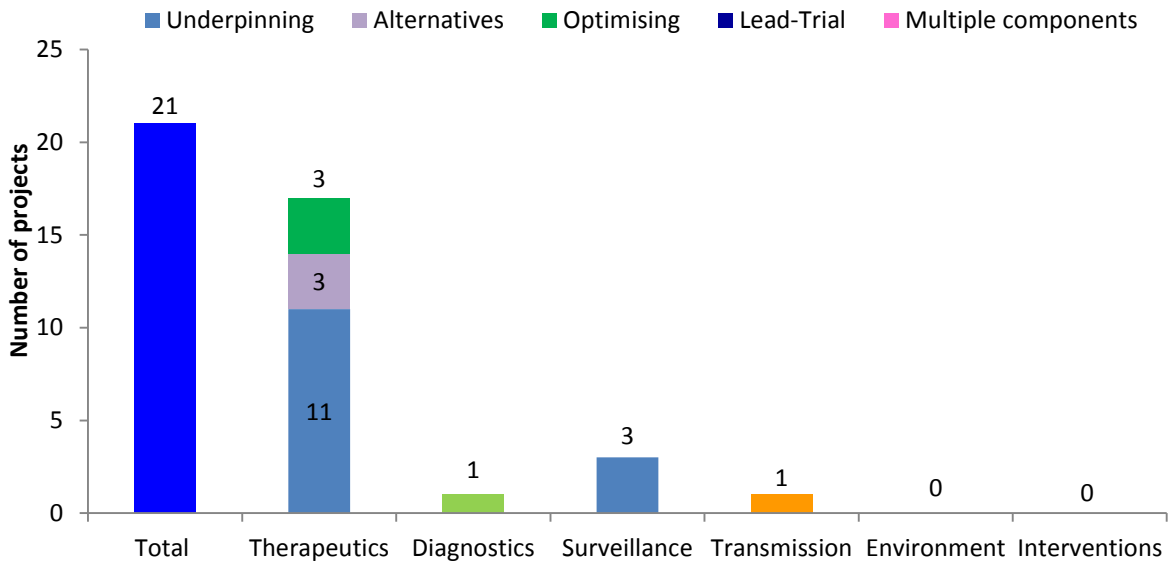


Figure 16: Total number of projects by priority topic: *Totals include national data from Romania from 2007-2013 and do not include EU and IMI data. Number of projects is not duplicated. Priority topic A. therapeutics is sub-classified.*

Commentary:

Organisations providing funding data for the mapping exercise:

- Ministry of National Education, the National Authority for Research, Technological Development and Innovation – www.research.ro

Spain:

	Total	A	B	C	D	E	F
Number	70	53	0	0	21	1	0
Investment	€15,322,133	€11,075,138	0	0	€4,176,795	€70,200	0

Table 17: Total number of projects and investment by priority topic: *Totals include national data from Spain from 2007-2013 and do not include EU and IMI investment. Some projects are classified under more than one priority topic, hence, the number of projects is duplicated. Investment is not duplicated as a percentage of investment has been assigned to each priority topic in projects crossing more than one priority topic.*

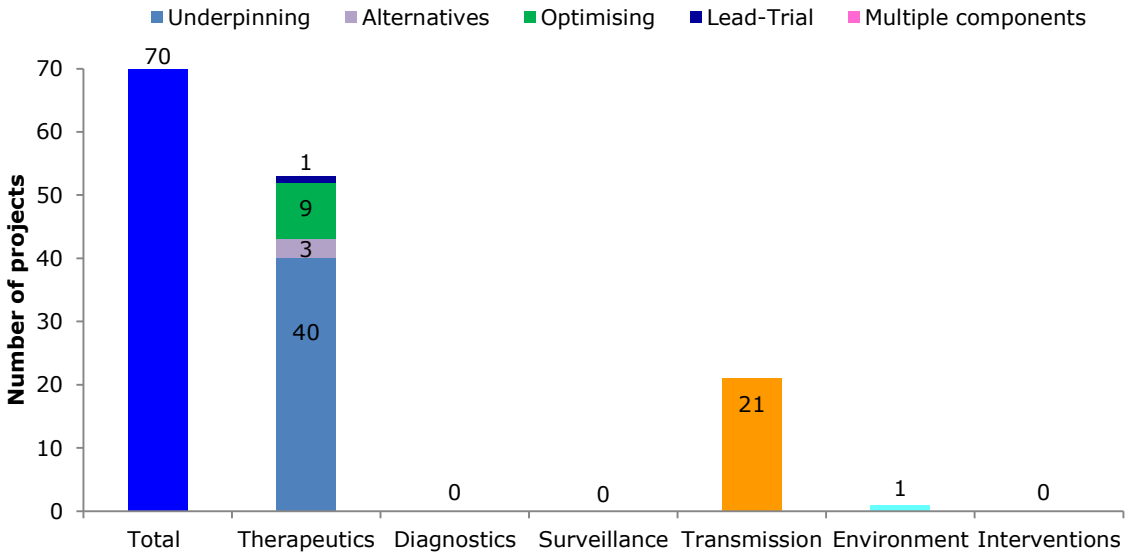


Figure 17: Total number of projects by priority topic: *Totals include national data from Spain from 2007-2013 and do not include EU and IMI data. Some projects are classified under more than one priority topic, hence, the number of projects is duplicated. Priority topic A. therapeutics is sub-classified.*

Commentary:

Organisations providing funding data for the mapping exercise:

- Ministry of Economy and Competitiveness (MINECO)
- National Institute of Health Carlos III (ISCIII)
- Spanish Network for Research in Infectious Diseases (REIPI)

Antimicrobial resistance research in Spain is carried out by Universities and public research organisation. They are funded for the most part by National Programmes managed by the Ministry of Economy and Competitiveness (MINECO), particularly DG Scientific and Technological Research in the field of molecular biology, biotechnology and biomedical research, and through the National Institute of Health Carlos III (ISCIII) mainly within clinical and health sciences research.

ISCIII, a publically funded institute with a budget of €280 M in 2013, performs intramural and extramural activities, has a role in the accreditation of health research institutes, and a regulatory one for bio-banking. The Institute is also responsible for managing Spain's Strategic Action for Health Research and developing the short-to-long term scheme within the National R+D+I Plan framework.

In addition, Regional Governments allocate funds for research, infrastructures, and training and career development, especially to Universities and regional research centres.

The figures presented in the mapping exercise are representative of research projects in the field of ABR; in addition, there is a significant contribution to ABR research funding provided by National Programmes managed by MINECO for training, mobility and career development, including PhDs and, postdoctoral fellowships and senior researcher's recruitment programme. The funding regarding these programmes was not included in the mapping exercise.

The funding for research projects is allocated through annual bottom up competitive calls, based on scientific assessment and strategic and impact assessment through a peer review evaluation process.

Sweden:

	Total	A	B	C	D	E	F
Number	60	40	7	0	9	9	5
Investment	€39,751,321	€26,746,037	€2,940,360	0	€2,018,452	€5,886,593	€2,159,879

Table 18: Total number of projects and investment by priority topic: *Totals include national data from Sweden from 2007-2013 and do not include EU and IMI investment. Some projects are classified under more than one priority topic, hence, the number of projects is duplicated. Investment is not duplicated as a percentage of investment has been assigned to each priority topic in projects crossing more than one priority topic.*

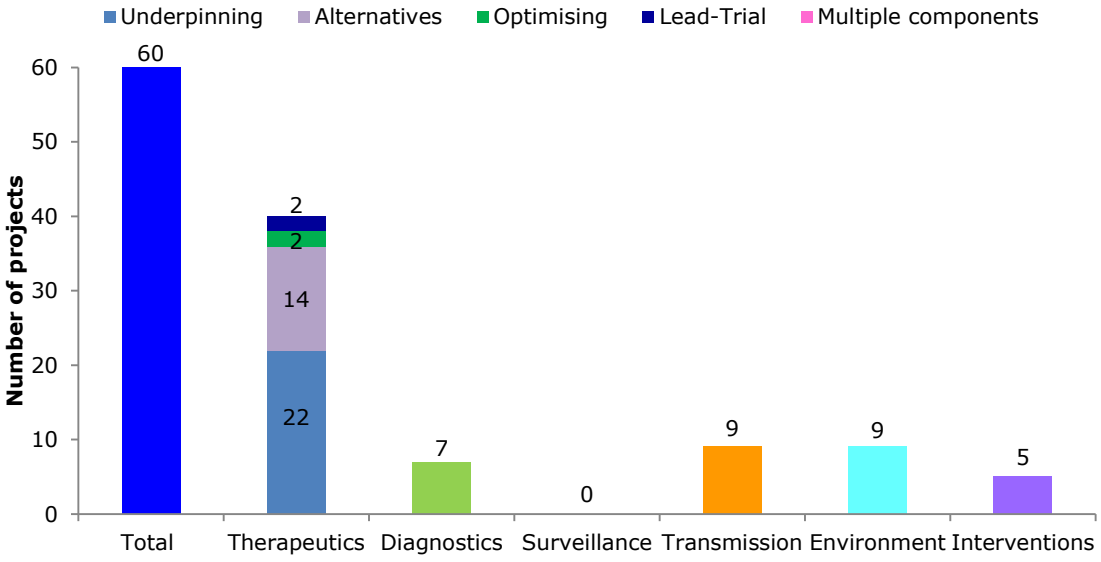


Figure 18: Total number of projects by priority topic: *Totals include national data from Sweden from 2007-2013 and do not include EU and IMI data. Some projects are classified under more than one priority topic, hence, the number of projects is duplicated. Priority topic A. therapeutics is sub-classified.*

Commentary:

Organisations providing funding data for the mapping exercise:

- Swedish Research Council (SRC)
- VINNOVA
- Forte
- Formas
- Swedish foundation for strategic research (SSF)

Swedish basic and applied medical research is primarily funded by the SRC. Formas contributes when there is an environmental or agricultural angle and Forte supports research concerning health, working life and welfare. SSF has the objective to support research in natural science, engineering and medicine that strengthens Sweden's competitiveness. VINNOVA is Sweden's innovation agency and promotes collaborations between companies, universities, research institutes and the public sector. In addition there is a significant contribution from the research charity sector, typically directed towards specific disease areas.

The reported Swedish ABR research funding reflects project grants with a clear ABR coupling awarded by the five funding agencies listed above. This distinction was made using keyword search and not by any pre-categorisation or program affiliation. What is not represented is all basic institutional funding that is not awarded to specific projects as is the case with all countries included in this exercise.

	Total	A	B	C	D	E	F
Number	15	9	1	0	2	3	0
Investment	€4,434,068	€2,928,331	€334,841	0	€245,889	€925,008	0

Table 19: Total number of projects and investment by priority topic: *Totals include national data from Switzerland from 2007-2013 and do not include EU and IMI investment. Number of projects and investment is not duplicated.*

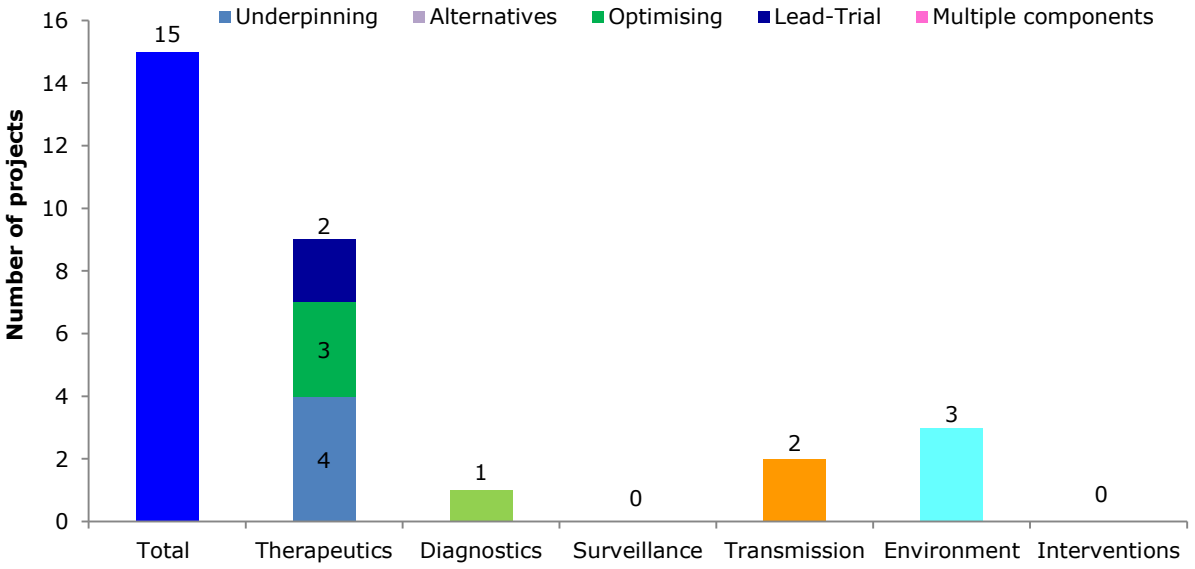


Figure 19: Total number of projects by priority topic: *Totals include national data from Switzerland from 2007-2013 and do not include EU and IMI data. Number of projects is not duplicated. Priority topic A. therapeutics is sub-classified.*

Commentary:

Organisations providing funding data for the mapping exercise:

- Swiss National Science Foundation (SNSF)

The Swiss National Science Foundation (SNSF) is Switzerland's foremost research funding organisation. Mandated by the federal government, the SNSF supports basic science in all academic disciplines, from history to medicine and the engineering sciences.

To ensure its independence, the SNSF was established as a private foundation in 1952. Its core task is the evaluation of research proposals. Every year, the SNSF awards approximately CHF 750 million to outstanding researchers. By awarding public research money based on a competitive system, the SNSF contributes to the high quality of Swiss research. Research on antimicrobial resistance is covered by the SNSF through project funding (division III of the SNSF). Swiss researchers can apply by submitting their project applications twice a year (1 April & 1 October).

Turkey:

	Total	A	B	C	D	E	F
Number	1	0	0	0	0	1	0
Investment	€153,012	0	0	0	0	€153,012	0

Table 20: Total number of projects and investment by priority topic: *Totals include national data from Turkey from 2007-2013 and do not include EU and IMI investment.*

Commentary:

Organisations providing funding data for the mapping exercise:

- The Scientific and Technological Research Council of Turkey (TUBITAK)

The Scientific and Technological Research Council of Turkey is the main research funder in Turkey, however, several Ministries also support research and innovation projects. The data in this exercise consists of the research projects supported by TUBITAK only and only one project met the inclusion criteria, largely due to the baseline investment required of ≥€100,000.

The Turkish Ministry of Development provides funds for infrastructure, although there is no specific programme directed to AMR, the funds are available for all types of research projects. http://www.mod.gov.tr/

The Ministry of Health has set a National AMR Surveillance System that operates according to the European Committee on Antimicrobial Susceptibility Testing standards. http://uamdss.thsk.gov.tr/ The MoH's strategic agenda includes piloting studies on AMR research. http://www.saglik.gov.tr/EN/

The Ministry of Food, Agriculture and Livestock (MoFAL) has set a regulation to follow up zoonosis, antimicrobial resistance and outbreaks, which supports epidemiological research within these areas. This regulation enables the Ministry to set infection prevention and control policies. The Ministry is also in charge of funding a database on zoonosis. The Ministry has set research on AMR as a priority topic in 2014. The Ministry of Health and the MoFAL work together to study human samples, livestock and food samples epidemiologically and to detect AMR rates. http://www.tarim.gov.tr/

The United Kingdom:

	Total	A	B	C	D	E	F
Number	433	296	86	9	44	2	27
Investment	€323,265,383	€198,249,551	€70,637,553	€17,415,768	€19,912,541	€505,270	€16,544,699

Table 21: Total number of projects and investment by priority topic: *Totals include national data from the United Kingdom from 2007-2013 and do not include EU and IMI investment. Some projects are classified under more than one priority topic, hence, the number of projects is duplicated. Investment is not duplicated as a percentage of investment has been assigned to each priority topic in projects crossing more than one priority topic.*

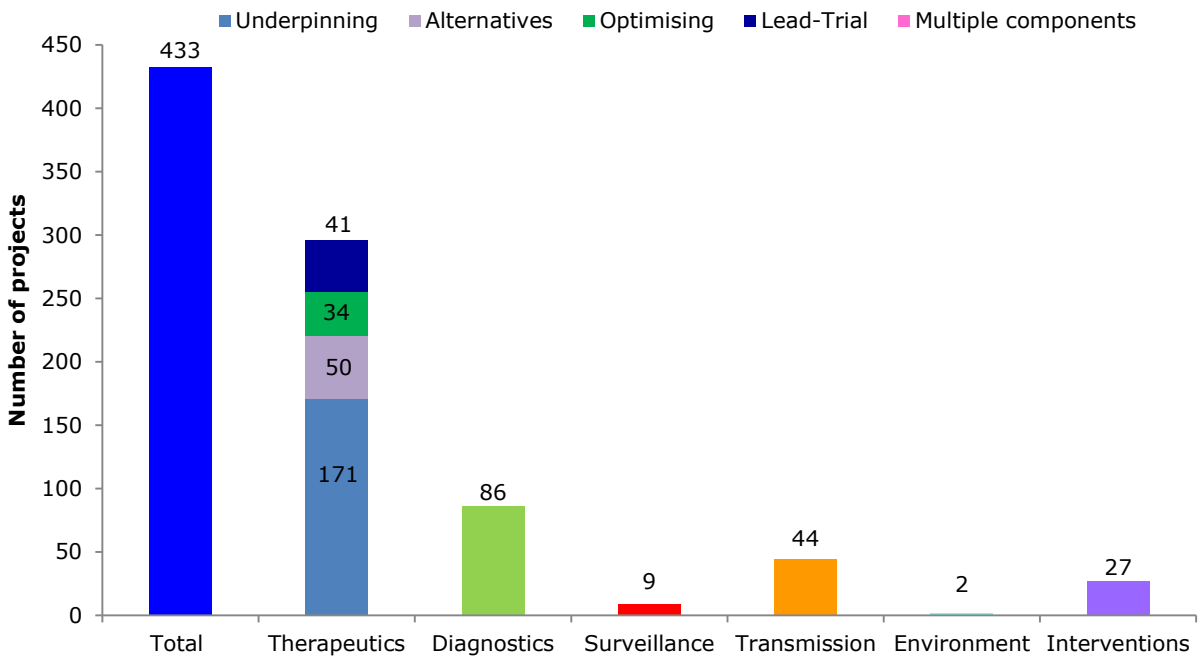


***Figure 20**: **Total number of projects by priority topic:** Totals include national data from the United Kingdom from 2007-2013 and do not include EU and IMI data. Some projects are classified under more than one priority topic, hence, the number of projects is duplicated. Priority topic A. therapeutics is sub-classified.*

Commentary:

Organisations providing funding data for the mapping exercise:

- Department of Health (DH)/NIHR
- Biotechnology and Biological Sciences Research Council (BBSRC)
- Engineering and Physical Sciences Research Council (EPSRC)
- Medical Research Council (MRC)
- Natural Environment Research Council (NERC)
- Technology Strategy Board (TSB)
- Department for Environment, Food and Rural Affairs (DEFRA)
- Wellcome Trust
- Food Standard Agency (FSA)

UK biomedical, health, veterinary and socio-economic research is funded for the most part through the academic sector in Universities, centres and NHS Trusts. The major funders are the Research Councils (MRC, BBSRC, EPSRC, and NERC), and Innovate UK (formally TSB) through central Government but with operational independence, and the devolved UK Health Departments, with the largest being the NIHR funding stream of the Department of Health (England) and DEFRA largely focusing on the veterinary sector and the FSA focusing on food safety. This exercise captured the extramural funding within these organisations but they may also fund ABR research via their intramural investments.

In addition, there is a significant contribution from the research charity, the Wellcome Trust. In addition to the projects captured in this exercise, the Trust also supports research into AMR through core funding of five Major Overseas Programmes, in Kenya, Thailand and Laos, Malawi, South Africa and Vietnam, and at the Wellcome Trust Sanger Institute.

The figures presented for the UK are representative of research specifically related to antibacterial resistance. However, substantive funding is provided through the UK Research Councils and Department of Health for more generic biology and infectious disease research supportive of this research domain that has not been captured by this exercise, including funding from additional research councils, STFC and ESRC.

Other agencies funding ABR related research not included in the mapping exercise:

- British Society for Antimicrobial Chemotherapy (BSAC)
- Healthcare Infection Society (HIS)
- The Royal Society
- Action Medical Research
- Scottish Enterprise
- Other UK based charities

The European Union Agencies:

	Total	A	B	C	D	E	F
Number	105	71	13	16	18	4	8
Investment	€314,072,980	€197,432,615	€38,266,222	€8,517,341	€42,683,210	€5,943,072	€21,230,520

Table 21: Total number of projects and investment by priority topic: *Totals include data from European Union Agencies (including FP 6, FP 7, DG- SANCO, and ECDC) from 2007-2013. The figures do not include DG Research's contribution to IMI. Some projects are classified under more than one priority topic, hence, the number of projects is duplicated. Investment is not duplicated as a percentage of investment has been assigned to each priority topic in projects crossing more than one priority topic.*

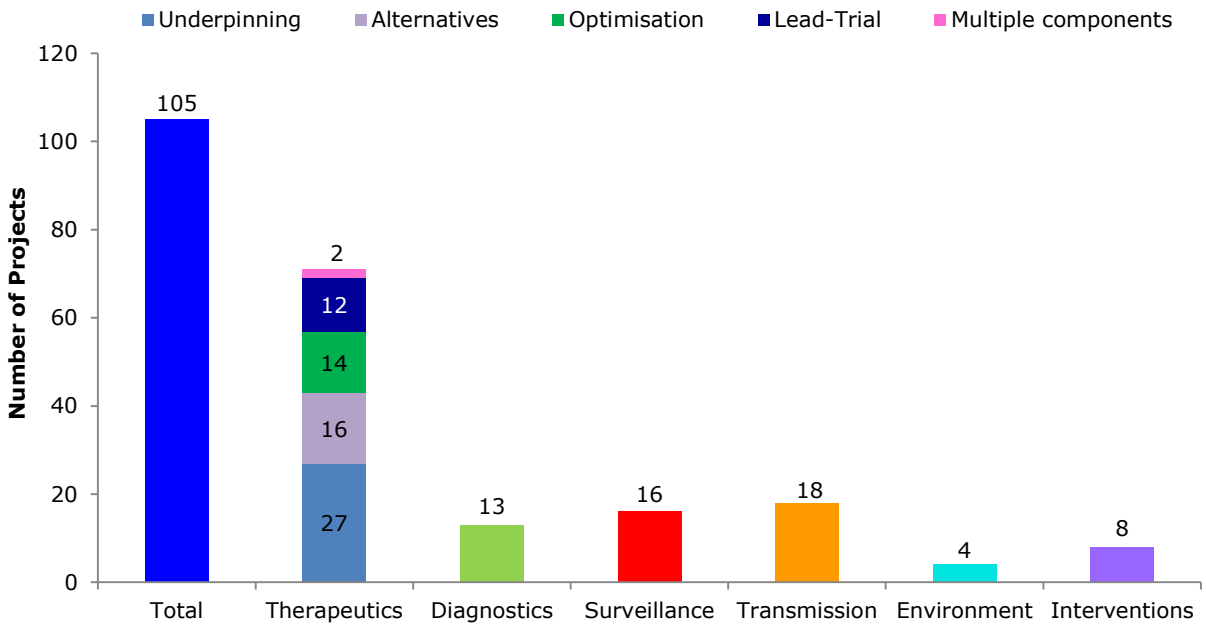


Figure 20**: **Total number of projects by priority topic:
Totals include data from European Union Agencies including FP 6, FP 7, ERC, DG-SANCO, and ECDC from 2007-2013 and do not include IMI projects. Some projects are classified under more than one priority topic, hence, the number of projects is duplicated. Priority topic A. therapeutics is sub-classified.

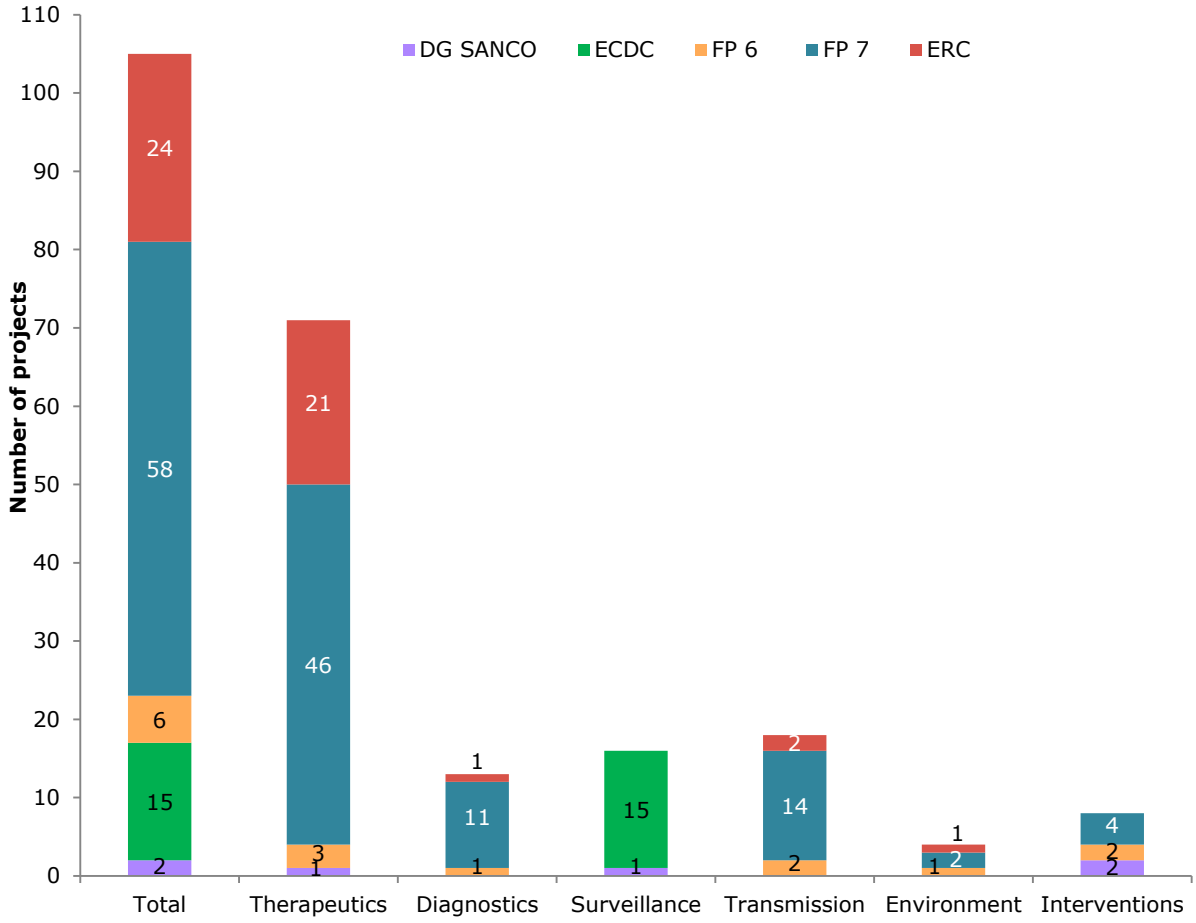


Figure 21: Total number of projects by priority topic per Agency:

Totals include data from European Union Agencies broken down by FP 6, FP 7, ERC, DG-SANCO, and ECDC from 2007-2013. These figures do not include IMI projects. Some projects are classified under more than one priority topic, hence, the number of projects is duplicated.

Commentary:

Data included in the mapping exercise:

- Directorates- General Research and Innovation (DG Research)
- Sixth Framework programme (FP 6)
- Seventh Framework Programme (FP 7)
- European Research Council (ERC)
- Directorates-General Health and Consumers (DG SANCO)
- European Centre for Disease Prevention and Control (ECDC)
- Innovative Medicines Initiative (IMI)

The figures presented in the analyses above (*Section 3.2.2*) relates to Directorates-General Research and Innovation (DG- Research) funding under the 6th and 7th Framework Programme including projects supported by the European Research Council from January 1, 2007. In addition, projects funded under the Directorates-General Health and Consumers (DG-SANCO) and European Centre for Disease Prevention and Control (ECDC) are also included in this mapping exercise.

Figures exclude funding for training (e.g. fellowships) and for research infrastructure (e.g. buildings, facilities) unless specifically embedded within large grants and could not specifically be disbanded.

Additional research that is relevant to this area and supported by the European Union Agencies but not included in the mapping exercise on bacterial resistance includes, in-house activities (particularly relevant to ECDC), underpinning bacteriology, and research on viruses, fungi and protozoa and the development of resistance in these organisms. Although vaccination may have a significant impact on reducing the use of antibiotics and is included in the mapping exercise, few vaccine research projects have been identified and included and therefore, this area is underrepresented in the EU level portfolio.

In addition, DG- Research contributes 50% of investment within the Innovative Medicines Initiative (IMI) research programme 1 along with a matched (mainly in-kind) contribution from the European Federation of Pharmaceutical Industries and Associations (EFPIA). These IMI funded projects are included in a separate analysis above (*Section 3.2.3*).

Colour Code:

Priority Topic	Colour Code
Total	
A. Therapeutics	
B. Diagnostics	
C. Surveillance	
D. Transmission	
E. Environment	
F. Interventions	

Priority Topic A.	Colour Code
I. Underpinning	
II. Alternatives	
III. Optimising	
IV. Lead-Trial	
V. Multiple Components	
Optimising & Lead- Trial	