European Geriatric Medicine (2019) 10:697–705
https://doi.org/10.1007/s41999-019-00219-8

RESEARCH PAPER

The impact of an ageing population on the required hospital capacity: results from forecast analysis on administrative data

Koen Van den Heede[1] · Nicolas Bouckaert[1] · Carine Van de Voorde[1]

Received: 24 May 2019 / Accepted: 10 July 2019 / Published online: 22 July 2019

Key summary points

Aim Evaluate the impact of population ageing on the required hospital capacity.

Findings As the general population is ageing, the hospital population is also ageing. Additional capacity needs can initially be counterbalanced by reductions in length of stay. Population ageing starts to peak from 2030 with additional hospital capacity needs: inpatient days (+21.9%) and hospital beds (+21.1%).

Message Investments in hospital alternatives as well as in geriatric expertise within hospitals are required to deal with the ageing population.

Abstract

Purpose In this study, we evaluate the impact of population ageing on the required hospital capacity.

Methods We used hospital discharge (years 2003–2014) and population data to estimate the required hospital capacity by 2025 for older inpatients (≥75 years) taking into account population changes and trends in hospital admission rates and length of stay. In addition, we developed an alternative scenario to evaluate the impact of accelerated ageing based on the peaks in population ageing from 2030 onwards.

Results The number of inpatient stays for our study population is expected to increase from 478,027 in 2014 to 590,313 in 2025 (+23.5%). The average length of stay is expected to decrease by 18.4% (−2.3 days). As a consequence, the number of inpatient days and the required bed capacity will only increase by 42,709 days (+0.7%) and 72 beds (+0.4%), respectively. The accelerated ageing scenario shows that the increase between 2014 and 2025 is more pronounced for inpatient stays (+50.5%), inpatient days (+21.9%) and hospital beds (+21.1%).

Conclusions Ageing will, if no drastic policy actions are taken, impact the required hospital capacity. This can initially (by 2025) be more or less controlled by further reductions in length of stay. From 2030, it is expected that the required hospital bed capacity will increase exponentially with a pronounced shift between general acute care beds towards geriatric and chronic care beds. If policy makers want to revert this trend, substantial investments in hospital alternatives will be required.

Keywords Ageing · Hospital capacity · Hospital reform · Population projections

Background

According to the United Nations, the population of almost all countries is ageing [1]. This evolution will challenge our healthcare systems. Although there is a societal trend to keep older persons at home as long as possible [2], also an increasing number of older persons will need hospital services [3]. In addition, healthcare services will have to be redesigned to accommodate the needs of the increasing number of geriatric patients [4, 5]. Indeed, a specific group of older patients (generally ≥75 years of age), called 'geriatric patients', needs a specific approach for the following

✉ Koen Van den Heede
Koen.vandenheede@kce.fgov.be

Nicolas Bouckaert
Nicolas.bouckaert@kce.fgov.be

Carine Van de Voorde
carine.vandenvoorde@kce.fgov.be

[1] Belgian Health Care Knowledge Centre (KCE), Doorbuilding, Kruidtuinlaan 55, 10th Floor, 1000 Brussels, Belgium

reasons: several complex and related problems, atypical appearances of diseases, polypharmacy, functional decline and psychosocial problems [4, 6, 7].

The proportion of older hospitalized patients with a geriatric profile is, depending on the measurement method, estimated to be between 39 and 83% of hospitalized older persons (≥ 75 years) [8, 9].

Outcomes for geriatric patients that receive a different approach, called 'comprehensive geriatric assessment (CGA)', are better compared to conventional care [10]. This approach can be described as: 'a multidimensional interdisciplinary process focusing on determining a frail older person's medical, psychosocial and functional capabilities in order to develop a coordinated and integrated plan for treatment and long-term follow-up'. The gold standard to implement the CGA approach in the hospital context is still the acute geriatric units (also known as acute care for elders or ACE units; geriatric evaluation and management units or GEMU; post-emergency geriatric units or PEGU) [11, 12]. Acute geriatric units are dedicated nursing units with a coordinated specialist multidisciplinary team with specific expertise in geriatric care. Compared to conventional care, acute geriatric care wards have more favourable outcomes [11, 12]. Nevertheless, a substantial portion of geriatric patients is also treated outside these geriatric wards [4].

The aim of the current study is to evaluate changes in the required hospital capacity in Belgium for older patients by means of a forecast analysis. Although examples exist where the impact of demographic evolutions on required hospital capacity is projected [13], these projections, to the best of our knowledge, do not take into account changing patterns in hospital care. Therefore, we will estimate the required hospital capacity by including past trends in hospital admissions and length of stay (LOS) as well as demographic changes.

Methods

Data sources

Data sources analysed are the Belgian Hospital Discharge Dataset (B-HDDS) and population data. The B-HDDS is a compulsory registration and includes for each hospitalization a summary in a single episode record. The dataset includes facility identifiers indicating where the hospitalization occurred, patient demographics, characteristics of the admission, principal and secondary diagnosis and procedure codes (International Classification of Diseases, 9th Version, Clinical Modification or ICD-9-CM), type of beds used during hospitalization, length of stay, discharge status and DRG assignment (All Patient Refined Diagnosis Related Groups or APR-DRG v28.0). The basic APR-DRG structure (determined by principal diagnosis or procedure) is extended by four categories of severity of illness (SOI), which are based on secondary diagnoses: 1 (minor), 2 (moderate), 3 (major) and 4 (extreme). Each APR-DRG is grouped in one of 25 Major Diagnostic Categories (MDC). Per MDC, a distinction is also made between medical APR-DRGs and surgical APR-DRGs. In the current study, a third group is added: chronic care stays. These are inpatient stays with a stay in a chronic care bed throughout the hospitalization period. These chronic care stays include the hospital stays with an entire stay in a chronic care bed (in general these stays are assigned to APR-DRG 860 'Rehabilitation' which does not allow to identify the underlying pathology such as stroke or hip fracture) as well as a part of a stay of a medical or surgical APR-DRG (i.e. time spent in a chronic care bed).

A second data source used is the population data including the observed population size by age and sex over the period 2003 to 2016. These data are based on the place of residence and aggregated at the level of the three Belgian regions: Flanders, Wallonia and Brussels. The future evolution of the population residing in Belgium is projected in a joint effort by the Federal Planning Bureau and Statistics Belgium. We used the latest available data that were released in March 2017, providing annual projections of the population size up to 2061, subdivided by age, sex and region [14]. These population projections take into account international migration, domestic relocation and the future evolution in fertility and mortality.

Study population

Hospital data were available for 2003–2014 for all inpatient stays. We developed the model on the entire dataset [15] but focus in this study on the results for the population of older persons. More in particular, we selected all patients that during their hospitalization stayed on an acute geriatric unit (G units), a psychogeriatric unit (S6 units) or were aged ≥ 75 years.

Baseline projection model

We developed a projection model with forecasts for the number of hospital stays, inpatient days and beds with a time horizon of 2025. The observed hospital use in 2014 was adjusted by taking into account the combined effect of three evolutions: change in population size and composition, the time trend evolutions of LOS and hospital admission rates. In the first step, the projections for hospital use were adjusted for the evolution in population size per demographic group (defined by sex and seven age groups) for the three Belgian regions. In the next step, statistical forecasts for the LOS and hospital admission rates up to 2025 were generated per APR-DRG-SOI group. Admission rates were expressed as hospital stays per 100,000 individuals in the

relevant subgroup. To avoid unstable estimates due to small cells, it was decided to make adjustments to the APR-DRG-SOI groups (i.e. combining them into a pathology group with a related APR-DRG-SOI) when there were < 400 stays per year on average. The choice of 400 stays as target value is based on the volatility of the data. These adjustments were done by a physician with expertise in medical coding and reviewed by a panel of clinical experts.

Statistical trend analysis is a commonly used technique to estimate future capacity needs and helps policymakers in the decision-making process [16]. The idea is to identify patterns (i.e. evolution in hospital admissions and LOS) in historical data that are assumed to continue into the future. In the current study, data were available for the 2003–2014 period. Time trends in LOS and admission rates were estimated via deterministic trend regression models and autoregressive integrated moving average (ARIMA) time series models. Deterministic trend regression models and ARIMA models were estimated on the entire data period (we used four data points per year: one per quarter). First, models were selected on their fit with historical data. Next, forecast accuracy of all remaining forecast specifications was evaluated for the final models. To this end, the data were split into two periods: an estimation (2003–2011) and a validation (2012–2014) period. The data span a long time period during which health policy and healthcare have changed. Through the use of ARIMA models and a validation period, more weight is given to recent observations and enduring trend modification in the computation of the forecast outcomes.

The estimated trends are assumed to capture epidemiological trends, medico-technical progress, development of community care, the ongoing development in medical practice and organization, the influence of financial incentives and other policy decisions, etc. Changes in LOS or admission rates that were not yet present in the data but appear suddenly, also called disruptive events (e.g. a massive investment in alternatives for hospital care; a new vaccine that prevents hospitalization), are not taken into account.

Although we consider as baseline model the combined effect of the trends in hospital admission rates and LOS and the demographic evolutions, we will also visualize the effect of the demographic changes separately.

Alternative scenario: accelerated ageing

The time horizon of the baseline model is 2025. Yet, the real demographic peak in older persons will appear from 2030 onwards [14]. Therefore, a scenario of accelerated ageing was developed. After all, it makes no sense to reduce hospital capacity when, for instance, 5 years later it would turn out that more capacity is needed. The objective of the accelerated ageing scenario is to uncover and emphasize potential pressure points in the long(er) term. Adjustments are made in the make-up of the population from 2017 onwards: the pace of ageing from 2017 onwards is doubled to be (for the 2025 estimates) in line with the projected demographic evolution up to 2034. More specifically, this means that for the year 2017, we use the population projections for 2018 to reweight hospital care usage; subsequently, we use the years 2020, 2022 … up to 2034. In the end, each projection year of the baseline results is matched to a new year. Important to the methodology is that only adjustments are made for the make-up of the population, not the population size. This allows to evaluate the effects of population ageing on hospital care use, independently from the effect of the change in population size on care usage.

Capacity indicators

The past, current and future capacity needs are expressed via three indicators: hospital stays, inpatient days and hospital beds. In the calculation of the estimated future volume of hospital stays, changes in population size and composition and admission rates (baseline model) are taken into account. More specifically, the future number of stays for a certain pathology group (e.g. 'knee joint replacement') and demographic group (e.g. women aged ≥ 75 years) in a specific year (e.g. 2023) corresponds to the number of hospital stays observed in 2014 multiplied by the relative change in population size and admission rates for that group of women between 2014 and 2023.

The projected number of inpatient days is computed by multiplying the projected number of stays for a particular year by the LOS observed in 2014 adjusted by the change rate since 2014.

To calculate the future number of beds, we compute the projected number of inpatient days and apply a specific 'normative occupancy rate' to infer the future bed need. These occupancy rates differ according to the bed type and are based on the 'normative occupancy rates' that are applied in the Belgian hospital payment system: 80% for intensive care (I), surgical (C) and internal medicine (D) beds; 90% for acute geriatric (G), psychogeriatric (S6) and other chronic bed types (S).

Results

Older patients in Belgian hospitals: current situation

In 2014, older persons (≥ 75 years) represent 9% of the Belgian population but account for 25.1% of all inpatient stays and 42.9% of all inpatient days. Older persons aged ≥ 85 years represent 2.6% of the population but account for 8.8% of all inpatient stays and 17.4% of all inpatient days.

The majority (65.6%) of the 478,027 inpatient stays (in 2014) in our study population concern medical pathologies, followed by surgical procedures (28.2%) and entire stays in chronic care beds (6.2%) (see Table 1).

The average length of stay (ALOS) of our study population is 12.5 days. While ALOS is quite similar for medical and surgical pathologies (11.1 and 10.1 days, respectively), it is much longer for chronic care stays (35.8 days). The ALOS is the highest in psychogeriatric wards (55.4 days) followed by other chronic care beds (33.7 days), acute geriatric care (18.5 days) and intensive care (13.2 days). It is much shorter in internal medicine (7.7 days) and surgical wards (7 days).

The inpatient days for the selected patient population are realized in geriatric beds ($n = 2{,}398{,}828$ days or 40.4%); internal medicine beds ($n = 1{,}401{,}267$ days or 26.6%); psychogeriatric ($n = 236{,}283$ days or 4%) or other chronic care beds ($n = 853{,}925$ days or 14.4%); surgical care beds ($n = 861{,}861$ days or 14.5%); intensive care beds ($n = 177{,}017$ days or 3%) or other bed types (see Table 1).

In Table 2, the inpatient days are expressed in terms of a required number of beds which totals (in 2014) 18,986 hospital beds. Besides acute geriatric beds ($n = 7302$ out of 7392 available beds) and psychogeriatric beds ($n = 719$ out of 760 available beds), also other bed types are used/required: internal medicine ($n = 4799$ out of 14,368 available beds), surgical beds ($n = 2952$ out of 14,310 available beds), chronic care beds ($n = 2599$ out of 5650 available beds), intensive care beds ($n = 606$ out of 2026 available beds), or other beds ($n = 9$ out of 7220 available beds).

Table 1 Hospital activity in 2014 and summary of projected activity in 2025

	2014	2025	Absolute difference 2014–2025	Relative difference 2014–2025 (%)
Inpatient stays (total)	478,027	590,312	112,286	23.5
Medical APR-DRG	313,820	392,359	78,539	25.0
Surgical APR-DRG	134,587	159,076	24,489	18.2
Chronic care	29,388	38,739	9351	31.8
Inpatient days (total)	5,952,622	5,995,331	42,709	0.7
Medical APR-DRG	3,497,773	3,655,190	157,417	4.5
Surgical APR-DRG	1,352,809	1,105,179	−247,630	−18.3
Chronic care	1,050,992	1,201,194	150,202	14.3
Inpatient days per bed type				
Intensive care (I beds)	177,017	175,895	−1122	−0.6
Internal medicine (D beds)	1,401,267	1,394,174	−7093	−0.5
Surgery (C beds)	861,861	693,104	−168,757	−19.6
Acute geriatric (G beds)	2,398,828	2,483,713	84,885	3.5
Psychogeriatric (S6 beds)	236,283	305 953	69,670	29.5
Other chronic care (all other S types)	853,925	921,772	67,847	7.9
Other bed types	2543	2444	−99	−3.9

Table 2 Licensed and required bed capacity. Source licensed beds: Federal Public Service (FPS) Health

	Licensed beds 2014	Required beds 2014	Required beds 2025	Absolute Δ 2014–2025	Relative Δ 2014–2025 (%)
Total	51,995	18,986	19,058	72	0.4
Intensive care (I beds)	2026	606	602	−4	−0.7
Internal medicine (D beds)	14,638	4799	4775	−24	−0.5
Surgery (C beds)	14,310	2952	2374	−578	−19.6
Acute geriatric beds (G beds)	7392	7302	7561	259	3.5
Psychogeriatric beds (S6 beds)	760	719	931	212	29.5
Other chronic care beds (all other S types)	5650	2599	2807	208	8.0
Other bed types	7220	9	8	−1	−11.1

The number of licensed beds is based on information from December 2014 provided by the FPS Health. Licensed CD beds are attributed for 50% to C beds and for 50% to D beds

Evolution of inpatient stays

The general population will grow with 5.3% between 2014 and 2025. This growth is more pronounced for older persons: 17.4% and 22.3% increase in the age groups of people aged ≥ 75 years and ≥ 85 years, respectively. As a result, the relative share in the population of persons aged ≥ 75 years and ≥ 85 years will be 10% and 3%, respectively.

In Fig. 1, it is shown that the number of inpatient stays for our study population increased from 402,812 in 2003 to 478,027 in 2014. Based on the demographic changes (i.e. demographic reweighting based on increase in population size and ageing of the population), it is expected that by 2025 this number will be increased with 18.5% (or $n = 88{,}534$). When also taking into account changes in admission rates, it is expected that by 2025 there will be 112,286 additional inpatient stays (or an increase by 23.5%). The increase is most pronounced for chronic care stays (+ 31.8%). Stays with a medical and surgical APR-DRG are expected to rise with 25% and 18.2%, respectively (see Table 1).

Evolution in length of stay

The ALOS in our study population is expected to decrease by 18.4% (= − 2.3 days) in 2025, resulting in an ALOS of 10.2 days. The decrease will be more pronounced for patients with a surgical APR-DRG (− 3.2 days or − 31.7%), compared with patients with a medical APR-DRG (− 1.8 days or − 18.4%) or a chronic care stay (− 4.8 days or − 13.4%). The expected decrease in LOS is a general trend across the different pathology groups. When looking at the ALOS per bed type, the expected decrease ranges between 13.7% (psychogeriatric beds) and 19.5% (internal medicine beds). Only for surgical beds, the decrease (30%) is more pronounced (see Table 3).

Evolution of inpatient days

In Fig. 1 (right side), it is shown that the number of inpatient days slightly decreased (with 4.3% or 269,612 days) from 6,222,234 inpatient days in 2003 to 5,952,622 in 2014. When only looking at demographic changes (i.e. with ALOS and admission rates fixed at the level of 2014), it is expected that by 2025 the number of inpatient days will increase with 18.2% or 1,081,776 inpatient days. Yet, when applying the baseline model (demographic changes, trend in admission rates and trend in ALOS) it is expected that the number of inpatient days will only increase with 0.7% or 42,709 inpatient days.

Evolution in required bed capacity

Based on the projections from our baseline model, it is expected that the required bed capacity for our study population will be more or less the same for internal medicine (− 0.5%) and intensive care (− 0.7%) in 2025 compared to 2014. Yet, the required hospital bed capacity is expected to grow with 3.5% on acute geriatric nursing units, 29.5% on psychogeriatric nursing units and 8.0% on chronic care nursing units. On the other hand, a large decrease in surgical beds (− 19.6%) is expected (see Table 2).

Ageing scenario

When the demographic changes are accelerated (see Fig. 1), the increase in the expected number of inpatient stays between 2014 and 2025 is more pronounced: + 241,492 (+ 50.5%) stays compared to + 112,286 or (23.5%) in the baseline model. Also, the expected evolution in inpatient days is different. In the baseline model, a limited increase of + 42,709 (+ 0.7%) is expected, while in the accelerated

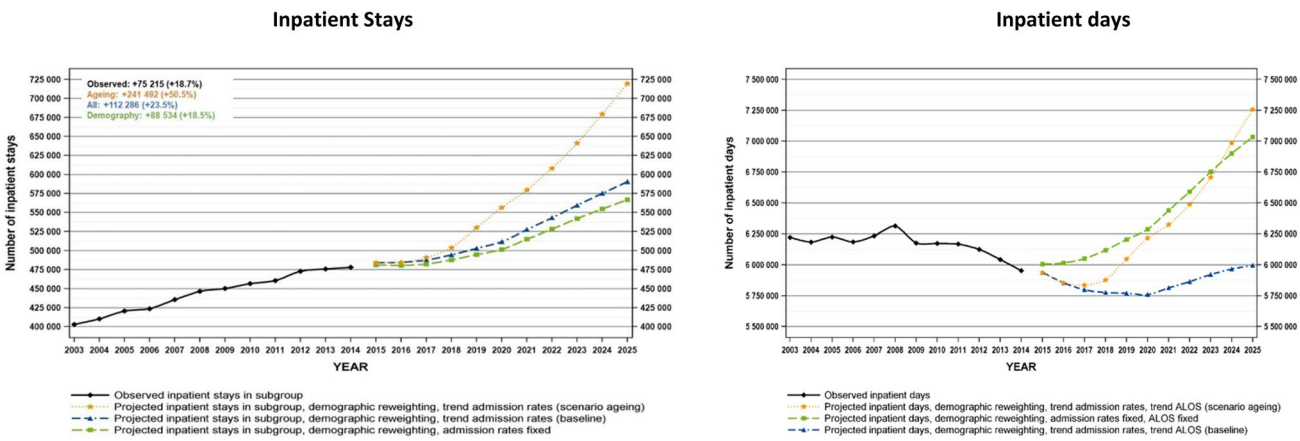

Fig. 1 Observed evolution and forecasts for hospital inpatient stays and days

Table 3 Hospital activity in 2014 and summary of projected activity in 2025

	2014 (days)	2025 (days)	Absolute difference 2014–2025 (days)	Relative difference 2014–2025 (%)
Average LOS (total)	12.5	10.2	− 2.3	− 18.4
Medical APR-DRG	11.1	9.3	− 1.8	− 16.2
Surgical APR-DRG	10.1	6.9	− 3.2	− 31.7
Chronic care	35.8	31.0	− 4.8	− 13.4
Average LOS ≥ 75	12.2	9.9	− 2.3	− 18.6
Average LOS ≥ 85	14.2	11.5	− 2.7	− 19.1
Average LOS elderly per bed type				
Intensive care (I beds)	13.2	10.8	− 2.4	− 18.2
Internal medicine (D beds)	7.7	6.2	− 1.5	− 19.5
Surgery (C beds)	7.0	4.9	− 2.1	− 30.0
Acute geriatric beds (G beds)	18.5	15.0	− 3.5	− 18.9
Psychogeriatric beds (S6 beds)	55.4	47.8	− 7.6	− 13.7
Other chronic care beds (all other S types)	33.7	28.4	− 5.3	− 15.7
Other bed types	16.1	13.7	− 2.4	− 14.9

ageing scenario the expected increase in inpatient days amounts + 1,304,793 (+ 21.9%).

The difference in the increase in the expected number of inpatient days between the baseline model and the accelerated ageing scenario can also be expressed in terms of required bed capacity: + 132 intensive care beds (+ 21.8% compared to baseline); + 1077 internal medicine beds (+ 22.4%); + 516 surgical beds (+ 17.5%); + 1573 acute geriatric beds (+ 21.5%); + 149 psychogeriatric beds (+ 20.7%); + 577 chronic beds (+ 22.2%).

Discussion

Our study documented that, anno 2014, a substantial share of the hospital capacity is used by older persons. While a large share of inpatient days for older patients takes place on geriatric nursing units, it is clear that the current capacity of these specialized nursing units is running at its limits. The estimated required capacity (7302 acute geriatric beds and 719 psychogeriatric beds) is just below the available capacity (7392 acute geriatric and 760 psychogeriatric beds). Moreover, several observations can be made based on the projections of capacity needs.

First, the hospital population is ageing at a faster pace than the general population. When only the demographic evolutions (population growth and ageing composition) are included and the admission rates and ALOS are fixed at the level of 2014, a steep increase in the required hospital capacity (1,081,776 additional inpatient days or + 18.2%) is observed. This is in line with projections made in other countries [17] where the impact of ageing, with no change in policy and practice, is expected to result in an increased need of additional hospital capacity.

Second, the impact of ageing in the short term (horizon 2025) is not so dramatic. In fact, the total required hospital bed capacity for our study population is estimated to increase with only 72 beds between 2014 and 2025 (from 18,986 to 19,058). Yet, it should be stressed that these estimates include the trends in hospital admission rates (which increase) and ALOS (which decreases). While admission rates increase and thus will result in extra capacity needs, the opposite is true for LOS. Apparently, the estimated reduction in ALOS is expected to offset the expected increase in population growth and ageing. A further reduction in LOS was also in other studies identified as the most important strategy to control the increasing demand in hospital capacity [17]. But is this realistic, given the important reductions in LOS that were already observed between 2003 and 2014? An analysis of the estimated reductions in ALOS per pathology was assessed by clinical experts as being realistic in the Belgian context [15]. Moreover, by and large, the estimated ALOS per pathology by 2025 corresponds with current lengths of stay for similar pathology groups in the USA, a country that is known to be a frontrunner in shortening the ALOS [15]. Yet, this will not be achieved automatically. On the contrary, a continued investment in a better management of inpatient services with the aim of increasing efficiency and reducing LOS will be needed. This is a challenge given that both in the international [18] and in the Belgian context [19] it has been shown that older patients represent a large share of the patients who stayed inappropriately in hospital and were waiting for discharge due to a lack of alternatives (e.g. a place in a residential care facility). As such, policy

efforts will not only have to target hospital care (e.g. financial incentives to stimulate efficiency and decrease length of hospital stay) but will also have to concern the development of alternative care structures (e.g. hospital at home; day-care services in nursing homes) and improved integration of care (e.g. smooth transition from hospital towards home care; outreach teams; follow-up visits after discharge) [13, 20–22].

It will be challenging not to compromise the quality of care and patient satisfaction while the LOS in hospital is further reduced. A special attention point will be the patient-to-nurse ratios. After all, this reduction in LOS will induce a higher patient turnover, compression of care and thus an increased nursing intensity per remaining nursing day [23]. Consequently, when the number of patients for which one nurse is responsible is not lowered, the quality of care and patient safety might be jeopardized [24, 25].

A third observation is that there are important shifts in the type of hospital beds that will be needed in the near future. While the required bed capacity on internal medicine and intensive care units will remain relatively stable, a sharp decrease (i.e. 19.6%) in required surgical beds is expected. This can be explained by the fact that compared to internal medicine, the care pathways for elective surgery can be better standardized leaving more room for reduction in LOS and shifts towards day surgery [26, 27]. In addition, it is observed that additional capacity will be needed on geriatric nursing units (i.e. acute geriatric and psychogeriatric units) and chronic care nursing units. This additional capacity can be obtained by converting bed types for which there is excess capacity (e.g. general surgery, maternity care and paediatric care) [15] in geriatric care capacity. This will require that policymakers proactively take measures to strengthen the geriatric workforce (nurses, physicians and other healthcare professionals). This is a challenge because the geriatric workforce is already known to be under pressure nowadays in many countries. Moreover, it is often perceived as one of the less prestigious disciplines of medicine [28–30]. Policy measures will be needed to increase the attractiveness of this medical specialism such as an increase in the number of available training settings, including a 'geriatric training (i.e. courses and clinical placements) component' in basic curricula of physicians, nurses and allied health professionals as well as making the discipline financially attractive to work.

A fourth observation is that expanding the capacity of the gold standard organizational model (i.e. acute geriatric nursing units) will not be sufficient. Already in 2014, an important number of inpatient days for older patients [9] are on non-geriatric nursing units. This number will continue to increase. As such, alternative organizational models will have to be developed to ensure that geriatric expertise is also available on non-geriatric wards. As geriatric consultation teams have failed in the past to impact clinical outcomes, more and more countries are now experimenting with alternatives such as the co-management model. This model can be described as 'the most far-reaching model of shared care between a general treating physician and a geriatrician since they manage the patient together from admission until discharge and are both responsible for the process and outcome of provided care' [31]. Yet, the evidence about co-management care models for geriatric patients is still too premature to be conclusive about its effectiveness [31–34].

A fifth observation is that it is time to act now to be prepared for the real challenges that are not situated in 2025 but 5 years later and beyond. Indeed, most of the patterns observed above (shifts in required bed types, increases in geriatric hospital capacity, the important share of inpatient days on non-geriatric wards) will exponentially grow by the time population ageing is peaking (from 2030 onwards). Since most of the policy measures (e.g. educating a workforce) take time to have impact, these results create a sense of urgency to act upon. The mainstream idea is that older persons should be cared for in other care setting than a hospital (e.g. at home, day-care facilities) whenever possible and that in future less hospital capacity is required. This study shows that a substantial investment in these alternatives is required to put this ambition into practice.

Our study has several limitations. First, we estimated the required hospital capacity based on utilization patterns rather than on needs. The claim that healthcare ought to be determined and distributed according to 'need' is frequently encountered in both the academic literature and policy documents, but often not achieved due to the absence of data about needs. Also, in this study the data availability was the reason to work with utilization patterns rather than with needs. When interpreting the results, it is important to take into account the difference between these concepts. Need is changed to a demand when an individual considers to have a need and is willing to spend resources such as money or time. Individuals may demand services but not receive care because they cannot afford the service, or because the service is not available. Hence, for demand to become use, also the supply side of the healthcare market has to be taken into consideration [35].

Second, to anticipate on the real demographic peak in older persons that will appear from 2030 onwards, a scenario of accelerated ageing was calculated. It should be noted that only adjustments are made for the make-up of the population, not for population size. As such, this accelerated ageing scenario is not the same as making projections until 2030. Our accelerated ageing scenario allows to evaluate the effects of population ageing on hospital care use, independently from the effect of the change in population size. The trend projections for ALOS and admission rates remain the same and correspond to the matching baseline projection year. This choice was made in favour of projections

until 2030 which would induce much more uncertainty in the projections of length of stay and admission rates.

Conclusion

This study showed that the demographic evolutions and the ageing population in particular call for careful hospital capacity planning. Indeed, already by 2025 additional hospital capacity in the domain of geriatric and chronic care will be needed to ensure that care for older patients can be provided in a qualitative manner. This additional capacity can be obtained by converting general surgical hospital beds, for which a surplus capacity will exist, into geriatric and chronic care beds. Yet, the real challenge is not to transform these structures but to make sure that an educated and experienced workforce is available to staff these structures. While initially further reductions in LOS can control the demand for additional capacity, this will (unless drastic policy actions are taken to boost hospital alternatives) no longer be possible from 2030 onwards when ageing starts to peak. Alongside alternatives to hospitals (e.g. nursing homes, respite care, hospital at home, outreach teams, medical day hospital for older persons, specific interventions for older persons in the emergency department) to further reduce the LOS and avoid inappropriate hospital admissions, a substantial injection in the hospital capacity for the older persons will probably be needed. This additional capacity concerns dedicated geriatric and chronic care nursing units as well as organizational models that enable to provide geriatric expertise on non-geriatric nursing units. The latter will be necessary to deal with the growing number of older and geriatric patients admitted outside geriatric units.

Acknowledgements We are grateful to Dr. Ingrid Mertens (Ministry of Health), Julien Regnart (Ministry of Health) and Stephan Devriese (KCE) for their help during the data handling process.

Funding This study was funded by the Belgian Health Care Knowledge Centre (KCE). The KCE is a federal institution which is financed by the National Institute for Health and Disability Insurance (NIHDI, RIZIV—INAMI), the Federal Public Service of health, food chain safety and environment, and the Federal Public Service of social security. The development of health services research studies is part of the legal mission of the KCE. Although the development of the studies is paid by the KCE budget, the sole mission of the KCE is providing scientifically valid information.

Compliance with ethical standards

Conflicts of interest The authors declare that they have no conflict of interest.

Ethical approval This article does not contain any studies with human participants performed by any of the authors.

Informed consent For this type of study (use of anonymized administrative data), formal consent is not required.

References

1. United Nations (2017) Ageing. http://www.un.org/en/sections/issues-depth/ageing/
2. WHO (2015) World report on ageing and health. World Health Organization, Geneva
3. Organization for Economic Co-operation and Development (OECD) (2004) Ageing societies and the looming pension crisis. OECD, Paris
4. Deschodt M, Claes V, Van Grootven B, Van den Heede K, Flamaing J, Boland B, Milisen K (2016) Structure and processes of interdisciplinary geriatric consultation teams in acute care hospitals: a scoping review. Int J Nurs Stud 55:98–114
5. Paulus D, Van den Heede K, Gerkens S, Desomer A, Mertens R (2013) Development of a national position paper for chronic care: example of Belgium. Health Policy 111:105–109
6. European Union of Medical Specialists–Geriatric Medicine Society (UEMS-GMS) (2008) Geriatric medicine definition in English, German, French, Dutch, Slovakian, Lithuanian, Hungarian, Swedish and Bulgarian, http://uemsgeriatricmedicine.org/UEMS1/dok/geriatric_medicine_definition.pdf
7. Wise J (2018) Number of older people with four or more diseases will double by 2035, study warns. BMJ 360:k371
8. Oo MT, Tencheva A, Khalid N, Chan YP, Ho SF (2013) Assessing frailty in the acute medical admission of elderly patients. J R Coll Physicians Edinb 43:301–308
9. Deschodt M, Wellens NI, Braes T, De Vuyst A, Boonen S, Flamaing J, Moons P, Milisen K (2011) Prediction of functional decline in older hospitalized patients: a comparative multicenter study of three screening tools. Aging Clin Exp Res 23:421–426
10. Ellis G, Whitehead MA, Robinson D, O'Neill D, Langhorne P (2011) Comprehensive geriatric assessment for older adults admitted to hospital: meta-analysis of randomised controlled trials. BMJ 343:d6553
11. Baztan JJ, Suarez-Garcia FM, Lopez-Arrieta J, Rodriguez-Manas L, Rodriguez-Artalejo F (2009) Effectiveness of acute geriatric units on functional decline, living at home, and case fatality among older patients admitted to hospital for acute medical disorders: meta-analysis. BMJ 338:b50
12. Fox MT, Sidani S, Persaud M, Tregunno D, Maimets I, Brooks D, O'Brien K (2013) Acute care for elders components of acute geriatric unit care: systematic descriptive review. J Am Geriatr Soc 61:939–946
13. Pallin DJ, Espinola JA, Camargo CA Jr (2014) US population aging and demand for inpatient services. J Hosp Med 9:193–196
14. Vandresse M, Duyck J, Paul J-M (2017) Demographic forecasts 2016-2060, population and households. Demographic forecasts. Federal Planning Bureau and Statistics Belgium, Brussels
15. Van de Voorde C, Van den Heede K, Beguin C, Bouckaert N, Camberlin C, de Bekker P, Defourny N, De Schutter H, Devos C, Gerkens S, Grau C, Jeurissen P, Kruse FM, Lefèvre M, Lievens Y, Mistiaen P, Vaandering A, Van Eycken E, van Ginneken E (2017) Required hospital capacity in 2025 and criteria for rationalisation of complex cancer surgery, radiotherapy and maternity services. KCE Reports. Belgian Health Care Knowledge Centre (KCE), Brussel
16. HayGroup (2015) Developing a Health Care Capacity Plan for Ontario—"Proof of Concept": report submitted to: The Ontario Hospital Association. Toronto, Ontario

17. Kwok CL, Lee CK, Lo WT, Yip PS (2016) The contribution of ageing to hospitalisation days in Hong Kong: a decomposition analysis. Int J Health Policy Manag 6:155–164
18. Toh HJ, Lim ZY, Yap P, Tang T (2017) Factors associated with prolonged length of stay in older patients. Singapore Med J 58:134–138
19. Nationale raad voor Ziekenhuisvoorzieningen (2015) Advies betreffende de alternatieve zorgvormen
20. Huntley AL, Chalder M, Shaw ARG, Hollingworth W, Metcalfe C, Benger JR, Purdy S (2017) A systematic review to identify and assess the effectiveness of alternatives for people over the age of 65 who are at risk of potentially avoidable hospital admission. BMJ Open 7:e016236
21. Philp I, Mills KA, Thanvi B, Ghosh K, Long JF (2013) Reducing hospital bed use by frail older people: results from a systematic review of the literature. Int J Integr Care 13:e048
22. Pedersen LH, Brynningsen P, Foss CH, Gregersen M, Barat I, Damsgaard EM (2018) Avoidable readmissions seem to be reduced by early follow-up visits for geriatric patients discharged from hospital. Eur Geriatr Med 9:613–621
23. Sermeus W, Delesie L, Van den Heede K, Diya L, Lesaffre E (2008) Measuring the intensity of nursing care: making use of the Belgian Nursing Minimum Data Set. Int J Nurs Stud 45:1011–1021
24. Aiken LH, Sloane DM, Bruyneel L, Van den Heede K, Griffiths P, Busse R, Diomidous M, Kinnunen J, Kozka M, Lesaffre E, McHugh MD, Moreno-Casbas MT, Rafferty AM, Schwendimann R, Scott PA, Tishelman C, van Achterberg T, Sermeus W, Consortium RC (2014) Nurse staffing and education and hospital mortality in nine European countries: a retrospective observational study. Lancet 383:1824–1830
25. Leary A, Punshon G (2019) Determining acute nurse staffing: a hermeneutic review of an evolving science. BMJ Open 9:e025654
26. Leroy R, Camberlin C, Lefevre M, Van den Heede K, Van de Voorde C, Beguin C (2017) Variability in elective day-surgery rates between Belgian hospitals—analyses of administrative data explained by surgical experts. Int J Surg 45:118–124
27. Lewis R, Edwards N (2015) Improving length of stay: what can hospitals do? Nuffieldtrust
28. Golden AG, Silverman MA, Issenberg SB (2015) Addressing the shortage of geriatricians: what medical educators can learn from the nurse practitioner training model. Acad Med 90:1236–1240
29. Kovner CT, Mezey M, Harrington C (2002) Who cares for older adults? Workforce implications of an aging society. Health Aff (Millwood) 21:78–89
30. Barriball L, Bremner J, Buchan J, Craveiro I, Dieleman M, Dix O, Dussault G, Jansen C, Kroezen M, Rafferty AM, Sermeus W (2015) Recruitment and retention of the health workforce in Europe. In: Workforce D-GfHaFSRaRotH (ed) Brussels
31. Grigoryan KV, Javedan H, Rudolph JL (2014) Orthogeriatric care models and outcomes in hip fracture patients: a systematic review and meta-analysis. J Orthop Trauma 28:e49–e55
32. Van Grootven B, Flamaing J, Dierckx de Casterle B, Dubois C, Fagard K, Herregods MC, Hornikx M, Laenen A, Meuris B, Rex S, Tournoy J, Milisen K, Deschodt M (2017) Effectiveness of in-hospital geriatric co-management: a systematic review and meta-analysis. Age Ageing 46:903–910
33. Buecking B, Timmesfeld N, Riem S, Bliemel C, Hartwig E, Friess T, Liener U, Ruchholtz S, Eschbach D (2013) Early orthogeriatric treatment of trauma in the elderly: a systematic review and metaanalysis. Dtsch Arztebl Int 110:255–262
34. Baroni M, Serra R, Boccardi V, Ercolani S, Zengarini E, Casucci P, Valecchi R, Rinonapoli G, Caraffa A, Mecocci P, Ruggiero C (2019) The orthogeriatric comanagement improves clinical outcomes of hip fracture in older adults. Osteoporos Int 30:907–916
35. Wright J, Williams R, Wilkinson JR (1998) Development and importance of health needs assessment. BMJ 316:1310–1313