D5.2: Second version of the guidelines on monitoring and measuring medical deserts

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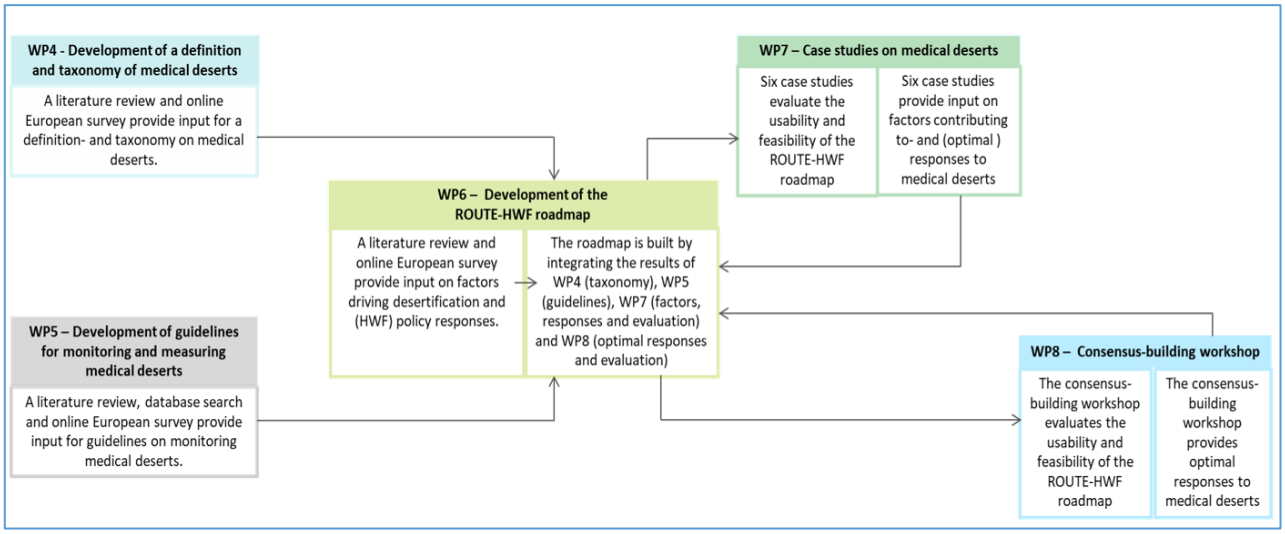
1. Introduction

The aim of this Deliverable 5.2, which is the second deliverable of Work Package 5, is to provide a second version of guidelines on measuring and monitoring medical deserts at national and subnational levels. The guidelines are designed to help public authorities and health professionals to gain a better understanding of (1) the origin and development of medical deserts, (2) how to monitor them, and (3) how to investigate and evaluate the effects of health workforce (HWF) policy measures to mitigate or eliminate medical deserts which is now often lacking (Ono et al., 2014). The ultimate goal of the guidelines is to provide a practical set of tools and data sources that contribute to an improved measurement system for medical deserts across Europe.

Together with the definition and taxonomy (as developed in Work Package 4), the measuring and monitoring guidelines will feed into the creation of the 'Roadmap out of medical deserts' that will be created in Work Package 6. The interplay between the definition and taxonomy, measuring and monitoring guidelines and the ROUTE-HWF roadmap is presented in Figure 1 below, along with the corresponding Work Packages (WPs) and methods of data collection and stakeholder engagement.

Figure 1. The interplay between the ROUTE Work Packages on the definition and taxonomy, measuring and monitoring guidelines, that feed into the ROUTE-HWF roadmap on medical deserts



This second deliverable of Work Package 5 (the second version of guidelines for monitoring and measuring medical deserts) will be followed by deliverables 5.3 that will be published later on in the ROUTE-HWF project. Deliverable 5.3 will provide a third version of the monitoring and measuring guidelines based on six country case studies and the final event during which the guidelines will be presented to stakeholders and feedback received.

By connecting the measuring and monitoring guidelines with the definition and taxonomy of medical deserts (in parallel provided in Deliverable 4.2), the project is paving the way towards creating the ROUTE-HWF roadmap out of medical deserts. The ROUTE-HWF roadmap will support EU Member States in a tailored manner, i.e., supporting them to design and implement specific policies related to specific types of medical deserts. It will provide a rationale for public authorities and health professionals at national and subnational levels to apply an optimal mix of HWF policies to their particular medical deserts – taking the context-sensitivity of these polices and medical deserts into account. The final goal is to mitigate the effects of medical

deserts and dissolving these, and hence to improve access to healthcare as well as quality of healthcare for citizens living in these areas, now and in the future.

2. From the first to the second version of the ROUTE-HWF taxonomy

This second set of guidelines on measuring and monitoring medical deserts builds upon the first version of the ROUTE-HWF taxonomy of medical deserts (see Deliverable 4.1 and Deliverable 5.1). The first version of the taxonomy is based on four dimensions or elements that jointly drive the process of desertification. The four elements concern two factors that drive the demand for health services in medical desert regions:

1. Aging of the population
2. Poor economic resources of the population

And two factors that drive the supply of health services in medical desert regions:

3. Shortages of healthcare workers
4. Lower accessibility of health services.

These four elements were subsequently operationalized into four dichotomous 'objects', each defining two exclusive and relative scores that regions within a country can obtain:

Ad 1: The proportion of inhabitants aged 65 and over living in the geographic area of interest is *higher* than this proportion of all inhabitants aged 65 and over in the country ('true/false');

Ad 2: The proportion of inhabitants below the poverty line living in the geographic area of interest is *higher* than this proportion of all inhabitants below the poverty line living in the country ('true/false');

Ad 3: The health professional-to-population ratio in the geographical area, is lower than this ratio in the country ('true/false');

Ad 4: The average travel time by public transport to the nearest public healthcare facility in the geographic area of interest is *longer* than the average travel time at the national level within the country ('true/false').

Combining the four objects resulted into a set of 15 unique types of medical deserts as depicted in figure 2 below:

Figure 2. First version of the ROUTE-HWF taxonomy to define and classify 15 different types medical deserts by four objects ('x' in the cells indicate that the object is 'true' or applicable for the specific type of medical desert area/region)

	DEMAND FOR HEALTH SERVICES – POPULATION AND HEALTHCARE DEMAND OBJECTS		**SUPPLY OF HEALTH SERVICES – AREA AND HEALTHCARE SUPPLY OBJECTS**	
	Object 1: Percentage population aged 65 and over	**Object 2: Economic resources of the population**	**Object 3: Population-provider ratio**	**Object 4: Travel time to public health facilities by public transport**
Type of medical desert	*The proportion of inhabitants aged 65 and over living in this area, is higher than this proportion of all inhabitants in the country*	*The proportion of inhabitants below the poverty line living in this area, is higher than this proportion of all inhabitants in the country*	*The health professional-to-population ratio in this area, is lower than this ratio in the country*	*The average travel time by public transport to the nearest public healthcare facility in this area is longer than the average travel time at the national level of the country*
↓				
1	x	x	x	x
2	x	x	x	
3	x	x		x
4	x		x	x
5		x	x	x
6	x	x		
7	x		x	
8	x			x
9		x	x	
10		x		x
11			x	x
12	x			
13		x		
14			x	
15				x

In Deliverable 4.2, it is described how the number of medical deserts are reduced to make the first version taxono/my more concise, comprehensive and empirically applicable. It was argued that the medical desert types 6 to 15 (in Figure 2 above) are less relevant to consider, because it is the accumulation of multiple objects that drive the process desertification (and hence to identify and classify medical deserts). As an implication, in D4.2 it is argued that a relevant type of medical desert should be defined by at least three of the four defining objects. This way, a medical desert type is defined by at least one object regarding the demand side, and at least one object regarding the supply side of the (regional) health service system. Applying this to the first version of the ROUTE-HWF taxonomy, logically rules out ten of the fifteen types of medical deserts leaving 5 types. The resulting five types of medical deserts (i.e. the second version of the ROUTE-HWF taxonomy) are shown in figure 3.

Figure 3. Second version of the ROUTE-HWF taxonomy to define and classify 5 'main' different types medical deserts by four objects/dimensions ('x' in the cells indicate that the object is 'true' or applicable for the specific type of medical desert area/region)

	DEMAND FOR HEALTH SERVICES – POPULATION AND HEALTHCARE DEMAND OBJECTS		SUPPLY OF HEALTH SERVICES – AREA AND HEALTHCARE SUPPLY OBJECTS	
	Object 1: Percentage population aged 65 and over	**Object 2: Economic resources of the population**	**Object 3: Population-provider ratio**	**Object 4: Travel time to public health facilities by public transport**
Type of medical desert	*The proportion of inhabitants aged 65 and over living in this area, is higher than this proportion of all inhabitants in the country*	*The proportion of inhabitants below the poverty line living in this area, is higher than this proportion of all inhabitants in the country*	*The health professional-to-population ratio in this area, is lower than this ratio in the country*	*The average travel time by public transport to the nearest public healthcare facility in this area is longer than the average travel time at the national level of the country*
↓				
1	x	x	x	x
2	x	x	x	
3	x	x		x
4	x		x	x
5		x	x	x

3. Can international data sources be used to measure and monitor the second version of the ROUTE-HWF taxonomy of medical deserts?

Introduction

While the second version of the ROUTE-HWF taxonomy defines five instead of 15 types of medical deserts, its empirical application remains to be based on the four objects as recalled in the previous section:

1. Measuring the **'aging of the population'** by the proportion of inhabitants aged 65 living in this area, compared to this proportion of all inhabitants in the country;
2. Measuring **'economic resources of the population'** by the proportion of inhabitants below the poverty line living in this area, compared to this proportion of all inhabitants in the country;
3. Measuring '**population-provider ratio'** by the health professional-to-population ratio in this area, compared to that ratio in the country;
4. Measuring **'accessibility of health facilities'** by the average travel time by public transport to the nearest public healthcare facility in this area, compared to the average travel time at the national level of the country.

In this Deliverable, we explore the applicability of international data sources at the regional level to (1) execute the measurement of the four taxonomy objects, and (2) to compare European country/regional statistics on these objects. This concerns an actual (but also *limited*) application of our second ROUTE-HWF taxonomy *using secondary data only*, to assess the opportunities and barriers to compare the existence of the five types of medical deserts within and between European countries.

A number of international (European) data sources was already explored in Deliverable D5.1, resulting in a number of attention points. One attention point is the need for national data sources if international sources are not available or sub-optimal to measure the objects. This was specifically the case for Object 3: 'Travel

time to public health facilities by public transport'. As we will show below, there are no international comparative data available to measure this object specifically. Hence, other data need to be used to measure the proximity of healthcare facilities, e.g., indicators that apply to car instead of public transport, to hospitals instead of public health facilities, or to travel distance instead of travel time. In a similar vein, the measurement of Object 4 concerning 'health professional-to-population ratio' can vary, depends on the concerning type of healthcare provider, being health workers in general, physician, nurses, general practitioners, dentists, etc.

Exploration of Eurostat data to apply the ROUTE-HWF taxonomy

Below, we present an analysis of the most recent data available from Eurostat, as the main statistical base for cross-national comparison for the European region. For each of the four taxonomy objects, the coverage and quality of the available Eurostat data is investigated. For the 30 European Economic Area (EEA) countries as the target group of our ROUTE-HWF project, data on the NUTS 2 level[1] is inspected as the standard regional classification that Eurostat provides on its public data browser portal.

1. *Measuring the proportion of inhabitants aged 65 and over living in an area (compared to this proportion of all inhabitants in the country)*

To measure and monitor this first indicator of our medical desert taxonomy at NUTS 2 level, the table "Population on 1 January by age group, sex and NUTS 2 region" as published by Eurostat was used. This data (latest available year: 2021) covers 22 of the 30 countries in the European Economic Area. Countries missing regional data at the NUTS 2 level for this indicator (and also the following indicators) are Cyprus, Estonia, Latvia, Luxembourg, Malta, Iceland and Liechtenstein. All these seven countries are relatively small in surface size and population, and therefore no regions at the NUTS 2 level are distinguished by the Eurostat data. For Bulgaria regional data on the NUTS 2 level is available, but not on age.

2. *Measuring the proportion of inhabitants below the poverty line living in an area (compared to this proportion of all inhabitants in the country)*

To measure and monitor the economic resources of the population at subnational level in Europe, two different indicators are publicly available on Eurostat: 'risk of poverty rate' and 'persons at risk of poverty or social exclusion'. We consider both as applicable, as they indicate the level of 'material deprivation' (i.e., lack of economic resources for e.g., healthcare usage and travelling) in populations. At the NUTS 2 regions level, data on 'persons at risk of poverty or social exclusion' cover more countries than risk of poverty rate. Data for the first indicator mentioned is available for 19 of the 30 EEA countries (latest available year: 2021). No regional data was available for the same (7) small countries as mentioned above (Cyprus, Estonia, Latvia, Luxembourg, Malta, Iceland and Liechtenstein), and in addition regional data for Austria, Belgium, France and Germany, data at the NUTS 2 level is missing[2].

[1] See; Classifications - Metadata - Eurostat (europa.eu).

[2] In the Reference Metadata webpage published by Eurostat (Income and living conditions (ilc) (europa.eu)), the database for this indicator is described as "*The database on "Income and living conditions", a collection of statistical indicators based on the EU Statistics on Income and Living Conditions (EU-SILC)*". An explanation for the missing statistics for Austria, Belgium, France and Germany can be related to the fact that "*In 2021, a new legislation on the implementation of EU-SILC came into force (…). The new legislation provided for multiple changes to EU-SILC data collection, in particular: (…) reformulated precision requirements at national and regional level (NUTS2) for the at-risk-of-poverty-or social-exclusion indicator and the persistent-risk-of-poverty rate*".

3. *Measuring the health professional-to-population ratio in an area (compared to this ratio in the country)*

To measure and monitor the fourth and last indicator of our medical desert taxonomy, i.e. the health professional-to-population ratio, Eurostat data provides a number of indicators. Data at the NUTS 2 level is available for the ratio physicians/doctors to 100,000 population (but not for all countries for nurses, midwives and/or other healthcare professionals). For the ratio population to medical doctors, Eurostat data is available for 20 of the 30 EEA countries. Data was not available for the seven countries mentioned earlier for which NUTS 2 data not available in general. For this indicator regional data is additionally missing for Bulgaria, Croatia and Ireland.

4. *Measuring the average travel time by public transport to the nearest public healthcare facility in an area (compared to the average travel time at the national level of the country)*

As mentioned in the first section of this chapter, there is no Eurostat data available at NUTS 2 level that specifically indicates our original taxonomy Object/indicator 'travel time by public transport to the nearest public healthcare facility'. Instead, we use an indicator that has been published in the Eurostat Regional Yearbook, being 'Population living within 15 minutes driving time of a hospital'. This indicator is based on a combination of sources ('TomTom Multinet', 'Geostat population grid', and 'Eurostat-GISCO hospital location'). The latest available year is 2020. For 22 of the 23 EEA countries for which Eurostat data is available at the NUTS 2 level data for this indicator is available, except for Greece.

Selection of countries to apply Eurostat data on our ROUTE-HWF taxonomy

From the overview above, we conclude that seven of the 30 European/EEA countries need to be firstly excluded from the application of our second version of the ROUTE-HWF taxonomy, as none of the health demand and supply indicators were available at the NUTS 2 level. These seven countries are:

- Cyprus
- Estonia
- Latvia
- Luxembourg
- Malta
- Iceland
- Liechtenstein

These countries apparently do not have/provide data at a NUTS-2 level because of the size of their surface and/or population size. For the other 23 European countries, data is available for one or more of four taxonomy objects, but an important and next consideration is its geographical granularity level. For instance, Finland is divided in only five NUTS-2 regions that (according to the country informants we consulted) cannot not accurately profile these areas in terms of our indicators to define them (potentially) as a medical desert. As this also applies to the other European countries, we need to define a 'minimum' level of NUTS-2-granularity. As a rule of thumb, we decided to exclude the countries where the number of NUTS-2 regions in the Eurostat statistics is below 10. As a result, we also excluded the following 11 countries from our further analyses:

- Slovenia
- Lithuania
- Slovakia
- Denmark
- Finland
- Portugal
- Norway
- Romania
- Hungary
- Czech Republic
- Sweden

After these selections, a set of eight European countries remains. For these countries, (1) scores on our taxonomy indicators are available at the NUTS-2 regional level, and (2) more than 10 NUTS-2 regions are distinguished within the country. The eight countries are:

- Belgium
- The Netherlands
- Greece
- Poland
- Spain
- Italy
- France
- Germany

Results of applying Eurostat data on our ROUTE-HWF taxonomy for 8 selected countries

The following eight tables below, show the names of the NUTS-2 regions in the eight selected countries and their scores on each of the four medical desert objects as defined by our taxonomy. Note that not for every country and region, data was available for all four indicators (as described in the Introduction section).

1. *Belgium*

For Belgium, we see that no data at the NUTS-2 is available to measure Object 2, leaving three Objects to identify which combination of desertification drivers occurs in which NUTS-regions within this country. Most Belgian regions (4 out of 10) show a combination of Object 1 and 3; dealing with relative high levels of aging of the population on the one hand, and lower physicians-to-population ratio on the other. These regions all happen to be situated in the Flanders part of Belgium (Provinces of Antwerpen, Limburg, Oost-Vlaanderen and West-Vlaanderen). The other regions are characterized by one Object only, except for the Luxembourg region that deals with a combination of lower physicians-to-population ratio and lower proportions of inhabitants living within 15 minutes driving time from a hospital.

Table 1. Scores of the regions within <u>Belgium</u> on the four objects as defined in the second version of the ROUTE-HWF taxonomy ('x' in the cells indicate that the object is 'true' or applicable for the region, '-' if no Eurostat was available for the region). Regions are sorted by the frequency of 'x-values'.

NUTS2 region	<u>Object 1:</u> The proportion of inhabitants aged 65 and over living in this region, is higher than this proportion at the country level	<u>Object 2:</u> The proportion of inhabitants at risk of poverty or social exclusion in this region, is higher than this proportion at the country level	<u>Object 3:</u> The physicians-to-population ratio in this region, is lower than this ratio at the country level	<u>Object 4:</u> The proportion of inhabitants living within 15 minutes driving time of a hospital in this region, is lower than this proportion at the country level
Prov. Antwerpen	x	-	x	
Prov. Limburg (BE)	x	-	x	
Prov. Oost-Vlaanderen	x	-	x	
Prov. West-Vlaanderen	x	-	x	
Prov. Luxembourg (BE)		-	x	x
Prov. Vlaams-Brabant	x	-		
Prov. Brabant wallon	x	-		
Prov. Hainaut		-	x	
Prov. Liège		-		x
Prov. Namur		-		x
Région de Bruxelles-Capitale/Brussels		-		

2. *<u>Germany</u>*

Eurostat data on Germany, at the NUTS-2 level, is not available for taxonomy Object on the proportion living below the poverty line. For Object 3 (physicians-to-population), data is not available for 26 out of the 38 regions. Given these limitations, we see that five German regions (mostly located in the East-Northern part of the country) deal with all three desertification drivers (Brandenburg, Mecklenburg-Vorpommern, Sachsen-Anhalt, Schleswig-Holstein and Thüringen). In four regions the combination of Object 1 (higher proportion 65 and older) and 4 (lower proportion living within 15 minutes from a hospital) is applicable. These two desertification factors are also dominant if we overview all regions for which Eurostat data was available. It should also be noted that 16 German regions at the last part of Table 2, have no 'x-scores' on the two Objects 1 and 4; indicating that they are not confronted by these medical desert drivers. These regions are mainly urban areas.

Table 2. Scores of the regions within Germany on the four objects as defined in the second version of the ROUTE-HWF taxonomy ('x' in the cells indicate that the object is 'true' or applicable for the region, '-' if no Eurostat was available for the region). Regions are sorted by the frequency of 'x-values'.

NUTS2 region	Object 1: The proportion of inhabitants aged 65 and over living in this region, is higher than this proportion at the country level	Object 2: The proportion of inhabitants at risk of poverty or social exclusion in this region, is higher than this proportion at the country level	Object 3: The physicians-to-population ratio in this region, is lower than this ratio at the country level	Object 4: The proportion of inhabitants living within 15 minutes driving time of a hospital in this region, is lower than this proportion at the country level
Brandenburg	x	-	x	x
Mecklenburg-Vorpommern	x	-	x	x
Sachsen-Anhalt	x	-	x	x
Schleswig-Holstein	x	-	x	x
Thüringen	x	-	x	x
Kassel	x	-	-	x
Hannover	x	-	-	x
Lüneburg	x	-	-	x
Koblenz	x	-	-	x
Stuttgart		-	-	x
Freiburg		-	-	x
Niederbayern		-	-	x
Oberfranken	x	-	-	
Unterfranken		-	-	x
Gießen		-	-	x
Braunschweig	x	-	-	
Weser-Ems		-	-	x
Trier		-	-	x
Saarland	x	-		
Dresden	x	-		
Chemnitz	x	-		
Leipzig	x	-		
Karlsruhe		-	-	
Tübingen		-	-	
Oberbayern		-	-	
Oberpfalz		-	-	
Mittelfranken		-	-	
Schwaben		-	-	
Berlin		-		
Bremen		-		
Hamburg		-		
Darmstadt		-	-	
Düsseldorf		-	-	
Köln		-	-	
Münster		-	-	
Detmold		-	-	
Arnsberg		-	-	
Rheinhessen-Pfalz		-	-	

3. *Greece*

Eurostat data for Greece at the NUTS-2 level is available for three of the four taxonomy Objects, except for the Object 4 (lower proportion living within 15 minutes from a hospital; see the Introduction section above). Almost all Greek regions (11 out of 13) deal with a lower physicians-to-population ratio (Object 3). Five of them (Anatoliki Makedonia/Thraki, Dytiki Makedonia, Ionia Nisia, Sterea Ellada and Peloponnisos) are also characterized by higher proportions of population aged 65 and older (Object 1) and at risk of poverty or social exclusion (Object 2). And four Greek regions hold combinations of Object 3 with Object 2 or Object 1. The overall image for Greece shows that there a rather strong dividing line between a large group of 9 regions that deal with two or three desertification factors – while a smaller sub-group of Greek regions (Voreio and Notio Aigaio, Ipeiros and Attiki (the two latter being mainland regions, including Athens as the capital)) apparently have 'better' scores on most medical desert indicators – clearly setting the national average.

Table 3. Scores of the regions within Greece on the four objects as defined in the second version of the ROUTE-HWF taxonomy ('x' in the cells indicate that the object is 'true' or applicable for the region, '-' if no Eurostat was available for the region). Regions are sorted by the frequency of 'x-values'.

NUTS2 region	Object 1: The proportion of inhabitants aged 65 and over living in this region, is higher than this proportion at the country level	Object 2: The proportion of inhabitants at risk of poverty or social exclusion in this region, is higher than this proportion at the country level	Object 3: The physicians-to-population ratio in this region, is lower than this ratio at the country level	Object 4: The proportion of inhabitants living within 15 minutes driving time of a hospital in this region, is lower than this proportion at the country level
Anatoliki Makedonia/Thraki	x	x	x	-
Dytiki Makedonia	x	x	x	-
Ionia Nisia	x	x	x	-
Sterea Ellada	x	x	x	-
Peloponnisos	x	x	x	-
Kriti		x	x	-
Kentriki Makedonia		x	x	-
Thessalia	x		x	-
Dytiki Ellada		x	x	-
Voreio Aigaio			x	-
Notio Aigaio			x	-
Ipeiros	x			-
Attiki				-

4. *Spain*

For Spain, Eurostat data at the NUTS-2 level is available for all four Objects of our taxonomy (apart from the missing data for the Ciudad de Melilla region on Object 3). Table 4 shows a scattered pattern, in terms of the 'x-scores' across the 19 regions. The region of Extremadura (located south west at the border with Portugal) stands out by dealing with all four desertification factors, while for a group of four regions (Castilla y León, Castilla-la Mancha, Andalucía and Canarias) three out of four Objects apply. The combination of Objects 2, 3 and 4 (higher proportions at risk of poverty or social exclusion, lower physician density, and lower proportions living within 15 minutes from a hospital) characterizes this subgroup. For the other Spanish regions with two 'x-scores', different types of combinations are shown. A sub-group of four regions do not

deal with any of the four medical deserts drivers (Comunidad Foral de Navarra, Comunidad de Madrid, Cataluña and Illes Balears) most of them including the larger cities in Spain.

Table 4. Scores of the regions within Spain on the four objects as defined in the second version of the ROUTE-HWF taxonomy ('x' in the cells indicate that the object is 'true' or applicable for the region, '-' if no Eurostat was available for the region). Regions are sorted by the frequency of 'x-values'.

NUTS2 region	Object 1: The proportion of inhabitants aged 65 and over living in this region, is higher than this proportion at the country level	Object 2: The proportion of inhabitants at risk of poverty or social exclusion in this region, is higher than this proportion at the country level	Object 3: The physicians-to-population ratio in this region, is lower than this ratio at the country level	Object 4: The proportion of inhabitants living within 15 minutes driving time of a hospital in this region, is lower than this proportion at the country level
Extremadura	x	x	x	x
Castilla y León	x		x	x
Castilla-la Mancha		x	x	x
Andalucía		x	x	x
Canarias		x	x	x
Galicia	x			x
Principado de Asturias	x		x	
La Rioja	x		x	
Aragón	x			x
Comunitat Valenciana		x	x	
Región de Murcia		x	x	
Cantabria	x			
País Vasco	x			
Ciudad de Ceuta		x		
Ciudad de Melilla		x	-	
Comunidad Foral de Navarra				
Comunidad de Madrid				
Cataluña				
Illes Balears				

5. *France*

France is divided at the NUTS-2 level in 27 regions, for which Eurostat data is available on 'aging' (Object 1), physicians-to-population ratio (Object 3) and proportion living within 15 minutes from a hospital (Object 4), but not proportion at risk of poverty or social exclusion (Object 2). Eight French regions are characterized by all three possible Objects, and hence deal with multiple drivers of desertification (Centre - Val de Loire, Bourgogne, Franche-Comté, Champagne-Ardenne, Limousin, Poitou-Charentes, Auvergne and Corse). A subgroup of six regions deal with two desertification factors (mostly 'aging' and physician density), nine with one of these two. The region Île de France, that includes Paris as the capital, and two other relatively prosperous French regions (Alsace and Rhône-Alpes) have no 'x-scores'.

Table 5. Scores of the regions within France on the four objects as defined in the second version of the ROUTE-HWF taxonomy ('x' in the cells indicate that the object is 'true' or applicable for the region, '-' if no Eurostat was available for the region). Regions are sorted by the frequency of 'x-values'.

NUTS2 region	Object 1: The proportion of inhabitants aged 65 and over living in this region, is higher than this proportion at the country level	Object 2: The proportion of inhabitants at risk of poverty or social exclusion in this region, is higher than this proportion at the country level	Object 3: The physicians-to-population ratio in this region, is lower than this ratio at the country level	Object 4: The proportion of inhabitants living within 15 minutes driving time of a hospital in this region, is lower than this proportion at the country level
Centre - Val de Loire	x	-	x	x
Bourgogne	x	-	x	x
Franche-Comté	x	-	x	x
Champagne-Ardenne	x	-	x	x
Limousin	x	-	x	x
Poitou-Charentes	x	-	x	x
Auvergne	x	-	x	x
Corse	x	-	x	x
Basse-Normandie	x	-	x	
Lorraine	x	-	x	
Bretagne	x	-	x	
Aquitaine	x	-		x
Midi-Pyrénées	x	-		x
Martinique	x	-	x	-
Haute-Normandie		-	x	
Nord-Pas-de-Calais		-	x	
Picardie		-	x	
Pays-de-la-Loire		-	x	
Languedoc-Roussillon	x	-		
Provence-Alpes-Côte d'Azur	x	-		
Guadeloupe		-	x	-
Guyane		-	x	-
Mayotte		-	x	-
Île de France		-		
Alsace		-		
Rhône-Alpes		-		

6. *Italy*

For Italy (as for Spain), Eurostat data at the NUTS-2 level is available for all four Objects of our taxonomy, allowing to make a 'full comparison' of its 21 regions. Table 6 does not show a clear or systematic pattern of 'x-score' combinations. The region of Molise, one of the smallest regions in the central south of the country, deals with all four drivers of desertification. Another subgroup of five Italian regions deal with different combinations of three drivers; a subgroup of nine regions with different combination of two 'x-scores' as well. The last group of regions in the table is characterized by one (varying) desertification driver, while the region of Emilia-Romagna (one of the most wealthy and densely populated regions) can be considered as the opposite of Molise region in terms of desertification.

Table 6. Scores of the regions within Italy on the four objects as defined in the second version of the ROUTE-HWF taxonomy ('x' in the cells indicate that the object is 'true' or applicable for the region, '-' if no Eurostat was available for the region). Regions are sorted by the frequency of 'x-values'.

NUTS2 region	Object 1: The proportion of inhabitants aged 65 and over living in this region, is higher than this proportion at the country level	Object 2: The proportion of inhabitants at risk of poverty or social exclusion in this region, is higher than this proportion at the country level	Object 3: The physicians-to-population ratio in this region, is lower than this ratio at the country level	Object 4: The proportion of inhabitants living within 15 minutes driving time of a hospital in this region, is lower than this proportion at the country level
Molise	x	x	x	x
Abruzzo	x	x		x
Basilicata		x	x	x
Calabria		x	x	x
Sardegna	x	x		x
Marche	x		x	x
Piemonte	x		x	
Valle d'Aosta/Vallée d'Aoste			x	x
Campania		x	x	
Puglia		x	x	
Sicilia		x		x
Provincia Autonoma di			x	x
Provincia Autonoma di Trento			x	x
Friuli-Venezia Giulia	x		x	
Lazio		x		x
Liguria	x			
Lombardia			x	
Veneto			x	
Toscana	x			
Umbria	x			
Emilia-Romagna				

7. *The Netherlands*

The Netherlands is divided at the NUTS-2 level in its 12 provinces, for which Eurostat data is available for all four Objects of our taxonomy (as Italy and Spain). Table 7 shows that Object 1 ('aging') and 3 (physician density) merely determine the desertification drivers across the Dutch regions. The northern province of Friesland (or: Fryslân) deals with all four desertification factors, followed by Drenthe and Zeeland that deal with a similar combination of three factors ('aging', lower physician density, and lower proportions living within 15 minutes from a hospital). Other regions shows a variety of two 'x-value' combinations. The four regions that deal with one or none of the desertification drivers, are typically located in the middle of the country, including the largest cities as Amsterdam and Utrecht.

Table 7. Scores of the regions within <u>The Netherlands</u> on the four objects as defined in the second version of the ROUTE-HWF taxonomy ('x' in the cells indicate that the object is 'true' or applicable for the region, '-' if no Eurostat was available for the region). Regions are sorted by the frequency of 'x-values'.

NUTS2 region	<u>Object 1:</u> The proportion of inhabitants aged 65 and over living in this region, is higher than this proportion at the country level	<u>Object 2:</u> The proportion of inhabitants at risk of poverty or social exclusion in this region, is higher than this proportion at the country level	<u>Object 3:</u> The physicians-to-population ratio in this region, is lower than this ratio at the country level	<u>Object 4:</u> The proportion of inhabitants living within 15 minutes driving time of a hospital in this region, is lower than this proportion at the country level
Friesland/Frvslân	x	x	x	x
Drenthe	x		x	x
Zeeland	x		x	x
Groningen		x		x
Gelderland	x		x	
Zuid-Holland		x	x	
Noord-Brabant	x		x	
Limburg (NL)	x		x	
Overijssel			x	
Flevoland			x	
Noord-Holland		x		
Utrecht				

8. *<u>Poland</u>*

The last country we show is Poland, divided in 17 NUTS-2 regions and with Eurostat data available for all four Objects of our taxonomy as well (except for two regional scores on Object 3). As for some other countries we described above (Italy, Spain) the regional 'scores' on the four Objects are scattered; showing different combinations of desertification drivers among the regions. Table 8 shows that no region has 'x-scores' on all four or three Objects or factors, but there is a substantial group of 8 Polish regions that have scores on two desertification drivers. These regions merely deal with a relative high proportion of at risk of poverty or social exclusion (Object 2), and a lower physicians-to-population ratio (Object 3), but in different combinations with each other and other factors. The four regions that do not deal with any desertification factor are not particularly located within the country, but (like in the other countries we showed above) the urban region around the capital (Warszawski stoleczny) is represented in this subgroup.

Table 6. Scores of the regions within Poland on the four objects as defined in the second version of the ROUTE-HWF taxonomy ('x' in the cells indicate that the object is 'true' or applicable for the region, '-' if no Eurostat was available for the region). Regions are sorted by the frequency of 'x-values'.

NUTS2 region	Object 1: The proportion of inhabitants aged 65 and over living in this region, is higher than this proportion at the country level	Object 2: The proportion of inhabitants at risk of poverty or social exclusion in this region, is higher than this proportion at the country level	Object 3: The physicians-to-population ratio in this region, is lower than this ratio at the country level	Object 4: The proportion of inhabitants living within 15 minutes driving time of a hospital in this region, is lower than this proportion at the country level
Slaskie	x			x
Wielkopolskie		x	x	
Dolnoslaskie	x		x	
Opolskie	x		x	
Kujawsko-Pomorskie		x		x
Warminsko-Mazurskie		x	x	
Lubelskie		x		x
Podkarpackie		x	x	
Lubuskie			x	
Lódzkie	x			
Swietokrzyskie	x			
Podlaskie		x		
Mazowiecki regionalny		x	-	
Malopolskie				
Zachodniopomorskie				
Pomorskie				
Warszawski stoleczny			-	

Important note on the limitation of the results presented

The tables and results for the eight selected countries showed above, should be interpreted with care and as a pilot. First of all, they are the result of a selection process based on availability and granularity of Eurostat data at the NUTS2 level. The eight selected countries are therefore and by no means 'representative' for the European region. Secondly, the results are limited as not for all of the four objects of our taxonomy Eurostat data was available. For four countries (Poland, The Netherlands, Italy and Spain) Eurostat data was available on all 4 objects, but for three countries data was missing at the NUTS-2 level for Object 2 (proportion of inhabitants at risk of poverty or social exclusion; Belgium, Germany and France) and Object 4 (proportion of inhabitants living within 15 minutes driving time of a hospital; Greece).

In this ROUTE-HWF project, six country case studies was conducted to first verify and complement the available Eurostat data at the NUTS2 level with national and additional data sources. This will show how the limitations of international data sources (for the application of our taxonomy) can be reduced or overcome. Secondly, by the case studies verification with country experts will take place, to analyse if the NUTS2-regions presented in the table above can 'actually' be considered as (a certain type of) medical desert in their country. The country case studies include four of the eight selected countries (The Netherlands, Spain, Poland and Germany).

4. Conclusion and implications

In this report, as a pilot, we described the potential measurement and monitoring of the second version of our ROUTE-HWF taxonomy using Eurostat as a secondary international data source. Based on the most recent Eurostat data available, we conclude that these can be applied for 8 of the 30 EEA countries. This is the result of two limitations. First, for seven countries no Eurostat data on health demand or supply is available at the NUTS 2 regional level. These are relatively 'small' countries in terms of population and surface. Second, for 11 countries the granularity at the NUTS-2 classification is too low to distinct a relevant number of regions (i.e. more than 10) within the country and hence to identify potential types of medical deserts based on regional scores on our four taxonomy Objects.

For eight remaining countries (Belgium, Germany, Spain, Italy, France, The Netherlands and Poland) we analysed the scores of their (more than 10 NUTS2) regions on the four objects of our (second version of the) ROUTE-HWF taxonomy. All objects are relatively measured, i.e. comparing the regional value/score with the national average. In presenting the results we applied a basic dichotomous decision rule, showing an 'x' if the regional value/score was either below or above the national average. By this rule, we abstract from the relative deviation of the regional score from the national average – which can be considered as a limitation. Another limitation is that we needed to adapt the operationalization of our four taxonomy Objects to the Eurostat indicators available. This implies that:

- For measuring 'population aging' as the first Object and desertification driver, we used the proportion of inhabitants aged 65 and over living in a region compared to this proportion at the country level;
- For measuring 'population poverty' as the second Object and desertification driver, we used the proportion of inhabitants at risk of poverty or social exclusion in a region, compared to this proportion at the country level;
- For measuring 'health professionals capacity' as the third Object and desertification driver, we used the physicians-to-population ratio in a region compared to this ratio at the country level;
- For measuring 'travel distance to health facilities' as the fourth Object and desertification driver, we used the proportion of inhabitants living within 15 minutes driving time of a hospital in a region compared to this proportion at the country level.

The resulting tables for the eight countries included in this report show different patterns of regional scores within the country and on the four taxonomy Objects. A common pattern appears to be the relative 'advantageous' position of regions that include large cities or the capital of the country. Regions that deal with relative many desertification factors are relatively often located in remote and/or rural areas of their country. This complies with the definition that is commonly used in research on medical deserts (cf Flinterman, 2023; Bes, 2023; Seils, 2023). Another common result was that across countries, 'population aging' (taxonomy Object 1) and 'health professionals capacity' (taxonomy Object 3) appeared to be the most frequent drivers for desertification. Still, for most counties no specific *combination* of the four desertification factors (Objects) could be observed as the most frequent or common. This challenges the key idea behind our ROUTE-HWF taxonomy, that a specific combination of desertification factors determine the type of medical deserts (and hence its most suited policy approach). It is therefore clear that more specific and in-depth data per country is needed, to actually apply our taxonomy as will be demonstrated by the country case studies performed within in the ROUTE-HWF project.

By using and applying Eurostat as a pilot, we gained new insights in the possibilities and limitations of measuring and monitoring our taxonomy using international data sources. We conclude that national data sources are needed to complement international data sources, to identify and classify their medical deserts based on our ROUTE-HWF taxonomy. An clear advantage of national sources is that granularity and specificity

of measuring the taxonomy indicators will be higher. It will enable to use data at a lower geographical level than the NUTS 2 regional classification, as retrieving Eurostat data at the NUTS 3 or 4 level will exclude more countries from the taxonomy analysis/application. But for *cross-national* comparison, international standards, definitions, measurement and data sources remain crucial. Here, the current limitation in terms of the availability and granularity of data at the NUTS-2 level calls for further investment in collecting and harmonizing regional data across European countries.

This second deliverable of Work Package 5 (the second version of guidelines for monitoring and measuring medical deserts) will be followed by Deliverable 5.3 that will be published at the end of the ROUTE-HWF project. Deliverable 5.3 will then provide a final version of the monitoring and measuring guidelines, based on six country case studies, and the final ROUTE-HWF expert workshop during which these guidelines are presented to stakeholders from multiple countries and their feedback is received.

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Eurostat data, pages and tables visited through https://ec.europa.eu/eurostat/. (in June/July 2023):

- Population on 1 January by age group, sex and NUTS 2 region
- Risk of poverty rate by NUTS 2 region
- Persons at risk of poverty or social exclusion by NUTS 2 region
- Population living within 15 minutes driving time of a hospital by NUTS 2 region
- Ratio physicians/doctors to 100,000 population by NUTS 2 region