

Smart regions in an ageing society - new challenges for spatial planning in relation to healthcare

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Abstract

Healthcare has become increasingly relevant for spatial planning - not only due to the Covid-19 pandemic, but also because of growing shortages in skilled labour. Ensuring equal living conditions and basic outpatient care is gaining importance. This article presents a digital decision support system developed within the Carl-Zeiss-Stiftung-funded project Ageing Smart - designing spaces intelligently. The tool includes (1) a data-based analysis of population and healthcare structures, (2) dynamic, intermodal accessibility analyses, (3) a survey on healthcare needs among baby boomers in four municipalities, and (4) a catalogue of analogue and digital options for action. In the future, scenario-based impact visualisation will be added. The system supports evidence-based, participatory decision-making and strengthens spatial planning as a key actor in shaping future-proof healthcare infrastructures.

Keywords: smart region, spatial planning, decision support system, demographic change, public health care

1. Healthcare within the context of demographic change

1.1 Ageing as a key element of demographic change in Germany

In general terms, demographic change describes the change in population in terms of quantity and quality that in Germany has been observed for years. This development can be summarised with the keywords 'older', 'more diverse' and - regionally differentiated - 'fewer or more' (Gans, 2018, p.376). However, closer inspection reveals demographic change to be a multi-faceted process, characterised by the coexistence of shrinking and growing populations, as well as an ageing and increasingly heterogeneous society. Demographic change is therefore accompanied by far-reaching spatial implications, which are also significant in terms of the equivalence of living conditions and the safeguarding of services of general interest (ibid.).

Shrinkage and growth are a reflection of the quantitative aspect of demographic change, which results in a decline in the natural balance. This is due to the persistently low birth rates since the 1970s and the resulting steady reduction in the number of potential parent generations. This is in contrast to the overall positive migration balance (Federal Statistical Office, 2024). However, migration patterns are subject to a variety of influencing factors (e.g. political, economic), which is why they vary from region to region and are not constant. Internal migration within Germany is a key indicator of variations in quality and attractiveness, particularly with regard to the labour market and educational opportunities, as opposed to overall net migration. In contrast, external migration across national borders is influenced by external factors such as humanitarian crises and geopolitical conditions (Fürst & Mäding, 2011, p.29). The outcome of these reciprocal dynamics between natural population development and different migration movements is growth and shrinkage processes that take place side by side in different areas, with equally different spatial characteristics and effects.

Germany's ageing population is defined by an absolute and relative increase in older people. This issue has long been resolved for Germany (Federal Statistical Office, 2024). The population decline in birth rates and shrinking of potential parents generations (also known as 'ageing from below') is counteracted by the steady rise in life expectancy ('ageing from above') (Gans, 2018, p. 379f.). The ageing of the baby-boomer generation is driving this development, as about 25% of the German population was born between 1955-1969 (Federal Statistical Office, 2024;

Stefan et al., 2022: 1ff.). Specifically, the population is getting older as the average age is rising and age groups are shifting. The number of senior citizens and very old people is increasing. The 15th coordinated population projection assumes an increase in the 67-79 age group by 2037, followed by further increases from 2050, while the number of people in the 80+ age group will increase by 2050. The number of people of working age (20-66 years) will decline until the mid-2030s and stabilise from 2037 (depending on immigration).

1.2 Impacts for spatial planning and development

As outlined above, the spatial impacts of demographic change are diverse. They affect e.g. housing markets and settlement density, land use, public infrastructure (including capacity utilisation, costs and replacement needs), traffic flows, economic performance, labour markets, supply and demand structures, public finances, segregation, ethnic and social conflicts, and even public safety. The resulting effects vary in nature and intensity depending on the specific demographic processes and are influenced by various contextual factors. Most of these developments present challenges requiring active engagement from spatial planners and policymakers (Fürst & Mäding, 2011, p. 30).

In quantitative terms, demographic change is particularly evident in the decline of the population in structurally weak, peripheral and rural areas (Maretzke, 2018, p. 32). This is often associated with reduced economic attractiveness and demand for private goods, services, housing and infrastructure. Consequently, these areas face challenges such as vacant buildings, rising per capita costs, infrastructure capacity issues, closures of shops and medical practices, increasing catchment areas, a decline in qualified labour, and a general loss of attractiveness. This is coupled with underprovision of essential public services (Fürst & Mäding, 2011, p. 31; Fina et al., 2018, p. 14). These developments can intensify into self-reinforcing cycles of problems that place significant burdens on municipalities which are already facing declining tax revenues (Fina et al., 2018, p. 14). Internal migration exacerbates these disparities, with young people in particular relocating to economically prosperous metropolitan regions. This widens the gap between shrinking rural areas and growing urban centres (BiB, 2023).

Qualitatively, ageing processes, which occur at varying intensities and paces across all German regions, represent the core challenge of demographic change. Those particularly affected include rural, peripheral areas with low population density, as well as urbanised regions and agglomerations with structural economic weaknesses (Gans, 2018, p. 382). While the increase in the old-age dependency ratio primarily challenges the pension system from a macroeconomic perspective, ageing from a regional and local perspective mainly stresses the social infrastructure, especially the provision of adequate healthcare and long-term care. The ongoing decline in the working-age population, combined with an increasing elderly population, exacerbates the imbalance between those in need of care and those able to provide it. The same applies to healthcare provision, where there is an increasing mismatch between the number of patients and the availability of service providers. As society ages, demands on infrastructure also change, affecting healthcare facilities, mobility infrastructure and cultural and recreational services. These needs were clearly identified in internal project workshops held in the seven model municipalities of the Ageing Smart project.

At the same time, an ageing society requires the built environment and public services to be adapted to meet the needs of older people. This involves promoting age-friendly housing and mobility solutions, providing access to healthcare and care services via alternative delivery models (e.g. mobile, digital, hybrid), and designing public spaces that cater to the social and physical requirements of older individuals (e.g. accessibility, seating; Körber Foundation & SRzG, 2020). In shrinking regions, it may also be necessary to reconsider existing infrastructure in light of demographic changes (BBSR, 2020).

1.3 Challenges for healthcare provision

General practitioners (GPs) are important because they're the first point of contact, have a close relationship with patients and coordinate further care and preventative measures. They're particularly important in rural regions, where distances to specialists and hospitals are greater (BBSR, 2025, p. 8). However, structural, demographic and economic conditions pose challenges to ensuring comprehensive, needs-based healthcare (BMWK, 2024, p. 202;

Cramer et al., 2022, p. 2). These areas have lower population density and a lower settlement and travel density (Ried, 2021). On the one hand, the steady ageing of the population is leading to an increasing need for medical care. This is leading to a rising number of elderly people, as well as an increase in multimorbidity and mobility restrictions. Changes in demand for age-specific infrastructure are therefore to be expected, particularly in outpatient, inpatient and nursing care facilities (Cramer et al., 2022, p. 2; Kuhn & Amelung, 2015, pp. 16–17). The effects of climate change on human health are also becoming increasingly noticeable (e.g. in the form of extreme heat events), and are exacerbating the situation (Birkmann & Blätgen, 2018, p. 1102).

This development is countered by declining treatment capacities due partly to population change and partly due to a declining willingness to set up a practice and a decline in full-time employment, alongside a drop in working hours (e.g. German Medical Association, 2023; Zwierlein et al., 2020). Here, too, the baby boomer cohort matters, since doctors aged 50 to 65 work long hours, which younger generations cannot easily cover (German Medical Association, 2023).

Alongside these quantitative challenges, there are also qualitative and spatial issues. There has been a maldistribution of specialists and a shortage of GPs willing to set up a practice. Spatially, there are disparities between affluent urban areas and rural communities where basic care is already at risk (Gerlach et al, 2014, p. 349 ff. and p. 377 ff.). It is hard to fill vacancies in these areas: in 2015–18, 50% of doctors were unwilling to work in rural areas (Zwierlein et al., 2020, p. 2; Jacob et al., 2015, p. 61 f).

Demographic change is putting increasing pressure on outpatient care, particularly in rural areas (Kuhn & Amelung, 2015, p. 18). Securing healthcare provision is therefore necessary, particularly with a view to achieving equality of living conditions (Stiewing & Mangels, 2022, pp. 410–411). Comprehensive measures are required in affected areas to counteract the aforementioned challenges and ensure comprehensive, needs-based healthcare. Local authorities are explicitly urged to establish integrated care and prevention structures, and to develop innovative, sustainable approaches (Böhm & Schönknecht, 2020, p. 1). However, control of the public healthcare system has largely been taken away from municipalities and transferred to statutory health insurance funds and medical service providers. Nevertheless, in the context of demographic change, the question of a stronger role for local authorities in this area arises. How can local authorities be actively involved in shaping local healthcare provision?

1.4 Research approach in the Carl Zeiss project 'Ageing Smart - Designing spaces intelligently'

The effects and challenges outlined in the context of demographic change clearly show that the baby boomer cohort in particular acts as a driver for some of these developments. The research project 'Ageing Smart - designing spaces intelligently', funded by the Carl Zeiss Foundation and the University of Kaiserslautern-Landau with 4.3 million euros over a period of five years, addresses these baby boomers, born between 1955 and 1969, and brings together spatial planning and supply-side approaches, baby boomer needs and local authority requirements and options for action in an integrated approach for the first time. The interdisciplinary research project, which is part of the university's "Region and City" research unit, is divided into ten sub-projects in the disciplines of spatial planning, urban sociology, climatology, computer science and mathematics and is coordinated by the Department of Urban Sociology under Prof Dr Annette Spellerberg.¹

As the largest patient group, baby boomers are particularly relevant to the healthcare sector. The 'Healthcare' sub-project, coordinated by the Chair of Regional Development and Spatial Planning, focuses on general practitioner, specialist and dental care in four rural-suburban municipalities: Kusel-Altenglan, Nieder-Olm, Geisaer Land and Remshalden. As well as healthcare provision (supply and demand) and transport infrastructure to ensure individual mobility and accessibility to medical facilities, the project focuses on the current housing situation, prospective residential location behaviour, and healthcare behaviour of baby boomers, as well as their requirements in terms of accessibility and medical care design.

¹ University of Kaiserslautern-Landau: "Ageing Smart - Designing spaces intelligently", <https://www.ageing-smart.de/>

The analysis of the preferences and needs of baby boomers serves to answer relevant questions and to derive needs and options for action in healthcare provision in rural-suburban communities. Later in the project, these will be used to feed into the planned decision support system, particularly in view of increasing demand with a simultaneous reduction in available supply. Of particular relevance here is the accessibility of the individual medical locations, which is why the development of a dynamic accessibility model to analyse time-dependent, intermodal accessibility and, in perspective, to optimise the location planning of different services represents an interdisciplinary cross-sectional approach from spatial planning and mathematics, with the aim of harmonising the needs of the ageing population, spatial development and local supply options (Stiewing et al., 2022, p. 132f.).

The objective of the joint project is the development of a data-driven, IT-based, and AI-driven decision support system (DSS) that can be utilised by public stakeholders in their planning and decision-making processes (municipalities ask, the DSS answers). Infrastructure, services and offerings should be developed in a manner that is demand-oriented, sustainable and future-oriented, with a view to ensuring and enhancing the quality of life of baby boomers and, in the long term, the entire population.

B With regard to the baby boomer cohort and the healthcare sector, questions arise concerning the supply of and demand for infrastructure and residential location behaviour, among other things: What are the current and future needs? Which infrastructures are increasingly in demand? How can the quality and accessibility of medical care in rural-suburban areas be improved by incorporating alternative services? What acceptance do digital, mobile and hybrid forms of healthcare provision have among the baby boomer generation? What relevance does the medical care infrastructure have for municipal development? What opportunities are there to influence the location of medical centres? What mobility services will be needed in the future? Where and how will baby boomers live in the future?

Taking demand and supply aspects into account, the role and potential influence of the municipal level in the area of healthcare was analysed and two rural and two suburban municipalities were examined with regard to the provision and accessibility of medical care. In addition, a survey on healthcare provision was conducted among baby boomers in these municipalities in order to generate data on the healthcare and residential location behaviour of baby boomers and the resulting challenges. The findings, e.g. on care structures, demand patterns and needs, residential location and mobility behaviour as well as the acceptance and relevance of digital-mobile forms of medical services, are used to identify specific requirements for action at and to formulate options for action to ensure healthcare provision and its accessibility. These will also be supplemented by the assessment of experts from politics and administration in the model municipalities, outpatient demand planning and representatives of the leading medical associations.

2. Healthcare as a future task of general interest to municipalities

2.1 Equal living conditions as a guiding principle for services of general interest

Alongside the guiding principle of sustainable spatial development, the provision of equal living conditions is a key objective of German spatial planning policy, which is outlined in the Spatial Planning Act and the Basic Law of the Federal Republic of Germany. This demands comparable opportunities for the population, municipalities and companies in terms of starting, development and funding, as well as access to and accessibility of infrastructures of general interest (Troeger-Weiß, 2023, p. 305). It also means ensuring a comparable quality of life for the population, regardless of regional, social or economic circumstances (Priebes, 2021, pp. 12-13). The task of spatial planning is therefore to organise living conditions throughout Germany in such a way that the population perceives them as equal (Rosenfeld, 2018, p. 838). Ensuring equal living conditions means guaranteeing everyone the basic requirements for a good life. 'Equivalence' refers to fundamental services like education, mobility and healthcare. The guiding principle seeks to minimise disparities between urban centres, rural areas and between federal states (Rosenfeld, 2018, pp. 837-838). The concept of equal living conditions is closely linked to social justice. Regional disparities in infrastructure, education, the economy and healthcare require political intervention (Priebes, 2021, p. 16). However, the concept of equivalence does not imply complete equality. Instead, the desired

equivalence involves defining minimum standards adapted to the regional conditions of individual sub-regions (Rosenfeld, 2018, pp. 841-842).

Equivalent living conditions also include equivalent healthcare. Therefore, ensuring adequate healthcare is considered the responsibility of public services of general interest (Gerlinger, 2021, p. 71), which are embedded in spatial planning and municipal policy as a public mandate (Pribs, 2013, p. 142). This includes outpatient, inpatient and nursing care. However, in addition to providing appropriate healthcare infrastructure, the accessibility of facilities is also important. According to the Federal Government's Equivalence Report, health-related equivalence largely depends on the characteristics and interactions of the following factors:

- the status and development of regional old-age dependency ratios;
- life expectancy and premature mortality;
- the quality and accessibility of medical and nursing care facilities, e.g. the density of care in terms of GPs and access to medical care regardless of place of residence (BMWK, 2024, pp. 42-65).

Significant differences exist between urban and rural districts, particularly regarding accessibility to medical care (BMWK, 2024, pp. 62-64). The number of inhabitants per GP varies considerably, highlighting challenges in rural areas (BMWK, 2024, p. 65). A population survey revealed that 16% of respondents rated good healthcare and nursing care as important for their local area's quality of life (BMWK, 2024, p. 87). Despite efforts to achieve equivalence in healthcare, challenges persist due to spatial disparities and demographic trends. Against this backdrop, minimum standards (basic care) of services of general interest and new concepts in medical care are being discussed (Baumgart & Rüdiger, 2018, p. 831).

2.2 Organisation of healthcare in Germany

In Germany, responsibility for healthcare is not organised by the state, but rather through a self-governing system in which responsibilities are divided between the federal, state and local levels, in accordance with the federal structure of the state. The federal government defines the legal framework in the German Social Code (SGB), among other things, while the federal states and self-governing bodies – the health insurance funds and Associations of Statutory Health Insurance Physicians (KVen) – are responsible for the more precise organisation. The supreme body of this system is the Federal Joint Committee (G-BA), comprising the National Association of Statutory Health Insurance Physicians (KBV), the National Association of Statutory Health Insurance Dentists, the German Hospital Federation, and the National Association of Statutory Health Insurance Funds (G-BA, 2023).

With regard to outpatient healthcare, the responsibility for ensuring sufficient and comprehensive medical care within the framework of statutory health insurance, as set out in § 75 (1) SGB V, lies with the medical service providers (represented by the KVs) and the health insurance funds. The former, in agreement with the respective state associations of health insurance funds, draw up a requirements plan (§ 99 SGB V), which regulates the number and distribution of medical practices based on guidelines issued by the Federal Joint Committee, thereby guaranteeing the provision of care in accordance with this mandate. The demand planning guideline (BPL-RL) establishes nationwide specifications that are implemented at a regional level by the state committees. The BPL-RL describes a comprehensive functional planning system that formulates specifications for care levels, doctor groups and corresponding planning areas, while allowing room for regional deviations. Each group of doctors (e.g. orthopaedists) is assigned to one of four care levels, which are planned at different spatial resolutions: general practitioner care (middle areas), general specialist care (districts), specialised specialist care (regional planning regions), and separate specialist care (state level). The supply situation for each doctor group and region is assessed by comparing the population-physician ratio with the target level (KBV, 2025).

Inpatient care, on the other hand, is primarily the responsibility of the federal states, which must ensure that sufficient hospital services are provided locally. This is financed according to the principle of dual hospital financing by the federal states and health insurance funds. However, most federal states have transferred this responsibility to counties, which often act as hospital operators and are directly and indirectly involved in hospital financing

(Böhm & Schönknecht, 2020, p. 12).

2.3 Municipalities and their role within outpatient healthcare in Germany

Although municipalities are limited in their role within this system, they remain responsible for ensuring public health under constitutional law as part of the state administration (Gerlinger, 2021, p. 16). Effective municipal healthcare also aligns with an overarching health-promoting policy and the 'Health in All Policies' (HiAP) strategy. The latter is a multi-level approach that aims to integrate health into all policy areas and establish societal responsibility for health (Köckler & Geene, 2022). Figure 1 therefore illustrates the role of local authorities with regard to healthcare, health promotion and prevention.

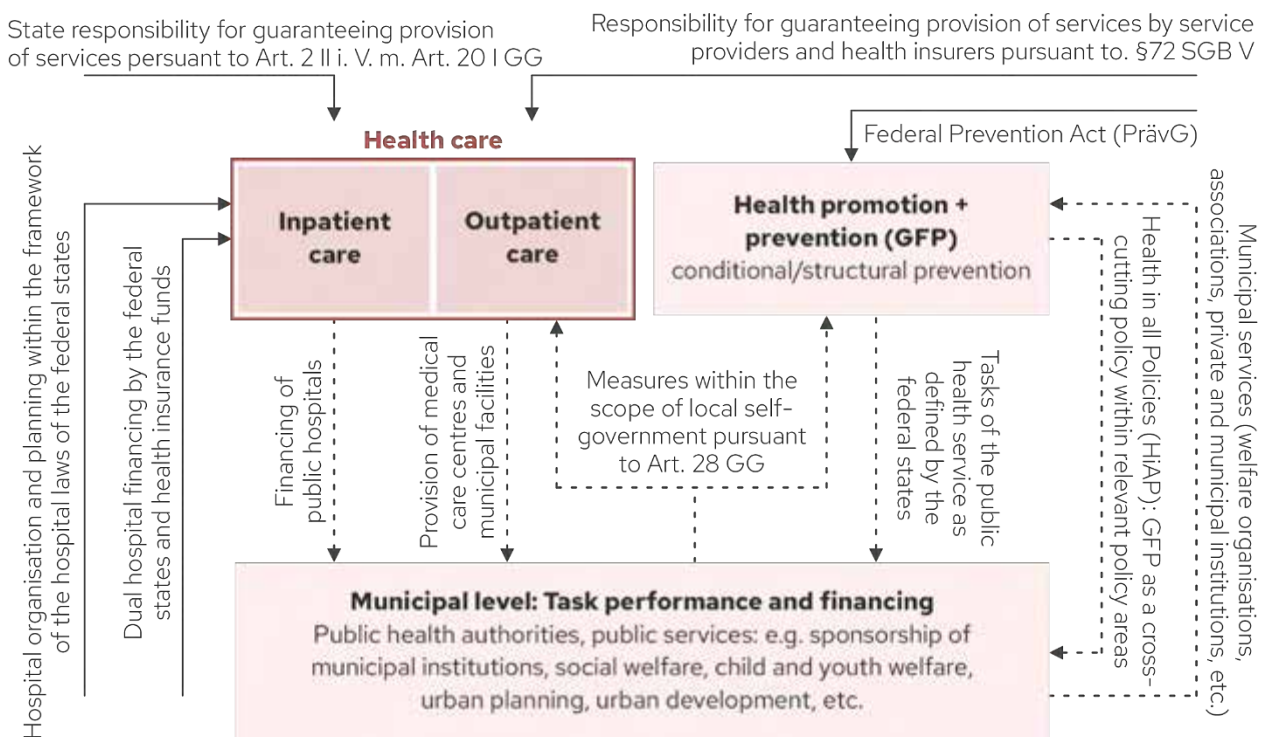


Fig. 1: The role of municipalities in the field of health (Stiewing & Mangels, forthcoming a).

Local authorities can explicitly act as service providers. The legal framework is defined by several acts, including SGB V and the Care Structure Act of 2012. Municipalities can operate their own facilities for direct medical care in justified exceptional cases (§ 105 (5) SGB V). Furthermore, § 95 (1a) SGB V permits the establishment of medical care centres (MVZ) under municipal or inter-municipal ownership, regardless of the approval of the KVs (Gerlinger, 2021, p.70). However, the implementation of this option remains challenging. Studies show that municipal officials are reluctant to establish MVZs, and concerns have been raised about their economic and organisational feasibility (Gerlinger, 2021, p.54; Barthen & Gerlinger, 2016; Kleinschmidt, 2019). The reasons cited include lack of financial resources and expertise. Consequently, the number of MVZs under municipal ownership has been low (Gerlinger, 2021, p.54). Most MVZs are initiated by small municipalities to minimise local supply bottlenecks (Müller, 2020, p.57).

In the context of demographic shifts, the German government passed the Act to Strengthen Healthcare Provision in March 2025. This act aims to enhance outpatient care, including through the simplification of municipal MVZs. While the GVSG is generally welcomed by municipal umbrella organisations, they also express criticism. In particular, they criticise the removal of previously planned opportunities for municipal stakeholders to influence healthcare provision. For instance, the following elements are no longer included: health regions; health kiosks; and primary care centres. Furthermore, the draft document focuses excessively on outpatient care, which means

that the GVSG contradicts the approach of cross-sectoral care. While the expansion of municipal healthcare is a key priority, it is vital to ensure that responsibilities are not significantly transferred to the municipalities, thereby limiting their capacity to deliver services.

Furthermore, municipalities have room for action thanks to the guarantee of municipal self-government enshrined in the German Basic Law (Art. 28 GG). Within this framework, local authorities can influence local health-care provision through targeted measures such as counselling services, providing practice premises, and offering financial incentives to doctors (Kuhn & Amelung, 2015, p. 18). Furthermore, municipalities can utilise health conferences or inter-municipal and regional networks to encourage collaboration among local stakeholders, thereby addressing gaps in care and ensuring its provision (Böhm & Schönknecht, 2020, pp. 6–10). This is particularly relevant given that demographic change and a shortage of skilled labour are putting increasing pressure on outpatient care in rural and suburban areas (Kuhn & Amelung, 2015, p. 18).

As Böhm and Schönknecht state, municipalities are the lowest administrative unit and have the most direct access to local people. This enables them to align healthcare, health promotion and prevention directly with local needs. As the bodies responsible for the entire local public administration, municipalities have a special role to play in improving health equity and equal opportunities.

3. Decision support for municipalities on healthcare provision

One of the tasks of spatial planning is to record and visualise different developments and their spatial and temporal relationships in a way that is appropriate for the target group as part of spatial observation. Spatial planning thus creates a basis for work and discussion for both political decision-makers and the population, for example for the development of spatial strategies and concepts of various kinds.

In dialogue with municipal stakeholders, including in the context of internal project workshops, networking meetings and conferences, it became clear that there is a need for support, particularly in smaller municipalities with few resources. These tend to have a superficial overview of the local facilities and, from the perspective of the municipal decision-makers, show a rather diffuse awareness of the problem under the keyword “shortage of doctors”. Feedback from the workshops held in the model municipalities as part of the project resulted in a multi-stage structure for concrete decision support, which is shown in Fig. 2.



Fig. 2: Components of the ageing smart decision support system in terms of healthcare

In addition to the generally understandable preparation of central trends and framework conditions, which also emphasise the relevance of the topic as a municipal task, the analysis of the current situation in the healthcare sector forms a necessary component for a fact-based decision-making basis. This includes

- general indicators of common spatial structural analyses alongside the requirements and needs of baby boomers surveyed in rural and suburban areas,
- analysis of the medical equipment on a municipal level and
- analysis of the intermodal accessibility of medical facilities.

The aim of this analysis is to describe the current situation of healthcare provision and to derive requirements for action at municipal level as a concrete contribution to decision-making support in municipalities

3.1 Perspective of the baby boomer generation on healthcare and mobility

Compared to previous generations, baby boomers are considered to remain fit and active for longer. However, as they age, this generation will also have greater need for medical care in the medium term. As the largest patient group in the future, baby boomers are therefore highly relevant for securing medical care and thus for municipal development. In this context, the subproject on healthcare conducted a partially standardised survey among baby boomers on healthcare in two rural (Geisaer Land and VG Kusel-Altenglan) and two suburban municipalities (Remshalden and VG Nieder-Olm) in Rhineland-Palatinate, Baden-Württemberg and Thuringia. (Stiewing & Mangels, forthcoming b). Based on e.g. statements on demand behaviour and needs for healthcare, (supra-local) residential location behaviour, mobility behaviour, the aim is to identify the need for action for both political decision-makers and healthcare providers and to formulate options for action to secure healthcare and mobility (Stiewing & Mangels, 2023, p. 403). Among other data, the following data is displayed in the DSS:

- subjective state of health as well as health restrictions, chronic illnesses, risk factors (multimorbidity) and social integration,
- Satisfaction with medical care and mobility at the place of residence,
- Acceptance of mobile and digital forms of healthcare provision,
- Importance of healthcare and mobility as location factors in the choice of residential location (past and anticipated),
- Requirements and wishes for living in old age.

For example, both mobile and digital services provide a flexible alternative to traditional healthcare. The survey therefore asked about acceptance of these types of service for medical consultations or treatments. Table 1 shows the corresponding approval ratings. Two-thirds of respondents can imagine using these services. From the perspective of baby boomers, mobile and digital services can therefore, at least in part, offer an alternative option for consultation or treatment and contribute to securing care, relieving the burden on doctors and improving quality in rural and suburban areas. A higher acceptance of mobile services and counselling is evident among respondents from the suburban model communities. The highest acceptance is among respondents for mobile and digital counselling (Stiewing & Mangels, forthcoming b).

Tab. 1: Acceptance of digital and mobile healthcare services: ('Can you imagine a. being advised/treated by a doctor in an a. online format (n = 279 / 505) / b. in a mobile doctor's office (n = 278 505)?'; percentages refer to the respective answer).

	digital counselling and treatment	digital counselling only	no digital counselling and treatment	mobile counselling and treatment	mobile counselling only	no mobile counselling and treatment
rural	23,3 %	43,4 %	33,3 %	53,8 %	14,7 %	32,1 %
suburban	31,4 %	45,8 %	22,7 %	59,2 %	12,1 %	28,7 %

3.2 Analysis of medical facilities in healthcare provision

In the area of healthcare, the following questions arise at the municipal level: What is the current situation of outpatient healthcare in the district / municipal association / municipality or in the municipal districts? What will the

healthcare situation probably be like in five to ten years' time? Where is there an acute and prospective need for action? A standard data-based inventory and analysis for a specific spatial area (e.g. a district, an association of municipalities) is usually part of a spatial structural analysis. This analysis usually comprises: "spatial structure and settlement development", "development and structure of the population" (including household structure), "development and structure of the economy and the labour market", "accessibility and infrastructure" and, depending on objectives, "trade" or "tourism". Relevant indicators are analysed and assessed using statistical data at municipal level and, where applicable, over time (usually development over the last ten years or so). Forecasts and comparative values can also be used to create a benchmark for assessing the current situation. Healthcare provision is usually considered as part of the analysis of social infrastructure within the framework of traditional structural analyses. The analysis is usually limited to the location of healthcare facilities (e.g. GP practices and clinics), the number of doctors and the quantitative ratio of doctors to inhabitants in the analysed spatial unit. A more detailed analysis is being carried out as part of the DSS, whereby following data is used:

- Basic data for visualisation, i.e. administrative boundaries (e.g. at district, municipal association and municipal level) as well as settlement areas and buildings,
- Data on spatial structure, in particular spatial types and central locations
- Data on transport infrastructure, i.e. private and public transport, including routes, stops, frequency, distances and accessibility
- Socio-demographic data (e.g. census) to assess quantitative demand, in particular the status and development of the population over the last ten years, population density and population forecast, as well as data on the age structure, e.g. average age, proportion and development of the baby boomer cohort and the over 65/75/85 age groups, life expectancy
- Key data on outpatient demand planning to assess supply in quantitative and qualitative terms, i.e. in particular planning areas, level of care, open seats, ratio of residents per doctor (in the DSS focused on smallest planning areas of outpatient care, i.e. general practitioner, dentist and general specialist care)
- Data on medical facilities at municipal level to assess supply in spatial terms, i.e. in particular address-specific locations of outpatient (individual and group practices, medical care centres) and inpatient care (public and private hospitals) as well as pharmacies and, if applicable, existing mobile, digital and hybrid forms of supply.

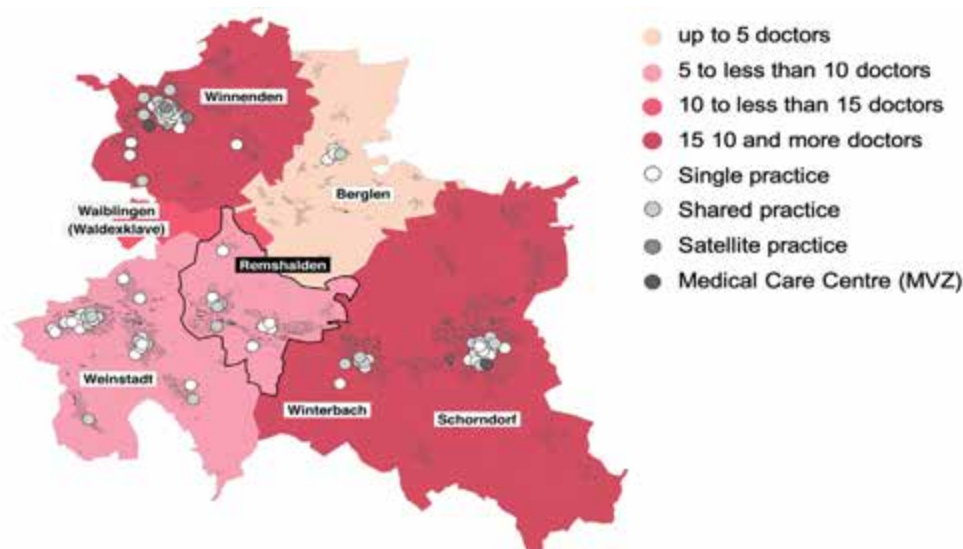


Fig. 3: Outpatient healthcare facilities and doctor-to-resident ratio in the pilote municipality of Remshalden, 2022

3.3 Analysis of intermodal, time-dependent accessibility in an algorithm-based accessibility model

In addition to the provision of medical facilities, accessibility is becoming increasingly important when assessing

medical services in terms of spatial quality, particularly against the backdrop of changing mobility in old age. In rural areas in particular, accessibility is a critical factor due to the sparser infrastructure network and longer distances. Standard structural analyses often depict accessibility by showing the existing transport infrastructure (usually motorised individual transport and public transport) and how long it takes to reach the nearest major or medium-sized centre by car. However, this assumes the availability of a private car, which gradually declines with age (BMVI, 2018, pp. 99–102). Additionally, the activity radius generally shrinks with age, making it more difficult to visit doctors in more distant locations (Stiewing & Mangels, forthcoming a). The analysis of healthcare provision is therefore supplemented by a mathematical accessibility analysis based on cross-sectional spatial planning and mathematical methods.

Accessibility analysis is no longer carried out purely statically in relation to the nearest major or medium-sized centre, or based on linear distance to the nearest infrastructural facility. Instead, it is time-dependent, intermodal and dynamic, in the sense of forward calculation. As part of an intermodal, thematically supported accessibility analysis, different means of transport and their interlinking can be considered, as well as individual mobility. As a component of the DSS, the model provides stakeholders in spatial planning administration (e.g. urban, transport and social planning), political decision-makers, and other stakeholders (e.g. from medical care, research, and demand planning) with an analysis tool. It considers different modes of transport and user profiles, enabling the identification of small-scale accessibility deficits and supply gaps within a planning area (Stiewing et al., 2022, pp. 131–141).

To analyse accessibility in the mathematical model, the locations of the facilities to be included (e.g. outpatient care) are first used as a basis. These locations are characterised by different structural features (e.g. type of practice). In addition, the age of the medical profession can be integrated into the DSS to provide insight into future supply, provided that the facilities remain unchanged. The calculation is also based on the underlying road network and real-time public transport timetable data. Previously defined parameters and ancillary conditions supported by transport planning also form the basis for the calculation (Stiewing et al., 2022, pp. 137–139). To reflect different types of mobility among users, three mobility profiles were configured in collaboration with the optimisation working group and the Chair of Urban Planning at the RPTU. These combine age-specific parameters relating to walking, cycling, public transport, and motorised private transport (MIT), enabling a differentiated analysis of the accessibility of medical services. The preconfigured, customisable 'limited mobility', 'average mobility' and 'above-average mobility' profiles are therefore used to analyse intermodal accessibility in the DSS.

The modelled accessibility is then assessed according to threshold values based on supply-side standards and recommendations for the accessibility of medical facilities. While 15 minutes is assumed for good or adequate general practitioner (GP) care, 30 minutes is used as the corresponding threshold for general specialist care. An exception to this is gynaecological care, which usually involves an annual consultation, so a threshold value of 20 minutes is set here (Stiewing & Mangels, forthcoming a). The same applies to dental care, as an annual consultation is also usually carried out here. Figure 4 shows a possible modelling result and depicts the healthcare situation for general practitioner care in the pilot municipality of Kusel-Altenglan from an accessibility perspective. This illustrates the impact of individual mobility on the quality of small-scale care provision. Analysing intermodal accessibility for the status quo and the anticipated temporal course can reveal areas where action is needed to secure healthcare provision. For example, underserved areas or areas where certain population groups are disadvantaged can be identified, even if the entire central or supply area has a sufficiently high level of supply (Stiewing et al., 2022, pp. 137–139).

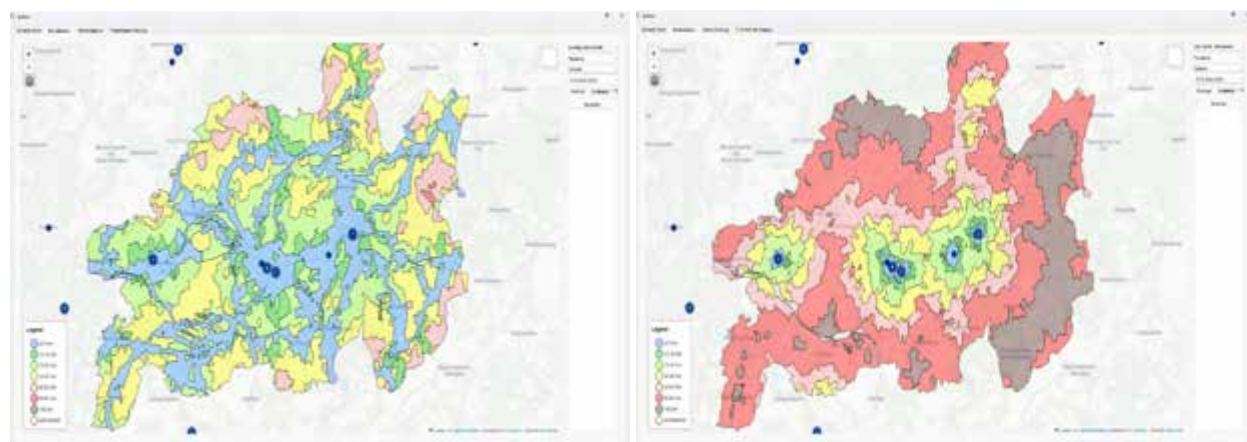


Fig. 4: Accessibility of the general practitioner care in the pilot municipality of Kusel-Altenglan with profile 'average mobility' (left) and 'limited mobility' (right), 2022

3.4 Municipal options for proactively shaping healthcare provision

Based on the described framework conditions and the structural analyses and surveys carried out for the rural and suburban model municipalities in the intermodal accessibility model, action is needed in the municipal provision of healthcare, including ensuring accessibility. Building on this analysis and problem definition, providing possible solutions in the DSS is the second step towards supporting decisions in the healthcare sector. This aims to safeguard the status quo and prevent a deterioration in accessibility, as well as the associated threat of an increase in scale of healthcare provision. The DSS options set out different 'interventions' with corresponding recommendations to support decision-making and, if necessary, alternative futures. They also serve to create scenarios in the decision-making process. As well as planning administrators and municipal decision-makers, the intended audience includes providers of medical services. The following questions take centre stage:

- How can the municipality improve healthcare in the community?
- What opportunities are there for doctors to set up in the community?
- What needs to be done step by step to realise a specific intervention?

As Fig. 5 shows, municipalities can become involved in healthcare to varying degrees. Initially, this commitment involves local authority representatives engaging with the topic and exchanging information with local medical service providers. This can lead to initial action plans, which can be summarised as "counselling", "support" and "mediation". One example is counselling in the context of the branch office. At the second stage, the municipality acts as a partner in searching for and, if necessary, establishing a location. This could include providing or leasing suitable practice premises, or selling real estate or building plots at favourable rates. At the third stage, the municipality becomes active as a moderator or driver by integrating health into its strategies and concepts. In this context, it also makes analysing the status quo and communicating about it the subject of municipal action. This can include inter-municipal strategies and networks. The highest level of municipal involvement is assuming an own care mandate, e.g. sponsoring or participating in a municipal medical care centre. These centres offer the option of employing doctors on a salaried basis, which is particularly popular with younger doctors (Dostal & Partner Management-Beratung GmbH, 2019; BMG, 2024). However, the individual stages do not necessarily build on each other; rather, they represent different organisational approaches that can be combined depending on local circumstances.



Fig. 5: Levels of municipal involvement in healthcare (Stiewing & Mangels, forthcoming b).

The options for action include measures to improve healthcare provision and accessibility in the short term, and health promotion and prevention in the long term. In the 'healthcare' field of action, measures in line with the 'service to people' approach are conceivable. For example, outpatient healthcare services could be provided independently of a location by creating additional services or through mobile and digital provision. In the 'mobility' field of action, the focus can instead be on improving accessibility to medical services through appropriate 'people to service' measures. Development concepts for healthcare or mobility can also be created for both strategies (Troeger-Weiß and Anslinger, 2015, p. 147). Opting for one approach represents an initial political preference decision. The options for action are divided into abstract approaches and measures as well as concrete best practice examples, and are presented in the form of standardised profiles. These profiles are stored in the DSS and contain information on the target group, implementation, challenges, timeframe, costs and the municipality's role.

The options for action can also serve as a basis for alternative scenarios to discuss various possible courses of action and their effects. One example of this is location planning, where the impact of different locations on accessibility can be visualised using the intermodal accessibility model outlined above (Stiewing et al., 2022, pp. 137-139). Examples include the inter-municipal establishment of a medical care centre, providing rooms and spaces for local doctors, and offering consulting services to doctors looking to set up a practice.

4. Outlook

Healthcare is a key aspect in the context of equal living conditions. Factors such as demographic ageing, population loss, the shortage of healthcare professionals and limited resources for the provision of infrastructure have a significant impact on the quality of care. These challenges not only jeopardise the idea of equal living conditions, but also make political and organisational interventions indispensable. Health must therefore be understood as a task for society as a whole, which makes both the active organisation of local authorities and an associated expanded understanding of their role, particularly in securing (outpatient) healthcare, appear sensible.

To date, healthcare has only been included in spatial structural analyses in spatial planning to a limited extent. Existing approaches often fall short, as they are usually limited to infrastructural facilities or the ratio of doctors to the population. These perspectives do not provide a sufficient basis for strategic decisions by planning administrations and politicians. The intermodal accessibility of healthcare facilities, taking individual mobility into account, is becoming increasingly important when analysing the municipal healthcare situation and should be brought into focus.

A data-based DSS can make a decisive contribution to planning and decision-making processes here. In the field of health, for example, it can be used to depict the current supply situation and derive key requirements for action and supplement and specify conventional spatial structural analyses in planning. For example, small- spatial disparities within a care area can be identified. Municipalities and other stakeholders (e.g. KVs, doctors willing to set up practices) in the area of healthcare are thus supported in developing infrastructural offers and services in a needs- and demand-orientated, sustainable and future-oriented manner.

In addition, the DSS enables local authorities to recognise and weigh up options for action in the areas of healthcare, mobility, health promotion and prevention and to implement them within the framework of various roles. Such a DSS can therefore not only be a tool for data exploration, but also an instrument for actively finding and shaping solutions to existing or foreseeable gaps in care. The DSS is initially focussing on the high-birth cohort of baby boomers and accordingly on age-specific infrastructures, offers and services in particular, including the area of healthcare. However, the use cases developed as part of the project are intended to be transferable to other facilities (e.g. local supply, retail, education). In the long term, the DSS can thus make an important contribution to intergenerational urban and spatial development in order to secure and promote the quality of life of both baby boomers and the population as a whole.

References

Akademie für Raumentwicklung in der Leibniz-Gemeinschaft (ARL) (2023) Forschungskonzept 2023–2028, Räumliche Transformation in Zeiten multipler Krisen. Hannover. [Online] available at: https://www.arl-net.de/system/files/pdf/2024-05/forschungskonzept_23-28_gesamt.pdf

Baumgart, S. and Rüdiger, A. (2018) Gesundheit in der Raumplanung. In ARL – Akademie für Raumforschung und Landesplanung (eds.) Handwörterbuch der Stadt- und Raumentwicklung. Hannover, pp. 829–835.

Birkmann, J. and Blätgen, T. (2018) Klimaanpassung. In ARL – Akademie für Raumforschung und Landesplanung (ed.) Handwörterbuch der Stadt- und Raumentwicklung. Hannover, pp. 1099–1111.

Böhm, K. and Schönknecht, M. (2020) Die Rolle der Kommunen im Bereich Gesundheit – Eine Analyse der Kooperationen zwischen Kommunen und medizinischen Leistungserbringern im Rahmen integrierter kommunaler Präventionsstrategien. Bochum.

Bundesärztekammer (2023) Ergebnisse der Ärztestatistik zum 31.12.2022. [Online] available at: <https://www.bundesärztekammer.de/baek/ueber-uns/aerztestatistik/2022>

Bundesinstitut für Bau-, Stadt- und Raumforschung (BBSR) (2025) Indikatoren zur Nahversorgung. BBSR-Analysen KOMPAKT 01/2025. Bonn.

Bundesinstitut für Bevölkerungsforschung (BiB) (2023) Demografische Lage in Deutschland. [Online] available at: <https://www.bib.bund.de/DE/Publikationen/Bevoelkerungsentwicklung/demografische-lage-in-deutschland.html>

Bundesministerium für Gesundheit (BMG) (2024) Medizinische Versorgungszentren. [Online] available at: <https://www.bundesgesundheitsministerium.de/themen/krankenversicherung/ambulante-versorgung/medizinische-versorgungszentren.html>

Bundesministerium für Verkehr und digitale Infrastruktur (BMVI) (2018) Mobilität in Deutschland MiB. Bonn.
Bundesministerium für Wirtschaft und Klimaschutz (BMWK) (2024) Gleichwertigkeitsbericht 2024. Berlin. [Online] available at: https://www.bmwk.de/Redaktion/DE/Publikationen/Wirtschaft/gleichwertigkeitsbericht-der-bundesregierung-2024.pdf?__blob=publicationFile&v=84

Cramer, E., Enste, P. and Wielga, J. (2022) Herausforderungen für die Gesundheitsversorgung in ländlichen Regio-

nen am Beispiel des südöstlichen Hochsauerlandes. *Forschung Aktuell*, 07/2022, pp. 1–8.

Dostal & Partner Management-Beratung GmbH (2024) Ärztemangel: Engagement-Stufen und Lösungsansätze für Kommunen. [Online] available at: <https://www.dostal-partner.de/aerztemangel-vorhaben-aus-nrw-bringt-kliniken-in-laendlichen-regionen-in-not>

Fina, S., Rusche, K. and Gerten, C. (2018) Indikatoren zur Abbildung der Gleichwertigkeit der Lebensverhältnisse in deutschen StadtRegionen. In Bundesinstitut für Bau-, Stadt- und Raumforschung (ed.) Gleichwertige Lebensverhältnisse im Spiegel demografischer Indikatoren. BBSR-Online-Publikation Nr. 11/2018. Bonn.

Fürst, D. and Mäding, H. (2011) Raumplanung unter veränderten Verhältnissen. In ARL – Akademie für Raumforschung und Landesplanung (ed.) Grundriss der Raumordnung und Raumentwicklung, pp. 11–73. Hannover.

Gans, P. (2018) Demografischer Wandel. In ARL – Akademie für Raumforschung und Landesplanung (ed.) Handwörterbuch der Stadt- und Raumentwicklung, pp. 375–396. Hannover.

Gemeinsamer Bundesausschuss (G-BA) (2023) Bedarfsplanung in der ambulanten Versorgung. [Online] available at: <https://www.g-ba.de/>

Gerlinger, T. (2021) Vom versäulten zum integrierten Versorgungssystem: Reformbedarf und Handlungsempfehlungen. In Hans-Böckler-Stiftung (ed.) Working Paper Forschungsförderung, No. 205, February 2021.

Jacob, R., Kopp, J. and Schultz, S. (2015) Berufsmonitoring Medizinstudenten 2014: Ergebnisse einer bundesweiten Befragung. In Kassenärztliche Bundesvereinigung (ed.) Bericht zur Lage der medizinischen Ausbildung. Berlin: Kassenärztliche Bundesvereinigung.

Kassenärztliche Bundesvereinigung KdöR (2024a) Bedarfsplanung. [Online] available at: <https://www.kbv.de/html/bedarfsplanung.php>

Köckler, H. and Geene, R. (2022) Gesundheit in allen Politikfeldern / Health in All Policies (HiAP). In Bundeszentrale für gesundheitliche Aufklärung (BZgA) (ed.) Leitbegriffe der Gesundheitsförderung und Prävention. Glossar zu Konzepten, Strategien und Methoden.

Körber-Stiftung and Stiftung für die Rechte zukünftiger Generationen (SRZG) (2020) Deutschland 2064 – Die demografische Zukunft der Nation. [Online] available at: <https://www.stiftungzukunftfragen.de/index.php?id=334>

Kuhn, B. and Amelung, V.E. (2015) Gemeinden unter Druck – Welche Rolle kann die Kommune bei der Lösung von ambulanten ärztlichen Versorgungsproblemen spielen? *Gesundheits- und Sozialpolitik*, 6(1), pp. 16–23.

Maretzke, S. (2018) Gleichwertige Lebensverhältnisse im Kontext demografischer Struktur- und Entwicklungsindikatoren. In Bundesinstitut für Bau-, Stadt- und Raumforschung (ed.) Gleichwertige Lebensverhältnisse im Spiegel demografischer Indikatoren, BBSR-Online-Publikation Nr. 11/2018. Bonn.

Müller, S. (2020) Medizinische Versorgungszentren. In Bundesinstitut für Bau-, Stadt- und Raumforschung (BBSR) (ed.) Gesundheit und Krankheit aus räumlicher Perspektive. Informationen zur Raumentwicklung, Heft 1/2020. Bonn, pp. 54–57.

Priebs, A. (2021) Gleichwertige Lebensverhältnisse: Als Beitrag der Raumordnung zu gesellschaftlichem Zusammenhalt und räumlicher Gerechtigkeit aktueller denn je! *Raumforschung und Raumordnung*, 79(1), pp. 12–25.

Ried, W. (2021) Sicherung der Daseinsvorsorge in ländlichen Räumen. [Online] available at: <https://www.bpb.de/>

themen/stadt-land/laendliche-raeume/334208/sicherung-der-daseinsvorsorge-in-laendlichen-raeumen/

Rosenfeld, M. (2018) Gleichwertigkeit der Lebensverhältnisse. In ARL – Akademie für Raumforschung und Landesplanung (ed.) Handwörterbuch der Raumplanung. Hannover, pp. 837–849.

Statistisches Bundesamt (Destatis) (2024) 15. koordinierte Bevölkerungsvorausberechnung: Annahmen und Ergebnisse. [Online] available at: <https://www.destatis.de/DE/Themen/Gesellschaft-Um-welt/Bevoelkerung/Bevoelkerungsvorausberechnung/begleitheft.html?nn=208696#vorbemerkung>

Stefan, B., Löppke, Y. and Spellerberg, A. (2022) Babyboomer in Deutschland – demografische, soziale und räumliche Differenzierungen. Analysen auf Basis des sozio-ökonomischen Panels 2019. Kaiserslautern.

Stiewing, M. and Mangels, K. (2023) Inside Babyboomer – Gesundheits- und Wohnstandortverhalten deutscher Babyboomer und deren planerische Herausforderungen für die Gesundheitsversorgung in ländlich-suburbanen Räumen. In Schrenk, M. et al. (eds.) REAL CORP 2023, pp. 403–413. Wien. [Online] available at: https://www.corp.at/archive/CORP2023_149.pdf

Stiewing, M. and Mangels, K. (forthcoming a) Analyse und kommunale Handlungs- und Entscheidungsoptionen zur Gesundheitsversorgung. In Spellerberg, A. and Ruzika, S. (eds.) Ageing Smart - Digitale Instrumente im kommunalen Kontext. Springer VS online.

Stiewing, M. and Mangels, K. (forthcoming b) Patientenorientierung aus Sicht der Generation Babyboomer – Anforderungen und Bedarfe im Bereich der Gesundheitsversorgung. In Spellerberg, A. and Ruzika, S. (eds.) Ageing Smart - Digitale Instrumente im kommunalen Kontext. Springer VS online.

Stiewing, M., Weber, T., Mangels, K., Ruzika, S., Fröhlich, N. and Hausbrandt, N. (2022) „Black Box Babyboomer“ – Was kommt auf Kommunen zu? Decision Support System mit Hilfe mathematischer Erreichbarkeitsmodellierung medizinischer Versorgungsstandorte. In Schrenk, M. et al. (eds.) REAL CORP 2022 Proceedings, pp. 131–141. Wien. [Online] available at: https://www.corp.at/archive/CORP2022_86.pdf

Troeger-Weiß, G. (2023) Bedeutung neuer Rahmenbedingungen und Trends für die Transformation ländlicher Räume: Steht die Gleichwertigkeit der Lebensverhältnisse auf dem Spiel? In Gesellschaft für Sozialen Fortschritt (ed.) Sozialer Fortschritt, 72(4), pp. 305–327. Berlin: Duncker & Humblot.

Troeger-Weiß, G. and Anslinger, J. (2015) Dienstleistungen in ländlichen Räumen – Trends und Handlungsansätze der Daseinsvorsorge. In Troeger-Weiß, G. and Arend, H. (eds.) Starke Wirtschaft – Starke Regionen. Gute Aussichten für das Land. Mainz, pp. 145–148.

Wiechmann, T., von Colbe, J.B., Linsen, T., Klemme, M. and Schulze Dieckhoff, V. (2024) Zur Zukunft der Planung. In Informationskreis für Raumplanung (ed.) RaumPlanung, 226(2), Dortmund.

Zwierlein, R., Portenhäuser, F., Flägel, K. and Steinhäuser, J. (2020) Determinanten der Niederlassung als Allgemeinmediziner – eine qualitative Studie. Stuttgart/New York: Verlag Wissenschaft und Praxis.