Equivalence of care?

Accessibility and Availability of Dialysis Services for Older Prisoners in Switzerland

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Purpose: According to the principle of equivalence of care, healthcare in prison has to be of the same standard and quality as in the general population. The study aims to determine (a) geographic accessibility of dialysis services for older prisoners and the older general population in Switzerland, and (b) whether accessibility and availability of dialysis care is equivalent.

Methodology: Spatial accessibility analysis incorporated four different data types: (1) population data; (2) administrative data, (3) street network data, and (4) addresses of prisons and hemodialysis services.

Findings: Analysis revealed that average travel time to the nearest dialysis service was better for prisoners (11.5min) than for the general population (14.8min). However, dialysis service for prisoners is hampered by the necessary lead-time in correctional settings, which, ultimately, leads to longer overall access times (36.5min). Accordingly, equivalence of dialysis care for older Swiss prisoners is not entirely respected for availability and accessibility.

Originality: The strength of our study lies in the combination of ethical principles and the highly tangible results of a spatial accessibility analysis. The ethics-driven empirical analysis provides arguments for policy-makers to review the current practices.

Key words: Accessibility, Inequity, Prison health, Older prisoners, Equivalence of Care, Ethics

Introduction

The *right to health* is a basic human right (World Health Organisation, 2006, United Nations, 1948) and encompasses the principle of equivalent care. At a practical level, the right to health can be operationalized by the four pillars of availability, accessibility, acceptability, and quality of healthcare as set out in the International Covenant on Economic, Social and Cultural Rights (UN Committee on Economic, 2000). The aspects of availability and accessibility embrace the idea that health facilities, goods, and services must be available in sufficient quantity and be accessible to everyone, above all to "the most vulnerable or marginalized sections of the population" (UN Committee on Economic, 2000,§12b). Moreover, physical accessibility implies that all sections of the population must be able to access health facilities, goods, and services. Again, this concerns especially vulnerable parts of the population (e.g. children, ethnic minorities, older persons, prisoners), since they are more likely to be deprived of equitable access.

Healthcare services in prison are usually geared towards common and acute problems (e.g. injuries, flus, allergies); it is more difficult to provide chronic disease care (Wang et al., 2014). In spite of the universally upheld principle of *equivalence of care* (EoC) according to which, healthcare in prison has to be of the same standard and quality as in the general population (Niveau, 2007, United Nations, 1982, Swiss Academy of Medical Sciences, 2018), access to healthcare services is often worse for older prisoners than for older adults in the general population (Charles and Draper, 2012, Olds et al., 2016). Accessing external services for chronic treatments that need to be administered several times a week is particularly complicated due to a lack of resources. This is also true in the Swiss context (Heidari et al., 2017, Wangmo et al., 2016). Correspondingly, Swiss prisoners have described that getting access to required healthcare out of prison was generally difficult, frequently humiliating, and often delayed (Galli et al., 2016, Heidari et al., 2017). Unlike other European countries (e.g. France, Netherlands),

Switzerland does not have correctional hospitals, but only 16 beds for acute cases in a security ward of a hospital (Amt für Justizvollzug, 2018, Amt für Justizvollzug, 2019). Lastly, limited accessibility of external healthcare services can be further amplified, if prisons are located in more rural areas – a phenomenon referred to as *spatial injustice* (Young and Badowski, 2017).

Chronic kidney disease is not only a typical health problem in older age, but also a health burden with high economic costs (Hill et al., 2016). In Switzerland, there are currently around 4.500 dialysis patients whose average age is 67.9 years (Ambuehl, 2017). At the same time, the population of older prisoners has been increasing significantly over the past decades (Human Rights Watch, 2012, Prison Reform Trust, 2018). In 2017, Swiss prisons recorded a total of 8.071 prison admissions, among them 943 persons older than 50 years of age (11.7 per cent) (Bundesamt für Statistik, 2018). Generally, prisoners aged 50 and older are considered old (Loeb and Abudagga, 2006). There is no available data on the numbers of incarcerated dialysis patients but studies have shown that older prisoners in Switzerland often perceive access to healthcare as insufficient and that access to medical services needs to be facilitated in Swiss prisons (Heidari et al., 2017, Galli et al., 2016). Related to this, it has been argued that one advantage of age-segregated prison facilities could be the provision of on-site dialysis (Thivierge-Rikard and Thompson, 2007). While no studies have addressed accessibility of dialysis for prisoners, accessibility of dialysis facilities for rural and urban patients from the general population has been studied, showing that rural dialysis patients have to travel much longer distances (Stephens et al., 2013). This in turn can have clinical implications, as there is an association between longer travel times and higher mortality, decreased quality of life, worse health outcomes, and less healthcare utilization (Maripuri et al., 2012, Thompson et al., 2012, Moist et al., 2008, Kelly et al., 2016, Jordan et al., 2004, Arcury et al., 2005).

Over the past decades, equitable accessibility to healthcare services has garnered attention and research has shown that "spatial barriers between consumer (…) and provider (…) contribute

to lower health care utilization (…), which may in turn give rise to poorer health outcomes" (Neutens, 2015,p14). In addition, spatial analysis of accessibility of healthcare has furthered the understanding of the geographic distribution of health services (Guagliardo, 2004). According to a literature review, health research has frequently used minimum travel times as a quantification of accessibility (Neutens, 2015). However, spatial accessibility analysis has not been used in a correctional setting and correctional facilities have been purposely left out of research on health professional shortage areas (Wang and Luo, 2005). Along similar lines, it has been argued (1) that ethical theories and accessibility-based approaches should be combined to advance equitable accessibility of healthcare services (Lucas et al., 2016, van Wee, 2016), and (2) that existing data should be used in new ways to address accessibility of healthcare services (Neutens, 2015).

Aiming to determine geographic accessibility of dialysis services for older prisoners and the older general population, we employed spatial accessibility analysis. This method allowed us to address the ethical question concerning Swiss prisoners' access to dialysis and its equivalence to the general population in respect of availability and accessibility. As such, our work examines current Swiss policies related to medical transport of patients in need of dialysis. Our analysis deliberately focused on the population of older prisoners as they suffer under (at least) two overlapping layers of vulnerability: being imprisoned and being old (Luna, 2009). Switzerland is a relatively small country, and it may come as a surprise to presume spatial injustice. However, factors such as long transportation times from remote prisons, the application of a "one rule for all" principle, lack of data and unclear administrative responsibilities indicate that the principle of equivalence of care is not upheld (Haesen et al., 2021).

Methods

Spatial accessibility of health care

Measures of spatial accessibility to healthcare can be grouped into four classes: provider-to-population ratios, average distance to a set of providers, gravitational models of provider influence, and distance to nearest provider (Guagliardo, 2004). Our analysis concentrated on the latter, which is usually measured from a patient's residence or from the centroid of a spatial raster-cell (Guagliardo, 2004) and which enabled us to compare accessibility of dialysis services for older prisoners and older general population in Switzerland. Further, accessibility is conceived as spatial opportunities for interaction with a particular emphasis on the spatial distribution of these opportunities and the potential to reach them (Páez et al., 2012, Hansen, 1959). Related to this, empirical evidence shows that social inequity in spatial distribution of healthcare providers exist (e.g. dialysis, pediatric providers) (Guagliardo et al., 2004, Stephens et al., 2013). Given its potential to determine travel times to the nearest dialysis center for Swiss prisoners and Swiss general population, spatial accessibility analysis is well suited to explore the principle of EoC with respect to accessibility of dialysis.

Data

Our analysis incorporated four different data types: (1) highly disaggregated population data (i.e. 100x100 meters raster-cells) from the Swiss Federal Statistical Office containing information on demographics of the resident population to spatialize the researched population (Swiss federal Statistical Office, 2018b); (2) administrative data from the Swiss Federal Office of Topography Swisstopo to spatialize cantons (Swiss federal states) (Federal Office of Topography swisstopo, 2018), (3) street network data from OpenStreetMap to which car travel speeds were assigned (OpenStreetMap), and (4) addresses of prisons from the Swiss Federal Statistical Office (Swiss Federal Statistical Office, 2018a), and hemodialysis services from the Swiss Society of Nephrology (Swiss Society of Nephrology, 2019). Peritoneal dialysis was not included in the analysis. While (1) was obtained through a University license, the remaining databases were open source. Data's suitability for analysing accessibility of services has been

sufficiently demonstrated in other work (Neumeier, 2016, Rauch and Rauh, 2016, Wieland, 2018, Helbich and Amelunxen, 2012, Stangl et al., 2021).

Since data on age composition of prisoners per institution were not available, we assumed that there are (or will be) older prisoners incarcerated in all Swiss prisons. This assumption was corroborated by the research team's knowledge that most prisons hosted older prisoners during the study period and by the preference of professionals working in the Swiss prison setting for age-mixed-housing (Galli et al., 2016, Wangmo et al., 2017). However, the number of prisoners in table 1 and throughout the paper does not necessarily refer to the actual number of (older) prisoners currently living in the respective prisons, but to the number of places in the institution. Similarly, since data on those in need of dialysis were not available, we assumed that persons of the general population aged 65 years and older can become in need of dialysis. Hence, we modelled car travel times for all Swiss prisons and all raster-cells with residents aged 65 years and older. The latter assumptions are credible because (a) every person aged 65 years and older can become in need of dialysis, (b) every person is entitled to human rights (i.e. the right to health) and (c) equity of access is typically understood as an objective notion without considering vertical equity (i.e. access variation dependent on variations in need) (Goddard and Smith, 2001).

Operationalizing the principle of equivalence of care

According to the Swiss Academy of Medical Sciences the principle of EoC means that "detained persons are entitled to receive care equivalent to that provided for the general population" (Swiss Academy of Medical Sciences, 2018,p.7). Hence, we needed to determine who the general population is that represents the reference for older prisoners. Usually, those in the general population aged 65 years and older are considered old (Eurostat, 2017). In contrast, due to accelerated aging in prisons, prisoners aged 50 years and older are considered old (Loeb and Abudagga, 2006, Loeb and Steffensmeier, 2006). However, the concept of

accelerated aging has been contested (Hayes et al., 2012, Merkt et al., 2020). Regardless of this debate, we compared older prisoners' (≥50) travel times to the nearest dialysis center with travel times of the general population (≥65). Again, because data on age composition of prisoners per institution were not available, we included all Swiss prisons based on the assumption that there are (or will be) older prisoners incarcerated in all Swiss prisons. Finally, we did not perform a demand-responsive analysis of accessibility, that is, modelling accessibility conditional on older persons' actual needs of dialysis, but analyzed in-principle accessibility.

Spatial accessibility analysis

Using ArcGIS (ESRI, Redlands, CA), we analyzed prisoners' and the general population's access to dialysis at a national and a cantonal level. A variable of interest was car travel time for all prisoners and for all 100x100 meters population raster-cells in which people aged 65 years and older reside (N=250.417). To protect individual privacy (i.e. rendering the identification of a single person impossible), each raster-cell of the available population data with an actual value in a range of "1" to "3" was assigned the value "3". As a consequence of this classification, data preparation required correction of counts for the respective raster-cells.

In Switzerland, all 26 cantons can have different judicial authority and health-related legislation, leading to differing prison systems, prison health services, and administrative or organizational obstacles (Handtke et al., 2012). Examples for organizational barriers are group transport from prison to a police station and then further individual transport from the police station to the hospital, meaning that a person coming back from the hospital might have to wait several hours at the police station for return transport to the prison. We left out such additional considerations that would further complicate the analysis (Tao et al., 2018a), since additional administrative barriers would only lead to increased travel times and worsen the medical transport of prisoners. For the general population, data on additional factors that determine travel times, such as contextual factors (e.g. a person's socio-economic status, work status) or

personal preferences (e.g. for services that are not nearest to a person's residence), were not available. In this light, our (conservative) findings are deliberately lower than real travel times and may be regarded as the best-case scenario (i.e. prisoners' and the general population's minimum travel times to dialysis). If our modelled best-case scenario does not meet the principle of EoC, it is highly unlikely that the principle of EoC is met in actuality. For the purpose of our study (i.e. determining whether accessibility and availability of dialysis care is equivalent for Swiss prisoners), determining travel times in this manner is sufficient.

Accessibility analysis involves not only the given infrastructure but also the estimated travel speed. Therefore, besides the 27 OpenStreetMap street types, our analysis further differentiated streets based on the surrounding population density and on respective speed limits (Bundesinstitut für Bau- Stadt- und Raumforschung im Bundesamt für Bauwesen und Raumordnung, 2019). In a further step, streetmap data was transferred into a routing network, which was then combined with both the highly disaggregated population data (100x100 meters raster cells) and the prison data enabling us to analyze accessibility for the general population and for prisoners in fine resolution. In total, 107 prisons (7.520 places), 99 dialysis centers, and 1.752.981 individuals outside the prison (≥65) were included in the analysis. Since a raster-based approach allows the calculation of individual, spatially highly disaggregated time information, we employed this method to determine accessibility of dialysis (Rauch and Rauh, 2016). Based on the combination of the streetmap data, population data, and prison data we calculated the time needed from (a) each population 100x100 meters raster-cell's centroid (with individuals aged 65 and older), and (b) from each prison to the nearest of the 99 dialysis centers. Travel time of each centroid of a raster-cell was assigned to all individuals aged 65 and older in the respective 100x100 meters raster-cell and travel time of each prison was assigned to all prisoners in the respective prison (Rauch and Rauh, 2016). This means that only those raster-cells in which older persons (≥65) reside were included in the analysis. Underlying our analysis

is the nearest center hypothesis according to which, an individual chooses the facility that is closest to their residence (Neumeier, 2016, Rauch and Rauh, 2016, Tao et al., 2018b).

Necessary lead-time in correctional settings

Apart from travel times, medical transfer from prison needs a certain lead-time to prepare the detainee for medical transport to external health-services. This lead-time includes, for example safety procedures, paper-work, and instructions. Data on lead-times in Swiss prisons were not available. According to collaborating Swiss health care professionals working in the correctional setting, it usually takes 20 to 30 minutes. Therefore, for the purpose of this paper, we set a mean lead-time of 25 minutes for prisoners, which was added to the modelled travel times post hoc. It is important to note that prisoners' lead-time represents an intrinsically different and additional expenditure of time, which community patients do not have to bear. The general population's lead-time, such as clothing oneself, packing, or waiting for transportation (e.g. taxi, ambulance) apply equally to prisoners. Those (non-prison specific) lead times of prisoners' and the general population average each other out and, hence, do not need to be modelled when examining overall access times to dialysis.

Statistical analysis

Quantitative data of spatial accessibility analysis was exported to SPSS 25 (SPSS Inc, Chicago, IL). To better understand the accessibility of dialysis services at the national and cantonal level, we employed descriptive statistical analyses (e.g. mean, median, quartiles, proportions). The units of analysis were prisoners and persons from the general population.

Results

On a national scale, spatial accessibility analysis revealed that the average travel time to the nearest dialysis service, was 2.4 minutes shorter for prisoners than for the general population (table 1). While these findings seem to indicate that with respect to prisoners' access to dialysis

services equivalence of care is respected (map 3), accessibility of dialysis service for prisoners is hampered by the necessary lead-time in correctional settings, which, ultimately, leads to longer overall access times for prisoners (map 4). Finally, it should be noted that our analysis (conservatively) modelled the shortest travel time for prisoners. Real travel times, thus, might be even longer, for example if a prison does not choose the nearest dialysis facility due to administrative constraints or differing health-related legislation, or if medical transport first collects prisoners form multiple prisons before they ultimately head for dialysis.

Accessibility of dialysis for prisoners

While overall prisoners' travel times to the nearest dialysis service were reasonable (table 1), mean travel times varied notably across Swiss cantons, ranging from eleven cantons with less than ten minutes, comprising 49.3 per cent of Swiss prisoner population (3705/7520), to five cantons with more than 20 minutes, comprising only 3.4 per cent (254/7520).

[Fig.1 - Map 1. Accessibility of dialysis for prisoners]

Among cantons with more than 150 prisoners (2 per cent of the Swiss prisoner population), three had mean travel times between 15 and 20 minutes, comprising 13.2 per cent of the Swiss prisoner population (994/7520). Map 1 depicts travel times in minutes to the nearest dialysis service for prisons (in parentheses) and operational capacities of prisons (bars).

Accessibility of dialysis for the general population

Those within the Swiss general population equal to and older than 65 years of age could, on average, reach the nearest dialysis service within 13.9 minutes; among them 25 per cent within less than 5.4 minutes, 50 per cent in less than 10.6 minutes, and 75 per cent in less than 18.2 minutes (table 1). Again, travel times varied materially across cantons, ranging from three cantons with less than ten minutes to five cantons with more than 20 minutes. Map 2 shows the

accessibility of dialysis services for the Swiss general population (≥65) on a continuum from red to green.

[Fig.2 - Map 2. Accessibility of dialysis for general population (≥65)]

Comparison of prisoners and the general population

In our study, the difference between mean travel times for prisoners and mean travel times for the general population was 2.4 minutes, with prisoners having shorter travel times (table 1, map 3). In three cantons, however, prisoners had to travel more than five minutes longer than the general population, accounting for 12.5 per cent (941/7520) of the overall Swiss prisoner population.

However, preparing prisoners for medical transport necessitates a certain lead-time, which adds 25 minutes to prisoners' net travel time to the nearest dialysis service. Adding this lead-time (map 4), the entire Swiss prisoner population faces significantly higher overall access times to dialysis services than the general population (on average: 22.6 minutes longer, range across cantons: 7.5 - 31.5 minutes longer; table 1, map 4).

[Fig.3 - Map 3 and map 4. Differences between prisoners and general population without (left) and with (right) lead-time]

Discussion

Our study not only provides important prison health-related information for Switzerland, but also offers practical considerations when critically assessing accessibility of healthcare services for prisoners in other countries. Findings reveal that, overall, prisoners' travel times to the nearest external dialysis facility are comparable to travel times of the general population. Still, prison-specific conditions (i.e. inevitable lead time to prepare the transport of a prisoner) result

in a considerably longer overall access time for prisoners as compared to the general population. Accordingly, equivalence of accessibility and availability of dialysis care for older Swiss prisoners is not entirely respected. In addition, due to an absence of medical or other supervision, transport conditions are often not adapted to post-dialysis patients who are at significant risk of hypotension. Swiss prisoners serving long sentences usually have to be cared for behind bars, as there is no external care or nursing facility for prisoners and only one prison offering 12 specialized places for prisoners aged 60 and above exists (Lenzburg, 2012). Moreover, Switzerland does not have any prison hospitals. Consequently, specialized healthcare services such as dialysis are not offered intra muros. The corollary of this is that Swiss prisoners have to be transferred to dialysis services and both the net travel time and the lead time have to be taken into consideration when examining medical transfer.

Generally, while prisoners can be considered vulnerable because of their imprisonment (Waisel, 2013, Harris et al., 2007), old age adds a second layer of vulnerability (Luna, 2009). In a similar vein, dialysis for prisoners has been described as a second prison, since it is a procedure which ties the prisoner to a machine and which needs to take place for several hours multiple times a week (Gibney, 2007). It can be argued that the necessary transport to the dialysis facility constitutes a third prison as it confines the prisoner to a small space, can add suffering to the existing illness and is often experienced as humiliating (Heidari et al., 2017). Referring back to layers of vulnerability, being in need of dialysis treatment adds a third layer of vulnerability, that is (1) old age, (2) imprisonment, and (3) illness and necessary medical transport. Another important finding of our study is that spatial injustice (i.e. limited accessibility of external healthcare services due to peripheral location of prisons) is not present in Switzerland (Young and Badowski, 2017) because many Swiss prisons are situated in urban areas. This renders prisoners' net travel times satisfactory despite existing Swiss geographical particularities that potentially hamper accessibility (e.g. mountains, lakes).

To remedy this situation of insufficiently realized EoC, various strategies should be considered. First, on-site dialysis could be offered in the biggest prisons where the highest number of older prisoners are held. These services could then also be accessed by prisoners from other institutions. However, this might not lead to improvements for all Swiss prisoners as lead-times for transport between correctional facilities would still impede accessibility. Second, lead times should be examined and possibly shortened, given that older prisoners who need dialysis will probably not pose the same risks as younger and healthy prisoners for whom the security protocols are devised. Moreover, for severely ill patients, a critical evaluation should take place to determine whether they should continue in detention. Third, older prisoners in need of dialysis could be re-distributed to a small number of centrally located prisons so that travel times are minimized. This re-distribution could happen across cantonal borders and would ideally lead to the creation of medicalized care facilities for older prisoners who have increased health care needs. On the one hand, such specialized facilities could improve access not only to dialysis but also to other health care services that are not easily accessible for older prisoners, such as geriatric consultations or treatment of and care for neurodegenerative disorders. On the other hand, this would result in age segregated prisons and both Swiss stakeholders' and prisoners' opinions on separate housing are split (Wangmo et al., 2017). It also would remove prisoners from a prison to which they have become accustomed. Fourth, administrative barriers to shorter medical transport need to be tackled, including the planning of transportation (Haesen et al., 2021). For example, prisoners in need of transports to external health facilities should be scheduled as the last stops in the transportation chain (i.e. after prisoners with other needs, such as transportation to attend court or transfer to another prison) before reaching the health facility, and the first stop on the way back to the respective prisons. However, this could result in longer travel times for other prison patients (e.g. receiving chemotherapy). Moreover, prison health services should be instructed to use the nearest dialysis center, even if this implies crossing cantonal borders. Administrative obstacles such as the crossing of cantonal borders need to be

resolved between cantons or on a national level. Finally, accessibility of dialysis can be considered as a proxy for prison healthcare in general. The current resource allocation for prison health, comprising resources tied to the use of facilities extra muros, must be rethought in view of the growing number of prisoners with chronic and incurable illnesses. In this context, it should be mentioned that kidney transplants on detained persons with end-stage renal disease are an under-researched topic and need more attention from general society and the transplant community (Qazi et al., 2013).

Limitations

Some limitations have to be acknowledged. First, the nearest center hypothesis underlying our analysis assumes that the closest dialysis service is always chosen which is not always the case. For example, different prisons may have different policies because of administrative constraints or differing cantonal legislation and individuals' preferences regarding dialysis services might not exclusively be based on travel times (i.e. non-spatial determinants). However, in such cases accessibility of dialysis services would be worse than the results of our analysis (i.e. longer travel times). Second, we did not include neighboring countries' dialysis services (Guagliardo, 2004). While prisoners are not transported to other countries for dialysis, it is possible that a (very small) fraction of the general population crosses national borders. Third, it has been argued that spatial accessibility analysis is less suitable for congested areas, where numerous provider options at a similar distance from any reference point exist (Guagliardo, 2004). Nevertheless, we particularly aimed to determine travel times to the nearest dialysis center and, ultimately, whether care is equivalent. Fourth, because of data protection and consequent classification of values, available data provided an artificially increased N. To remedy this, we applied a correction of classified values. Finally, our model did not address weather, further socio-demographic variables (e.g. ethnicity, gender), or a person's potential need to use public transport. Still, our analysis has merit because, first, weather would affect both prisoners' and

the general population's travel times and, second, person-related variables were not available at an individual level and, thus, could not be linked to available population data.

Conclusions

The strength of our study lies in the combination of ethical principles and the highly tangible results of a spatial accessibility analysis (Lucas et al., 2016). Our study illustrates that equivalence of care regarding accessibility of dialysis, is not entirely respected in Switzerland. The reason for this is not the travel time per se, but the combination of travel times and incompressible lead times that precede the medical transport. Our findings represent a best-case scenario for Swiss prisoners' accessibility of dialysis, since additional factors that we did not include in our analysis, such as administrative barriers, can further delay transportation. Conversely, actual average travel times can hardly be shorter than our modelled ones. Finally, our findings hold implications for other categories of patients in prison who are also in need of medical transport to external health-services. Here, the correctional setting (i.e. necessary lead times) is likely to challenge EoC too.

Future research should address relevant factors surrounding medical transportation of prisoners. Due to the aforementioned variation in administrative and correctional procedures among Swiss cantons, the particular settings of correctional institutions should be examined, for example with respect to transfer policies, personal and financial resources, the number of prisoners in need of dialysis, or other health problems. Our ethics-driven empirical analysis provides arguments for policy-makers to review the current practices and helps to define starting points to rethink medical transport in correctional settings, not only for older but also for young and middle-aged prisoners in need of dialysis. Ultimately, spatial accessibility analysis could be a useful tool for countries that do not have prison hospitals to estimate accessibility of primary healthcare services for incarcerated persons, and to develop an integrated approach for areas where the principle of EoC is not yet achieved.

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Data statement: While highly disaggregated population data cannot be made available, all other data were open source. Population data are available from Swiss Federal Statistical Office but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available. The datasets generated and analyzed during the current study are not publicly available, since they employed the above mentioned population data. Further results for smaller administrative areas (e.g. communities, cities) or comparisons between different geographical areas can be made available by the corresponding author upon reasonable request.

Table 1. Accessibility of dialysis services for Swiss prisoners and general population

	Travel time in minutes[1]									
	Prison(er)s			**Population ≥ 65**					**Comparison**	
	Mean (SD)	**Nr. prisons**	**Nr. prisoners**	**Mean (SD)**	**Q1**	**Median**	**Q3**	**Max**	**Mean Δ ≥ 65[2]**	**Mean Δ ≥ 65 + 25Min[3]**
Switzerland	**11.5 (7.4)**	**107**	**7.520**	**13.9**	**5.4**	**10.6**	**18.2**	**165.3**	**-2.4**	**22.6**
Zurich	8.6 (4.6)	18	1571	9.3	4.7	8.1	12.8	44.5	-0.7	24.3
Bern	11.6 (7.7)	10	971	15.8	6.4	13.6	22.3	88.4	-4.2	20.8
Lucerne	8.3 (7.8)	3	206	14.8	5.4	10.9	19.9	94.8	-5.5	19.5
Uri	-	-	-	13.3	4.2	6.9	16.6	67.0	-	-
Schwyz	21.4	1	33	14.8	7.1	13.6	22.9	55.4	6.6	18.4
Obwald	27.1	1	7	36.6	28.4	33.8	48.4	81.8	-9.5	15.5
Nidwald	22.0	1	32	22.7	16.9	23.5	28.1	63.2	-0.7	24.3
Glarus	0.7	1	13	13.8	5.2	12.9	17.4	47.9	-13.1	11.9
Zug	17.9 (7.3)	2	165	12.1	6.0	10.5	16.8	37.6	5.8	30.8
Fribourg	18.2 (7.4)	2	302	17.0	9.2	16.5	23.6	63.1	1.2	26.2
Solothurn	8.3 (5.0)	3	184	14.5	6.7	12.1	19.2	64.7	-6.2	18.8
Basle-City	5.3 (1.1)	3	243	6.0	3.9	5.0	6.7	18.4	-0.7	24.3
Basle-Country	9.9 (8.6)	7	200	11.5	5.7	8.6	14.7	51.3	-1.6	23.4
Schaffhausen	6.0	1	43	14.1	5.8	8.8	21.5	43.8	-8.1	16.9
Outer Rhodes	14.2 (0.0)	2	74	11.4	4.5	12.1	15.9	49.7	3.1	28.1
Inner Rhodes	24.1	1	5	23.4	22.7	24.9	26.5	42.7	0.7	25.7
St. Gall	12.5 (6.3)	10	335	13.6	7.6	12.9	17.4	55.0	-1.1	23.9
Grisons	26.7 (15.5)	2	177	39.1	10.7	26.6	59.8	165.3	-12.4	12.6
Argovia	17.7 (7.0)	7	527	13.7	8.5	12.8	18.5	41.7	4.0	29.0
Thurgovia	11.3 (7.3)	6	146	16.4	9.1	16.7	22.8	40.8	-5.1	19.9
Ticino	11.4 (0.1)	4	298	12.5	3.8	7.0	14.1	148.3	-1.1	23.9
Vaud	8.5 (3.7)	6	787	12.2	3.9	8.6	17.1	124.0	-3.7	21.3
Valais	9.5 (4.2)	4	266	20.3	6.9	16.1	26.2	110.4	-10.8	14.2
Neuchatel	8.9 (8.8)	2	147	15.4	5.3	11.8	18.1	81.3	-6.5	18.5
Geneva	13.2 (2.2)	7	743	6.7	3.4	5.9	8.2	39.4	6.5	31.5
Jura	2.0 (0.5)	3	45	19.5	5.8	14.2	30.2	115.1	-17.5	7.5
	Map 1			Map 2					Map 3	Map4

Note. All values were rounded to first decimal point. [1]To the nearest dialysis service; [2](mean travel time for prisoners) – (mean travel time for general population ≥65); [3]adding the lead time.

Figure 1. Map 1. Accessibility of dialysis for prisoners

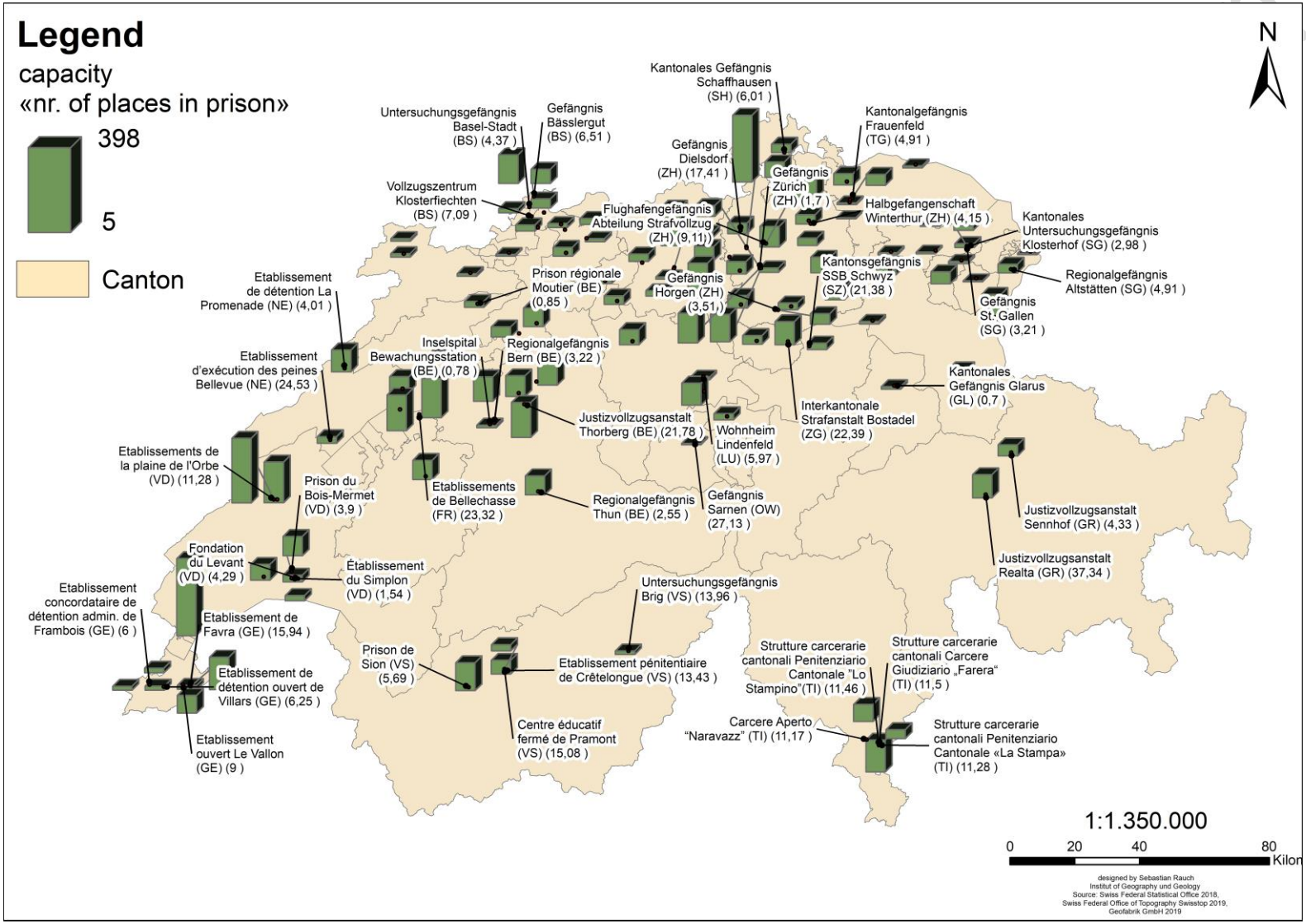

Figure 2. Map 2. Accessibility of dialysis for the general population (≥65)

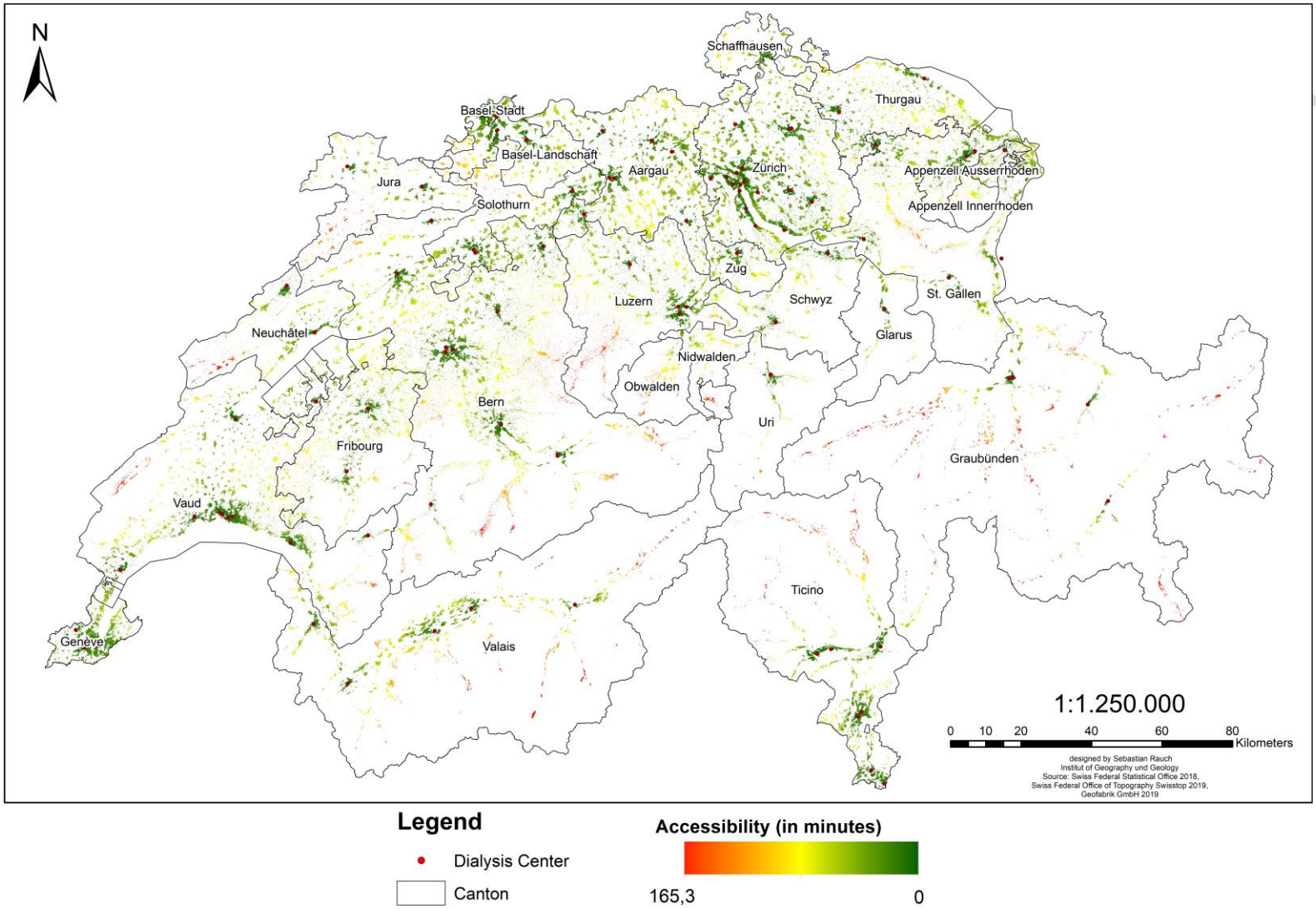

Figure 3. Maps 3 and 4. Differences between prisoners and general population without (left) and with (right) lead-time