D5.1: First version of the guidelines on monitoring and measuring medical deserts

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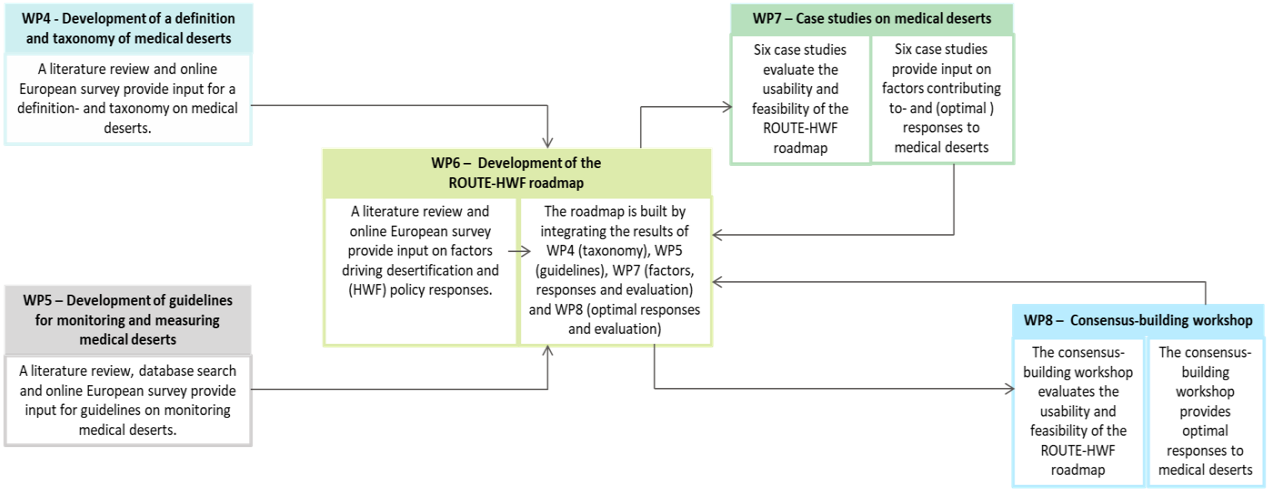
1. Introduction and goal

The aim of this Deliverable 5.1, which is the first deliverable of Work Package 5, is to provide a first 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 goal of the guidelines is to provide a practical set of tools 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 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 first deliverable of Work Package 5 (a first version of guidelines for monitoring and measuring medical deserts) will be followed by deliverables 5.2 and 5.3 that will be published later on in the ROUTE-HWF project. Deliverable 5.2 and 5.3 will provide a second and a third version respectively 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 (provided in Deliverable 4.1), 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. Approach and method

This deliverable and first set of guidelines on measuring and monitoring medical deserts is based on three data collections that have been executed within the ROUTE-HWF project so far: (1) the findings of a scoping review, (2) a European survey and (3) insights gathered during five national stakeholder workshops that have been held in Spain, Poland, Croatia, Finland and the Netherlands in 2022. The scoping review of over 200 studies had provided a wide array of elements that scholars have used to define, measure and monitor medical deserts. This 'population' of elements was presented to experts and stakeholders in different countries, to do a first-hand assessment of their comprehensiveness, relevance and usefulness in different settings and healthcare systems.

To develop the first guideline on how EU Member States can measure and monitor medical deserts at national and subnational levels, we have followed a three-step guideline development process:

1. First, we define the required measurements and data on medical deserts at national and subnational levels, and identify existing bottlenecks in this area. This step builds upon Deliverable 4.1, which in turn is based on the literature review and the results of the ROUTE-HEWF survey and five stakeholder workshops.
2. Second, we define an initial set of guidelines for developing the key components of a measurement framework for medical deserts. This initial set is also based on the results of the scoping review, the survey and five stakeholder workshops.
3. Third, we present the actual first set of guidelines on measuring and monitoring medical deserts.

The next chapter will describe the results of Step 1 and 2. Thereafter, the final chapter will present Step 3, being the conclusion of this Deliverable and the first set of guidelines on measuring and monitoring medical deserts.

3. Results: toward a first version of guidelines on monitoring and measuring medical deserts

Step 1: Define the required measurements and data on medical deserts at national and subnational levels, and identify existing bottlenecks in this area

In 2021 and 2022, a scoping review was conducted of 240 studies on characteristics of and policy responses to medical deserts (Seils et al., 2022; Flinterman et al., 2022). From this review, a large number of elements was extracted that were used in research to define rural areas and medical deserts. The scoping review resulted in a list of 13 elements or objects that potentially can define (and hence measure and monitor) medical deserts:

- Population size of the area
- Percentage of poverty in the area
- Percentage of population aged 65 and over
- Infant mortality rate in the area
- Mobility of the population in the area

- Health needs of the population in the area
- Number of HWF in the area
- Economic resources in the area
- Education and occupation options in the area
- Presence of a hospital or other health services in the area
- Population to provider ratio
- Distance/time to facilities
- Distance/adjacent to metropolitan area.

In Deliverable 4.1, this list was further analyzed and compressed to develop a medical desert taxonomy that is concise, inclusive, comprehensive and extendible (Nickerson, Varshney, & Muntermann, 2013). In a first step, the list of 13 elements was validated through the results of a survey conducted among EU Member States and five stakeholder workshops held by the ROUTE-HWF consortium members in 2022 in their respective countries (the Netherlands, Finland, Spain, Poland and Croatia). This resulted in a selection of 6 elements or dimensions of medical deserts:

1. Percentage population aged 65 and over
2. Mobility of the population
3. Economic resources
4. Population-provider ratio
5. Presence of healthcare services
6. Distance/time to facilities

After consideration on this list (analysing their conceptual interrelations, overlap and distinctiveness) a final set of four key dimensions or objects of medical deserts was derived:

1. Percentage population aged 65 and over
2. Economic resources of the population
3. Travel time to public health facilities by public transport
4. Population-provider ratio

To construct the (first ROUTE-HWF) medical desert taxonomy, the final four objects were dichotomized (i.e. operationalized into variables containing two exclusive categories) and subsequently combined into a set of 15 unique types of medical deserts. This taxonomy of 15 medical deserts types is depicted in figure 2 below:

Figure 2. First version of a taxonomy to define and classify 15 different types medical deserts by four objects/dimensions

Type of medical desert	POPULATION AND HEALTHCARE DEMAND OBJECTS		AREA AND HEALTHCARE SUPPLY OBJECTS	
	Object 1: Percentage population aged 65 and over *The proportion of inhabitants aged 65 and over living in this area, is higher than the proportion of all inhabitants in a country living in this area*	**Object 2: Economic resources of the population** *The proportion of inhabitants below the poverty line living in this area, is higher than the proportion of all inhabitants in a country living in this area*	**Object 3: Travel time to public health facilities by public transport** *The average travel time by public transport to the nearest public healthcare facility in this area is larger than the average travel time at the national level of the country*	**Object 4: Population-provider ratio** *The proportion of health professionals working in this area, is lower than the proportion of all inhabitants in a country living in this area*
↓				
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 the two next steps, we elaborate on the four key medical desert dimensions from a monitoring and measurement perspective.

Step 2: Define a set of initial guidelines that supports public authorities and healthcare professionals in monitoring and measuring medical deserts

As argued in Deliverable 4.1, a guideline following Nickerson's taxonomy development method is to create monitoring and measurements that are based on (a) a limited number of exclusive categories and (b) can be applied to different countries and areas. The main challenge, as addressed in the previous chapter, is to control for differences in population size, facility distances that naturally exist between and within countries in the European region. This challenge already emerged from our scoping review (Seils et al., 2022; Flinterman et al., 2022). Here we note that a major barrier for a *comparative* measurement and monitoring of medical deserts is that the elements can have different meanings, ranges and standards across and within countries. In some cases, this is due to fact that countries have a decentralized healthcare system, with regions having their specific healthcare policies, conditions and standards. More in general, the analysis of the definitions in the scoping review found different definitions of an 'area' as such. An area can be defined as a community, county, province, mountain, island, or another type of area demarcation. A non-nominal (i.e. ordinal or interval-based) definition of an area is to measure it in terms of square kilometers or equivalent (cf. van Hassel, Verheij and Batenburg, 2019). Dividing a country in equal physical areas of a prespecified/relevant (surface) size, at least provides an objective measure that can be used to compare areas between and within countries. A country that has a total surface of 100 square kilometers for instance, can then be divided in five equal areas of 20 square kilometers each – although this type of geographical division will also depend on the landscapes shape and type of borders. Likewise, an alternative is to define areas within countries based on an equal number of inhabitants. A country that has a total population of 1,000,000 inhabitants for instance, can then be divided in five equal areas of 200,000 inhabitants each, regardless the location and other physical characteristics of the area.

Second, in applying elements to define medical deserts for monitoring and measurement purposes, it needs to be taken into account that certain data is available in some countries but not in others. More important, the relevance of certain elements (and hence the related data) differs across countries. Therefore, guidelines for monitoring and measurement should not specify which data are to be collected per country or type of medical desert. Instead, it should support stakeholders in determining which data are relevant *in their own local context* and how to efficiently collect, analyze and interpret these. In other words, there is no 'one-size-fits all way' to monitor and measure medical deserts, because of the context-sensitivity of the phenomenon.

An important initial guideline is that this need to adapted and tailored to the specific context and characteristics of medical deserts in a given country or region. For this reason, the ROUTE-HWF project aims to support relevant stakeholders at national and local levels in EU Member States, but not before it is known what type of medical deserts they are dealing with and what the characteristics of their medical deserts entail. Only then monitoring and measuring medical deserts can be developed within the specific local context.

Third, as a result of the country experts and stakeholders we consulted (see section 2), it should be noted that rurality is seen as a key indicator to measure and monitor medical deserts in view of the uneven distribution of the population across regions. It is seen as a direct 'proxy' for medical deserts in those cases where there is no 'formal' definition of a medical desert. This is in line with the association between

medical deserts and rural areas as found by the scoping review. Population density and rurality are seen as determining factors for health services access, which is – for example – confirmed for the Netherlands. For this country, it was mentioned that labour market shortages in rural areas are related to larger distances to schools, while these shortages are additionally increasing because the pace of ageing is often higher in rural areas. Some respondents, however, noted other trends as for example Poland. Here, medical services data indicate that differences between rural areas and cities are minor and mostly non-significant. Also, waiting time for 'index procedures' were not higher for rural "voivodeships" [1] with relative shortages of staff. Areas with small villages (e.g. villages up to 2,500 inhabitants) are not always considered as medical deserts as well. Respondents have mixed views on this indicator, depending on the country, region and the type of health care model. It was suggested to look at larger territorial units that include multiple small villages.

Finally, the measurement of any medical desert characteristic depends on countries' health care system. It is relevant in those countries with a bigger proportion of private providers whereas it is less relevant in the countries in which private care providers have a less significant role. There are socio-economic determinants reflecting the use of services. In Poland, for example, private services (not financed by public funds) are available all over the country. No data is available on their geographical usage. Socioeconomic status has significant impact on accessibility and usage of these services. Patients who have (or want) to rely only on public system have to wait for services longer. Those who can and want afford private expenses very often use this opportunity to avoid long waiting times (it is the principal motivation to use these services - declared by 74% of private services users). In Austria, the proportion of elective physicians has grown disproportionately strong compared to contract/public care physicians in recent years and the principle of generally accessible and freely available care applies in Austria.

4. Conclusion: the first version of guidelines on monitoring and measuring medical deserts

Step 3: Present the actual first set of guidelines on measuring and monitoring medical deserts

In this last step, we re-focus on the operationalizations (i.e. measurement) of the four key objects/dimensions to define and classify medical deserts, as presented above in step 1. Taking the initial guidelines as described in the previous section into account, we will address how:

1. To measure 'percentage population aged 65 and over' by the proportion of inhabitants aged 65 living in this area, compared to the proportion of all inhabitants in a country living in this area;
2. To measure 'economic resources of the population' by the proportion of inhabitants below the poverty line living in this area, compared to the proportion of all inhabitants in a country living in this area;
3. To measure 'travel time to public health facilities by public transport' 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;
4. To measure 'population-provider ratio' by the proportion of health professionals working in this area, compared to the proportion of all inhabitants in a country living in this area.

[1] A voivodeship is the highest-level administrative division of Poland, corresponding to a province in many other countries. The term has been in use since the 14th century and is commonly translated into English as 'province' or 'state'.

1. *Measuring 'percentage population aged 65 and over' by the proportion of inhabitants aged 65 and over living in this area, compared to the proportion of all inhabitants in a country living in this area*

The age composition of a population – and its change in terms of 'aging' or 'greying' – is highly relevant for the need, demand and use of nearly any type of health service, in any country or region. Still, the (negative) association between age and health status varies. First, by type of disease, impairment and health problem. The prevalence of visual impairments, for instance, is stronger correlated with age than the prevalence of oral health problems. Secondly, the association between age and health status has changed over time, as the quality of life of elderly had improved; people life longer and longer in good health. And thirdly, the correlation between age and health status remains dependent on the prosperity and health expenditure level of countries.

This implies that this dimension, the age composition of a population, should be related to the characteristics of the healthcare system following one of the initial guidelines presented in the previous section. Specifically, this brings upon the question if 65 is actually the 'right' or most relevant cut-off point for this medical desert taxonomy dimension. In a way, 65 can be considered as a 'random' age limit – although it might be related to the formal retirement age in many countries. But this retirement age is shifting because of the trends beforementioned, i.e. that life expectancy is increasing and economically the need to work longer. It therefore makes sense to argue that this depends on the country: for one country 65 might be the most relevant 'turning' age in terms of health care needs or age composition, while for another country this would be 70. On the other hand, it should be recognized that cross-national comparison is hampered if different definitions are applied for different countries. In most of the (international) demographic statistics, the age of 65 is used as a standard cutoff point to describe the aging of a population, in particular in relation to healthcare usage and regional differences within European countries at the co-called NUTS-2 level (see https://ec.europa.eu/eurostat/web/products-eurostat-news/-/ddn-20210316-1). For this first version of measurement guidelines we will therefore hold on to the proportion of the population 65 and over, while in the second version we will reconsider to adjust this measurement four countries if necessary.

2. *Measuring 'economic resources of the population' by the proportion of inhabitants below the poverty line living in this area, compared to the proportion of all inhabitants in a country living in this area*

Public health data on use of medical services indicates that persons with lower income or socioeconomic status more frequently rely on health services which can translate into longer waiting times. It is therefore a relevant criterion that is used to determine a populations' demand for care, next to age composition that we discussed in the previous dimension. Differences in healthcare use among social categories are well documented in terms of healthcare renunciation and late use or different use of medical specialists. The probability of consulting health professionals and the number of annual visits is not identically distributed across socioeconomic groups, after controlling for age, sex and health status. This is particularly observed for the use of specialists.

The 'poverty line' is an internationally used indicator that can be retrieved at both country and cross-national level (https://www.worldbank.org/en/news/factsheet/2022/05/02/fact-sheet-an-adjustment-to-global-poverty-lines). This indicator is strongly related to the gross domestic product, net annual income, national minimum wage or 'living income concept' of countries. It can be well applied for measuring and monitoring the second dimension of our medical desert definition, and to compare areas within countries on this indicator.

3. *Measuring 'travel time to public health facilities by public transport' 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*

The measurement of this element explicitly takes into account the system of public transport versus personal transportation. Some neighboring European countries have agreements that allow patients to access services in different countries if the healthcare facility is closer to their domicile. The criterion is usually discussed and used in the context of child births and out-of-hour and emergency services as well as in the context of regionalization/centralization of healthcare service provision. Relevant given remote areas, transportation issues make it difficult to have access (e-health has helped), reliance on personal transportation. Home services can be limited and so there is reliance on family, neighbors, etc. helping patients to travel to a health facility. This also depends on the need, as distances can be shorter for primary care but longer for specialized care. This draws back on one of the initial guidelines as formulated in the previous section, where it is stated that the type of care that is needed affects the importance of travel distances and times. The relevance of the distance factor naturally depends on the extent to which physical presence is required to address a health condition, as argue in the first section of this report.

Currently, data provided by Google Maps and other geographical location and navigation systems are available to measure travel times by public transport for nearly all European countries (cf. Weiss et al., 2020).

Data from Poland indicate that in 56 communities ("gmina" - 2.26% of all communities in Poland) there were no family physicians and patients had to travel to another community or county. In 17 counties ("powiat" - 4.47% of all counties in Poland) 25% of population had to travel to another county for family physician visits. Availability of family physician had no significant correlation with number of visits. The average numbers of services used for family medicine, specialist outpatient care, hospitalizations have been slightly lower in communities with no family physician as compared to communities with family physicians available but only the difference in average number of visits to family physician per capita per year (5.58 vs 5.96) reached statistical significance. In a "matched pair" analysis there were no significant differences between communities without family practice and those with family practice present in primary care visits, specialist outpatient care, visits in hospital emergency departments and in hospitalizations. The issue of the quality of care was also mentioned. One of the participants to the Polish stakeholder workshop said that: "(…) we need to remember that it is not the access to any type of care, but access to the optimal/high quality of care, (…) thus in the Polish setting measuring and monitoring the quality of care should be a first step, prior to defining indicators to define and measure medical deserts".

In Croatia, attempts were made to introduce helicopter-based emergency services, especially for the Dalmatian coast region and Croatian islands. Due to procurement and problems due to financial issues, helicopter-based patient transfers to secondary or tertiary care centers are conducted only occasionally with the aid of the Croatian military and air force. The need for this service is assessed on a case-by-case basis. Due to the patients' perceived difference in healthcare quality between health facilities in Dalmatia in comparison to those in the continental part of the country, many patients try to obtain treatment outside of Dalmatian hospitals, typically presenting (often with a delay) to the university hospitals in Zagreb.

Another example from Austria, show that the Austrian Structure Plan for Health, defines quality criteria for all medical specialties, including maximum travel times in minutes, within which at least 90 percent of the resident population of a province should be able to reach the nearest service-providing location. Seen by some respondents as a more relevant criterion than travel distance (emergency for example: a service within 30 minutes is a criterion used) because it incorporates a number of constraints (e.g. traffic conditions).

4. *Measuring 'population-provider ratio' by the proportion of health professionals working in this area, compared to the proportion of all inhabitants in a country living in this area*

A valuable source to measure and monitor population-provider ratios among European countries (and to compare these ratios between areas/regions within countries) are the Health at a Glance statistics published by the OECD (https://www.oecd-ilibrary.org/social-issues-migration-health/health-at-a-glance-europe_23056088), the Country Health Profiles published by the OECD (https://www.oecd.org/health/country-health-profiles-eu.htm), as well as the Country fiches published at https://healthworkforce.eu/countrysheets/. Regional distribution of health professionals are published according to the NUTS classification by Eurostat, while national ratio averages are derived from the OECD/Eurostat databases.

Still, with regard to this medical desert dimension the following attention points need to be taken into account that come forward from the six stakeholder workshops and country surveys set out:

- Indicators related to providers bring the question what a 'provider' actually means. It can be that in some areas there is only one provider as such organizationally speaking so it needs to be clarified what represents a provider (individual workers, organizations, healthcare units, centers, etc.). Health workers is a more accurate term as it covers the individual level whereas the word healthcare providers have different meanings
- In providing care, the coordination between different types of care and provision models are also important to note (e.g. in primary care, occupational health, specialized care et cetera). The interconnection between different characteristics was emphasized, and the suggestion is not to use the criteria in isolation, but in relation to each other capturing characteristics of the healthcare system and provision model, population characteristics and characteristics of the area. Also, it was noted to look at links between health and social care as well as between different types of providers, including non-profit organizations. and the levels of care which impact patient-focused care.
- Cultural sensitivity is also to be emphasized in terms of the skills that professionals need in order to provide services effectively to different people. This factor can be noted also as part of the characteristics of health providers and healthcare system. It is therefore important to take the characteristics of the health care system into account.
- Additional attention is required on specialist availability in "rare" specialties. The services are available everywhere but waiting times can be very different. For instance, among Polish voivodships and counties endocrinologists per 100,000 population - min. 2, max. 9; internal medicine 45 and 128, general surgery 17 and 30, pediatrics 29 and 56, ob.-gyn. 15 and 26, psychiatry 8 and 18 respectively. In Poland, 'health care need maps' are being published since 2016 to provide statistical data on health care providers location and characteristics. However, caution is needed while interpreting these indicators. For different reasons, the ratio of the number of doctors or nurses per 1,000 population for example might not adequately inform on their actual HWF productivity/availability per area. First, working in multiple health care facilities at the same time is common in Poland which overestimates the supply per area. Second, the ratio of the number of doctors and nurses per 1,000 population does not consider the age structure of the health workers and hence their future capacity due to outflow – which in the Polish setting is highly relevant due to fast medical staff aging. Likewise, data on patient migration also needs to be considered in interpreting HWF ratios per area. Although general data on population density or socio-economic status per area are available via national statistical offices, in Poland information is limited on patients travel to neighboring municipalities to access primary health care services or the patients admitted to hospital outside their region. These data are only available for the public sector via reporting records of the public payer (in Poland the National Health Fund - NHF) and do not cover medical providers in the private sector that have been systematically growing within the last years.

- It is difficult to have an accurate measurement of healthcare needs due to population mobility and a low population density in some regions. On the other hand, the criterion is frequently used internationally and captures a characteristic of the health workforce as well as a population characteristic. It was also noted that this criterion is important because there are significant differences in healthcare professional ratios among regions. Differences at county levels are most likely not important as physicians work on average in more than two places and thus may cover facilities in areas with lower staff indicators. France, for example, uses the indicator for a certain number of health services/professions particularly in the field of outpatient care but density and distance are always commonly used also. In Poland, as another example, there are no officially established "minimal" ratios except for family physicians, where number of patients per family physician is established (not more than 2,750) but is considered indicative only. Real numbers of patients per family physician vary from min. 463 to max. 3,521. Regarding all physicians the lowest indicators (min. 248/100,000, max. 573) are in 4 voivodeships, each in different region of the country. Similar differences are seen in indicators for dentists (min. 61, max. 117) with lowest indicators in 2 voivodeships, nurses (min. 541, max. 899) with lowest indicators in 4 voivodships located in northern and western regions. This criterion resonates well with the concept of medical desert, but it is an indicator that is not sufficiently known and used in practice across different countries. In Croatia, participants in the stakeholder workshop have noted that young physicians are not inclined towards work in rural areas, and also dislike working away from major academic health care centers, perhaps due to lacking skills for independent work as general physicians. There is a major lack of certain specialists (pediatricians for example) in certain parts of the country. Croatian health care workforce is poorly mobile and reluctant to change employers. In addition to general practitioners, there is a lack of emergency physicians, so the service is increasingly relying on nurses. Pharmacists, as the most readily available health care workers, may have a role to play in mitigating health workers shortages in certain areas.

Conclusion

This first deliverable of Work Package 5 (a first version of guidelines for monitoring and measuring medical deserts) will be followed by deliverables 5.2 and 5.3 that will be published later on in the ROUTE-HWF project. Deliverable 5.2 and 5.3 will provide a second and a third version respectively 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.

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References

Batenburg, R. (2015). Health workforce planning in Europe: Creating learning country clusters. *Health Policy,* 119(12), 1537-1544.

Domagała, A., Klich, J. (2018). Planning of Polish physician workforce–systemic inconsistencies, challenges and possible ways forward. *Health Policy*, 122(2), 102-108.

Flinterman, L., González-González, A.I., Seils, L., Bes, J., Ballester, M., Bañeres, J., Dan, S., Domagala, A., Dubas-Jakóbczyk, K., Likic, R., Kroezen, M., Batenburg, R. (2022). Characteristics of medical deserts and approaches to mitigate them: a scoping review of empirical studies. *Under submission*.

Janes, R., Elley, R., Dowell, A. (2004). New Zealand Rural General Practitioners 1999 Survey--Part 2: gender issues. *N Z Med J.* 2;117(1191):U814.

Kroezen, M., Dussault, G., Craveiro, I., Dieleman, M., Jansen, C., Buchan, J., . . . Sermeus, W. (2015). Recruitment and retention of health professionals across Europe: a literature review and multiple case study research. *Health Policy*, 119(12), 1517-1528.

Nickerson RC, Varshney U, Muntermann J. A method for taxonomy development and its application in information systems. European Journal of Information Systems. 2013:22;3.

OECD/European Union (2020), Health at a Glance: Europe 2020: State of Health in the EU Cycle, OECD Publishing, Paris, https://doi.org/10.1787/82129230-en.

Ono, T., Schoenstein, M., Buchan, J. (2014). Geographic Imbalances in Doctor Supply and Policy Responses, *OECD Health Working Papers*, No. 69, OECD Publishing, Paris.

Seils, L., Flinterman, L., González-González, A.I, Bes, J., Ballester, M., Dan, S., Domagała, A., Dubas-Jakóbczyk, K., Likic, R., Kroezen, M., Batenburg, R. (2022). Characteristics of medical deserts and approaches to mitigate them: a scoping review. Oral presentation at the *WONCA World Rural Health Conference*, June 17-20, 2022, Limerick, Ireland.

Steinhaeuser, J., Otto, P., Goetz, K., Szecsenyi, J., Joos, S. (2014). Rural area in a European country from a health care point of view: an adaption of the Rural Ranking Scale. *BMC Health Serv Res*. 2;14(1):147.

Van Hassel, D., Verheij, R., Batenburg, R. (2019). Assessing the variation in workload among general practitioners in urban and rural areas: An analysis based on SMS time sampling data. *Int J Heal Plann Manag*., 34(1):e474–86.

Weiss, D.J., Nelson, A., Vargas-Ruiz, C.A. et al. Global maps of travel time to healthcare facilities. Nat Med 26, 1835–1838 (2020). https://doi.org/10.1038/s41591-020-1059-1.