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Hospital care for persons with AIDS in the European Union

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Abbreviations: AIDS, acquired immunodeficiency syndrome; CS, chronic stage of AIDS; EU, European Union; HIV, human immunodeficiency virus; IPD, hospital inpatient days; LS, late stage of AIDS; OPC, outpatient hospital contacts; PCP, *Pneumocystis carinii* pneumonia; Ppy, per person-year; PWA, person with AIDS; PY^{CS}, person-years in the chronic stage of AIDS; PY^{LS}, person-years in the late stage of AIDS; R, reference scenario; T, therapy scenario; THC, total hospital contacts; U, unavoidable scenario.

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Abstract

This study estimates the current and future hospital resources for AIDS patients in the European Union (EU), using multinational scenario analysis (EU Concerted Action BMH1-CT-941723). In collaboration with another EU-project ('Managing the Costs of HIV Infection'), six national European studies on the utilization of hospital care for AIDS have been selected to provide the data for our analysis. The selection criteria involve recentness, quality, comparability, accessibility and representativeness. Baseline hospital resource utilization is estimated for hospital inpatient days and outpatient contacts, using a standardized approach controlling for two severity stages of AIDS (chronic stage and late stage). The epidemiological part of the study is based on standard models for backcalculating HIV incidence and projecting AIDS incidence, prevalence and mortality. In the next step, baseline resource utilization is linked to epidemiological information in a mixed prevalence and mortality-based approach. Several scenarios render different future epidemiological developments and hospital resource needs. For the year 1999, hospital bed needs of 10 000–12 700 in the EU are indicated, representing an increase of 20–60% compared to the estimated current (1995) level. The projected range for 1999 corresponds to a maximum of 0.65% of all hospital beds available in the EU. The growth in the number of outpatient hospital contacts is projected to possibly exceed that of inpatient days up to 1.82 million in 1999. Our methodology illustrates that estimation of current and future hospital care for AIDS has to be controlled for severity stages, to prevent biases. Further application of the multinational approach is demonstrated through a 'what-if' analysis of the potential impact of combination triple therapy for HIV/AIDS. Estimation of the economic impact of other diseases could as well benefit from the severity-stages approach. © 1997 Elsevier Science B.V.

Keywords: European Union; Scenarios; Projections; Economic impact; Hospital care; Severity staging; AIDS

1. Introduction

Several studies in the European Union (EU) have produced projections of the future costs of HIV/AIDS [1–6]. To date, such economic impact estimation has been limited to the level of an individual region or country. Only one study has attempted to go beyond the national level by developing several scenarios of the future bed needs and hospital costs for the EU as a whole [7]. Recently, an EU Concerted Action was initiated for the development of multinational scenarios to estimate the epidemiological and socio-economic impacts of AIDS [8,9]. In this paper we report on the impacts of AIDS on the hospital care systems. Estimation of this impact at the multinational level must be based on a standardized approach towards analyzing available national information on health care resource utilization and costs, as has been developed in a parallel EU-project [10–12]. In addition, standardized surveillance and modelling of the national HIV/AIDS epidemics is needed, since the expected number of AIDS cases is the starting point of any estimation of the national burden on health care resources [13,14].

Scenario analysis provides techniques for estimating disease impact under uncertain future conditions in terms of epidemiology, prevention, medical treatment and health care technology. It involves the definition of a generic set of future projections, representing different 'what-if' scenarios which are compared to a specifically defined baseline including the reference scenario [15]. Our previous analysis [7] suggested that hospital bed needs of persons with AIDS (PWAs) in 1995 would range from 5000 to 10 000 for the EU as a whole, based on reported average intensities of care in the few European studies on hospital resource utilization that were available at that time. It was impossible to specify the care intensities according to patient characteristics, such as severity level of AIDS. Since this time, more data have become available and further progress has been made in the methodology of multinational scenarios through the EU Concerted Action. In the present paper, we report on methodological improvements in the scenarios on hospital care and present updated multinational scenario results. In particular, we are now able to apply an approach that allows the specification of relevant stages of disease severity. The choice for an actual severity staging is related to differences in health care utilization within the AIDS stage, between the AIDS stage and pre-AIDS stages and to effects of recently introduced new therapies to HIV/AIDS (for example combination triple therapy).

In the next paragraph we focus a standardized approach for comparing data from international databases on hospital resource utilization of PWAs, accounting for stages of disease severity. Furthermore, the incorporation of severity stages in the projection/scenario methodology is described. In the Section 3 a baseline set of scenarios is presented for hospital bed needs and outpatient hospital facilities until 1999 for the EU, using a standardized model for the past, current and future development of national HIV/AIDS epidemics. Finally, a 'what-if' analysis of the potential impact of combination triple therapy is presented and an application of our approach to other diseases is discussed. In general, this study can benefit the planning of hospital care facilities for PWAs in the next years at the EU-level.

2. Data and methods

2.1. Backcalculation and epidemiological information

In the framework of a previous [16,17] and the current EU-Concerted Action an empirical backcalculation methodology has been developed and applied as a standard approach for epidemiological estimations in all European countries [18,19]. Our latest application [20] was based on AIDS surveillance data as of 31 March 1994 according to the 1987 AIDS surveillance case definition [21,22]. A staged model is used for disease progression [23] that takes into account under-reporting, delays in reporting [24] and possible effects of pre-AIDS treatments [25]. Work to improve and update the epidemiological model is still ongoing in the Concerted Action. Therefore the estimates used in this paper should be considered as preliminary.

For each individual EU member state, the output of the epidemiological model comprises estimated (1978–1993) and projected (1994–1999) annual adult transmission-group-specific incidence of HIV and AIDS[2]. In these calculations, two assumptions for the post-1993 HIV incidence were used to predict post-1993 AIDS incidence. In one, annual HIV incidence is constant from 1994 onwards at the estimated average 1990–1993 level. In the second no new infections occur after 1993, and thus provides an estimation of the unavoidable future AIDS epidemic given the prevailing treatment standards. Linking both assumptions with hospital care gives rise to respectively the reference scenario (R) and the unavoidable scenario (U). In the present analysis, prevalence and mortality of PWAs have been estimated from an assumed exponential survival distribution in the AIDS stage with a mean of 2 years for PWAs diagnosed in 1987 or later, and 1 year for those diagnosed earlier [7]. In view of ongoing developments in AIDS therapies and related survival improvements [26,27], we investigate a third scenario labelled therapy scenario (T). This scenario indicates the impact on prevalence and hospital care of prolonging survival to a mean of 3 years.

2.2. Information on hospital care in the EU: study selection

Several reviews summarize studies on the impact of AIDS on European health care systems [28–31]. In addition, several new studies in this field have reported results in the last 3 years. In total 22 studies have reported results for hospital care utilization: one for Belgium [32], France [33] and Portugal [34], two for Germany [35,36] and Spain [1,37], three for Greece [38–40], Italy [41–43] and four for The Netherlands [2,44,45] and the UK [46–49]. Of the studies 50% refer to the 1980s, the rest include 1990 or later. In general, sizes and distributions of the patient populations in these studies do not yet allow the assessment of differences between transmission groups. Inclusion of studies in this list is based on minimum technical standards on quality and comparability, related to the sample size, registration period and reporting (for example of disease stage) [11].

For the present purpose of linking epidemiology and health care in future scenarios a further selection of studies was necessary. Three criteria were adopted. Firstly, information should be recent (1990 or later) reflecting current efficiency of practices in hospital care. During the 1980s and into the 1990s, efficiency has changed due to increasing experience with managing PWAs [50,51]. Furthermore, resource utilization has been controlled by more effective use; for example the substitution of less expensive outpatient care for hospital inpatient care [52]. Secondly, selected studies should include data that can be assumed to be representative of the national situations. We consider the representativeness of study estimates to be safeguarded in multicenter studies. Thirdly, the resource utilization

[2] Because of small numbers the method was not applied to Luxembourg. In the present analysis we do not consider Luxembourg since the contribution to EU-totals on incidence, prevalence and health care needs can be neglected. The three countries who joined the EU in 1995 (Austria, Finland and Sweden) are not yet included.

data of selected studies should be patient-based, enabling resource utilization to be linked to individual patients, patient groups and disease stages, such as HIV infection and specific opportunistic illnesses. The studies satisfying most of these criteria are summarized in Table 1 [53–61].

2.3. The severity-staging concept

Several studies have indicated the importance of severity of illness for resource utilization of PWAs [62–67]. In some studies a U-shaped relationship between AIDS-related resource utilization and disease progression has been hypothesized [68–70]: high resource utilization immediately following the AIDS diagnosis and during the late terminal stage and low resource utilization during the intermediate period. This pattern describes the development of economically defined severity levels. Fig. 1 presents information for hospital inpatient days using data from one Dutch study [70]. Clearly, the rise in resource utilization intensity is more pronounced for the late phase and extends over several subperiods, whereas the rise in intensity after AIDS diagnosis seems to exist only in the first subperiod. Further analysis excluding PWAs with *Pneumocystis carinii* pneumonia (PCP) as AIDS-defining diagnosis, demonstrated intensities of hospital inpatient days utilization below the average level in both the period following the onset of the disease and the intermediate phase (Fig. 1). The availability of PCP prophylaxis in recent years supposedly contributed to "a shift in inpatient days utilization from the time near date of diagnosis toward the time of death" [71]. Compared to other periods, almost 4-fold hospital inpatient resource utilization or costs during the last 6 months of life is reported for The Netherlands and the USA in the early 1990s [2,72–74].

In consequence of the above, a study with a relatively large share of late stage PWAs is likely to report a completely different pattern of hospital inpatient resource utilization than one with predominantly non-late stage (chronic) PWAs. Neglecting this phenomenon could lead to serious errors in estimating hospital

Table 1
Selected studies on hospital resource utilization for scenario analysis

Country and reference source	Period	Hospitals	PWAs	PY^{CS}	PY^{LS}
France [54,55]	1992–1993	9	1384	922	237
Greece [39,55–57]	1990–1991[a]	2	101	86	36
Italy [43,58]	1994	10	264	104	40
The Netherlands [2,59]	1991–1992	4	182	145	39
Spain [60]	1990–1993	1	97	30	21
UK [47,61]	1990–1991	1	122	67	25

The table includes the estimation period, number of hospitals involved, number of persons with AIDS (PWAs), number of person-years in the chronic stage (PY^{CS}) and number of person-years in the late stage (PY^{LS}).

[a] In the Greek study some pre-1990 registration could not be excluded.

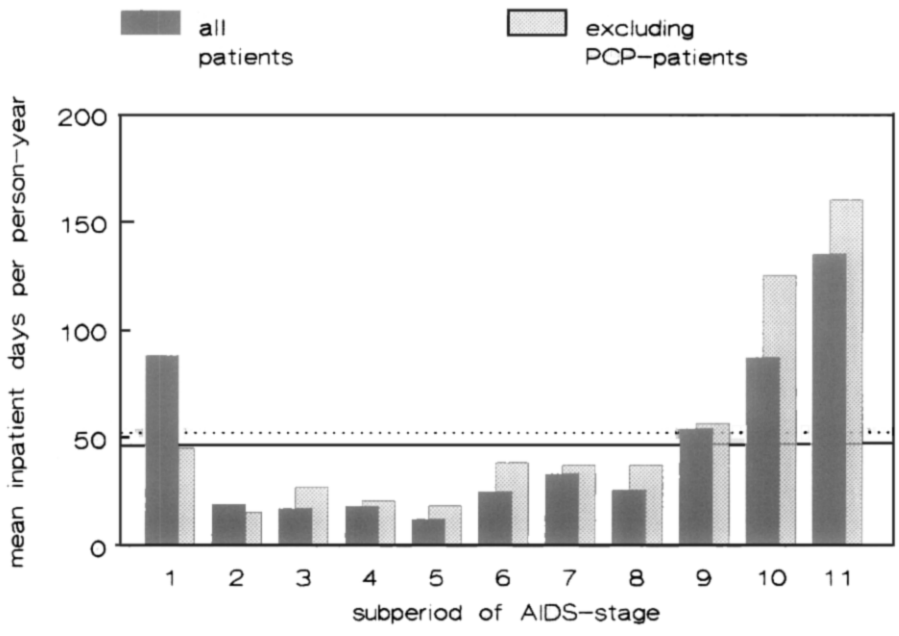

Fig. 1. Mean number of inpatient days per person-year in the Academic Hospital Utrecht (the Netherlands; [70]) for 11 consecutive subperiods during the AIDS-stage for all patients who died in 1990–1992 ($n = 54$; 43.28 person-days per subperiod) and excluding those with *Pneumocystis carinii* Pneumonia (PCP) as AIDS-defining diagnosis ($n = 32$; 36.82 person-days per subperiod). The solid line shows the average level for all patients, the dotted one the average level for non-PCP patients.

resource utilization parameters per person-year (ppy) [75]. We have therefore chosen to differentiate two stages for PWAs: a final stage of maximally 6 months before death (late stage; LS) and a stage for the foregoing period (chronic stage; CS). This staging concept has previously been applied to The Netherlands [2].

2.4. The severity-mix modelling approach

Standardized data on person-years, inpatient days and outpatient contacts (outpatient visits or day-care treatments) were collected from the selected studies, in order to estimate resource utilization ppy in CS and LS. Person-years and resource utilization were attributed to LS if they occurred during the final 6 months of AIDS preceding death[3] and were attributed to CS, if they occurred before the final 6 months preceding death (for deceased patients) or before the last 6 months of their registration (for patients alive by the end of the registration or follow-up period). The last column in Table 1 shows person-years in CS and LS in the selected studies.

[3] If the period between AIDS diagnosis—or the start of the registration—and death was less than half a year, the whole period was attributed to LS.

In the next step epidemiological information was linked with ppy hospital resource needs of PWAs. Estimated ppy hospital resource utilization was used as an approximate for resource needs, implicitly assuming that recorded resource utilization reflects actual care needs. The approach adopted for linking was a mixed prevalence and mortality-based approach. Annual resource needs for CS were estimated by multiplying the annual period-prevalence in CS by the appropriate ppy resource-need parameters for CS[4]. Annual resource needs for LS were estimated by multiplying annual mortality by the duration of stay in LS (6 months or less) by the appropriate ppy resource-need parameters[5]. It was assumed that ppy resource need remains stable over calendar time in each stage so that the effect of changes in epidemiology can be isolated. Estimates are presented for the years 1990, 1995 and 1999, using computer simulation and a spreadsheet. The year 1990 was chosen as the baseline year since epidemiological estimates are reliable and the economic data used are centered around 1990 in the original studies. The year 1995 was included to enable comparison with our previous estimates.

2.5. Generalization to the whole EU

Table 1 provides a partial picture of AIDS hospital resource utilization patterns in the EU. No adequate hospital resource utilization information could be selected for Ireland (no studies available), Belgium (most recent available study was from 1988), Denmark (most recent available study was from 1986) and Germany (most recent available study was from 1987) and Portugal (no patient-based information and no information on ambulatory hospital services available). To generalize our

[4] Period-prevalence of PWAs was measured in terms of person-years. For simplicity, we modelled the AIDS incidence to occur halfway the year. The formula for the number of person-years in CS in year t is:

$$PY^{CS}(t) = (P(t) - I(t) * P[S > 0.5]) * 1.0 + I(t) * P[S > 1.0] * 0.5 + I(t) * P[0.5 < S < 1.0] * E[S - 0.5 \mid 0.5 < S < 1.0]$$

Where P(t) is the end-of-the-year prevalence, I(t) the incidence in year t, $P[S > 0.5]$ is the probability of a PWA surviving longer than a half year after AIDS diagnosis, $P[S > 1.0]$ is the probability of a PWA surviving longer than one year after AIDS diagnosis, $P[0.5 < S < 1.0]$ is the probability of a PWA surviving between a half and one year and $E[S - 0.5 \mid 0.5 < S < 1.0]$ the expected survival in CS of PWAs surviving between a half and one year (slightly less than 0.25 years due to the characteristics of the exponential distribution). The factors 1.0 and 0.5 represent the durations of stay in CS of respectively the non-incident and the incident parts of end-of-the-year prevalence.

[5] The formula for the person-years in the late stage in year t is:

$$PY^{LS}(t) = (M(t) - P[S < 0.5] * I(t)) * 0.5 + P[S < 0.5] * I(t) * E[S \mid S < 0.5]$$

With M(t) mortality in year t, $P[S < 0.5]$ reflects the probability of a PWA surviving less than a half year after AIDS diagnosis and $E[S \mid S < 0.5]$ the expected survival of PWAs dying within a half year after AIDS diagnosis. The latter duration is smaller than 0.25 years due to the characteristics of the exponential distribution used. The factor 0.5 in the first part of the formula reflects the duration of stay in LS of PWAs surviving half a year or longer.

results to the whole EU, we calculated average ppy resource needs in CS and LS for each year in the countries of Table 1, and applied these to the countries with missing information. To indicate some of the sensitivity of the results with regard to this assumption, as an alternative we applied data of neighboring countries to the missing countries (Dutch data for Germany and Denmark; French data for Belgium; Spanish data for Portugal; UK data for Ireland).

3. Results

Table 2 presents estimated hospital resource utilization per person-year for the two severity stages of PWAs. Inpatient days ppy vary between 4 (Greece; CS) and 160 (Spain; LS). Inpatient days ppy in the late stage are several times those in the chronic stage. In Greece relatively frequent use is made of outpatient services for CS patients (one of the two Greek hospitals specializes in dermatology, involving a high intensity of outpatient care management). In both Italy and Greece total

Table 2
Hospital resource utilization per person-year of AIDS by country and patient group (chronic versus late; see text)

Country	Stage	IPD	OPC	THC
France	CS	57.2	12.7	69.9
	LS	143.4	11.0	154.4
Greece	CS	4.3	75.6	79.9
	LS	44.1	33.8	77.9
Italy[a]	CS	32.6	44.1	76.7
	LS	59.8	28.5	88.3
The Netherlands	CS	23.5	21.0	44.5
	LS	79.7	22.9	102.6
Spain[b]	CS	22.6	13.6	36.2
	LS	159.8	22.9	182.7
UK	CS	26.8	14.9	41.7
	LS	65.1	22.8	87.9

Reference source as in Table 1.
CS, chronic stage; LS, late stage; IPD, inpatient days; OPC, outpatient contacts; THC, total hospital contacts (inpatient days and outpatient contacts).
[a] Due to the relatively short registration period of 7 months we did not discard the last 6 months before registration closure of surviving patients, which would have left only 1 month per surviving patient. Instead, we attributed all person-years and resource utilization of patients with a relatively low life expectancy to LS, in particular of those diagnosed in the most severe Turner-stage (estimated median survival: 7 months) [63]. The Italian one is the only selected database that includes information on the Turner-stage.
[b] Since the registration is based on episodes of disease, the last 6 months had to be approximated by taking the last or last few episodes.

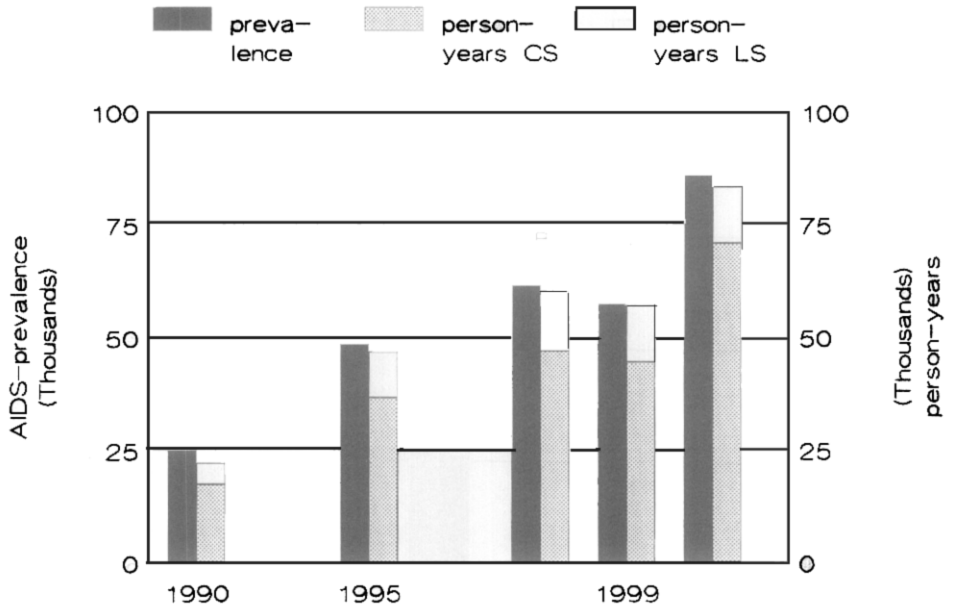

Fig. 2. AIDS prevalence and person-years in 1990, 1995 and three scenarios for 1999 (R, U and T: see text). Person-years are differentiated between chronic stage (CS) and late stage (LS).

hospital contacts ppy are rather similar for CS and LS[6]. France and Spain exhibit the opposite pattern of a high proportion of inpatient resource utilization (up to 93% for LS patients in France). Furthermore, in these two countries and The Netherlands and the UK total hospital contacts ppy exhibit greater care intensity for LS than for CS. Total hospital contacts ppy in CS are around 70–80 for France, Greece and Italy and around 35–45 for The Netherlands, Spain and UK. Estimated ppy outpatient contacts don't provide an obvious pattern: lower for CS than LS in Spain and the UK, similar in France and The Netherlands and higher for CS than LS in Greece and Italy.

Fig. 2 presents some of the epidemiological results for the EU used as a basis for estimating total current hospital resources for PWAs and producing future resource needs scenarios. End-of-the-year prevalence is estimated to have grown from 25 000 PWAs in 1990 to 49 000 in 1995. Projections corresponding to the three scenarios all demonstrate a higher prevalence in the year 1999 (up to 86 000 PWAs for the therapy scenario T). The projection for the unavoidable scenario U—without new HIV infections since 1993—shows an increase of 18% between 1995 and 1999. The reference scenario R—including new HIV infections from 1994 onwards—indicates an increase of 27% over the same period. Due to the fact that AIDS incidence is higher than AIDS mortality, the estimates of person-years in Fig. 2 are below

[6] Total hospital contacts are the sum of inpatient days and outpatient contacts and represent the intensity of hospital–patient interaction.

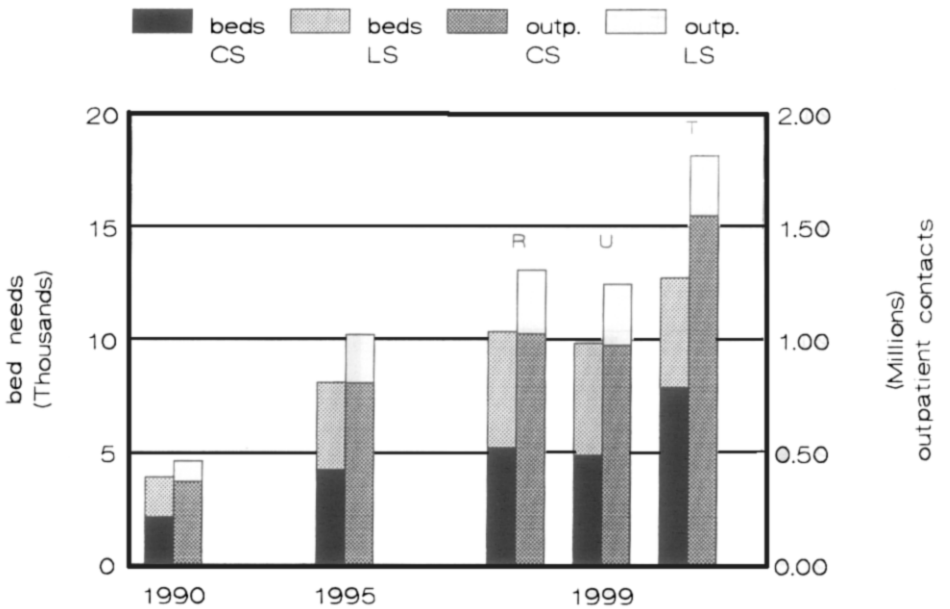

Fig. 3. Hospital bed needs (left axis) and outpatient contacts (right axis) for AIDS in 1990, 1995 and three scenarios for 1999 (R, U and T: see text). Contributions to resource needs are differentiated in chronic stage (CS) and late stage (LS).

estimated prevalences (end-of-the year prevalence includes incident cases and neglects mortality). The severity mix is such that 22% of the person-years refers to LS, except in scenario T where only 15% refers to LS. The North-South shift in the AIDS epidemic causes the proportion of person-years in Spain and Italy in the EU-total to increase from 42% in 1990 to 56% in 1999.

Fig. 3 presents our baseline set of three scenarios. In the reference scenario, hospital bed need is projected to increase by 28% from 8100 in 1995 to 10400 in 1999 (Fig. 3)[7]. Respective growth rates for scenarios U and T are 22 and 57%. The latter growth rate for scenario T indicates that person-years outgrow hospital beds by 13%. The corresponding projected trend in ppy inpatient days is therefore downward in scenario T, as opposed to the stabilization projected in scenarios R and U (1990: 54.5; 1995: 53.7; 1999R: 53.3; 1999U: 53.4; 1999T: 47.4). The trend in this 'average EU ppy inpatient days figure' is affected by two driving forces: the distributions of person-years (i) over countries (geographical development) and (ii) over CS and LS (severity-mix development). The increasing relative importance of the Spanish and Italian epidemics in the EU causes a downward pressure on total EU ppy inpatient days due to the relatively low ppy inpatient days for CS in Spain and LS in Italy. Reductions in overall ppy inpatient days for scenarios R and U can

[7] Scenarios on bed need are derived from the inpatient days estimates, assuming a bed occupancy rate of 85%.

be explained by the dominance of the geographical development. The severity-mix development dominates scenario T, where the explicit assumption of increasing survival inflates the relative importance of CS with relatively low ppy inpatient days. Ppy inpatient days for CS and for LS are respectively 34–37 and 118–119. Except for scenario T, there exists a tendency of a growing contribution of LS to EU bed needs, towards 50% in 1999. Because the intensity of care in terms of nursing, specialist consultations and drugs is probably higher for PWAs in LS, the average inpatient day in 1999 carries a higher burden of care. As an important consequence, in two of the scenarios a higher average burden of care per inpatient day adds to the projected growth in the number of inpatient days.

In the reference scenario, hospital outpatient contacts are projected to increase by 28% from 990 000 in 1995 to 1.3 million in 1999 (Fig. 3). Respective growth rates for scenarios U and T are 22 and 78%. For all scenarios, growth rates are identical to those for total person-years. Therefore, corresponding projected ppy outpatient contacts are stable over time and between scenarios with a range from 20.9 in 1990 to 21.8 in later years. The increase from 1990 onwards can be explained by the increasing importance of the Italian epidemic in the total EU-epidemic, with relatively high ppy outpatient contacts in Italy. Ppy outpatient needs differ little between CS and LS (respectively 22 versus 21). As for person-years, approximately 80% (85% in scenario T) of outpatient contacts are associated with CS. In general, the share of outpatient contacts in total hospital contacts is projected to increase slightly from 29% of 3.5 million contacts in 1995 to up to 31% of 5.8 million contacts in scenario T in 1999.

4. Discussion and conclusions

4.1. The severity-mix approach

To make relevant comparisons and projections, resource utilization studies have to be standardized with respect to the severity mix of the patient population. Neglecting the severity mix would overestimate resource utilization of the 'average PWA' in a study with a relative high proportion of severe patients. As mentioned above, our severity-weighted EU-average in 1990 for ppy inpatient days amounts to 54.5. Its unweighted counterpart would be 62.6 ppy inpatient days in that same year, illustrating the importance to account for severity mix. Our operationalization of the severity concept in chronic and late stages (CS and LS) has been chosen in accordance with major European resource utilization studies and with the outcomes of epidemiological modelling. The estimates demonstrate a significantly higher ppy inpatient days utilization in LS than in CS. Our findings on the relatively high resource utilization in the late stage of AIDS resemble results of US-studies on health care resource utilization in the late stage of any disease [76–79]. In 1961 it was assessed that hospitalization costs of adults who died in that year were 3-times those of survivors [80]. Lubitz and Prihoda [81] found that 5.9% of Medicare insured (primarily elderly) patients who died in 1978 accounted for 27.8% of total

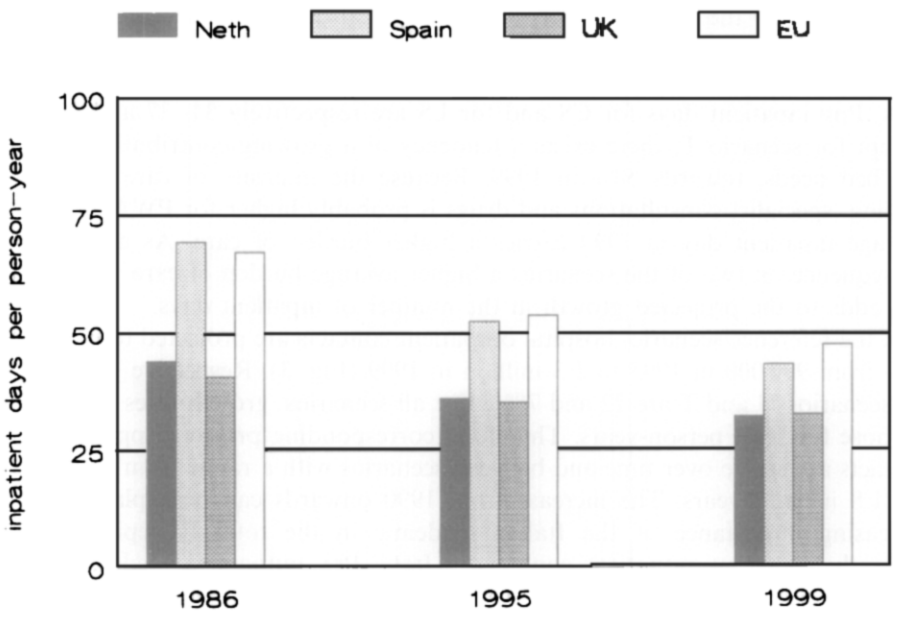

Fig. 4. Model-based trend in hospital inpatient days per person-year: backprojected (1986), estimated (1995) and projected in 1999 in scenario T (see text) for three countries and the EU as a whole.

Medicare expenditures. In general, ppy costs in the final year of life are 6.8-times those for patients who were prevalent at the end of the year, ranging from 5.2 to 10.3 times depending on the underlying cause of death [82–84]. Hospital inpatient days ppy exhibit a similar factor of 6.8 on average. Up to 80% of costs in the final year of life appear in the final 6 months of life (for example, in 1988 ppy Medicare expenditures in the last 6 months of life were 11.1-times ppy expenditures excluding the last 6 months). Therefore, severity staging as applied to AIDS is probably relevant to other diseases as well. Furthermore, our severity staging can easily be extended to other diseases since it is relatively straightforward, based on time—distance to the point of death.

Several studies have registered decreasing trends in ppy hospital inpatient days [45,47,49]. We have shown that an important factor for explaining these trends is a shift in the severity-mix in favor of CS if survival increases. Extending our model backwards gives ppy inpatient days for the pre-1990 period, for example, 1986 in Fig. 4. In 1986 the patient group with 1 year average survival dominated and ppy inpatient days is estimated at 67 for the EU as a whole. Fig. 4 reflects the modelled response of ppy inpatient days to an ongoing increase in survival from 1 year in 1986, 2 years in 1995 to 3 years in 1999 in scenario T. The country-specific results of our severity-staging model are in line with the reported trends in the Netherlands and the UK [45,47,49]. Similar mechanisms can be assumed for other countries as well (for example, Spain).

4.2. Comparative analysis

To compare the scenarios in this paper with our previously published projections [7], we substitute our current estimate of 54.5 ppy inpatient days in the EU in 1990 into the previous methodology. This would have produced a bed need of 3700 in 1990 and projections for 1995 ranging from 3800 to 5000. Our current estimates for those years are slightly higher for 1990 (3900) and significantly higher for 1995 (8200). Our previous approach to estimating person-years was based on the assumption that each AIDS case prevalent at the end of the year accounts for the whole of the respective year. Our current approach involves specific estimates of person-years for incident patients, patients who were prevalent during the whole year and for mortality. In addition, the correction for under-reporting of AIDS cases was undertaken for the current scenarios only, increasing the estimated prevalence by 18.5% for the whole EU in 1990 and 1995. These two factors together can explain the slight increase that we find for 1990. The major explanation for the significant difference in 1995 is a drastic change in epidemiological projection, previously showing a decrease in AIDS incidence to a low level in 1994 and 1995. Based on more recent AIDS incidence data [20], our current estimate shows an increasing or levelling AIDS incidence in the period 1990–1995, corresponding to a current AIDS prevalence estimate for 1995 of 48 500. This is 66% higher than the maximum estimate (29 300) in [7]. Obviously, there are several factors causing underestimation of the future health care impact. The recent (1993) extension of the AIDS case definition to include pulmonary tuberculosis will increase the number of new AIDS cases. Furthermore, we did not include resource needs for pre-AIDS stages, which might become more important if prophylactic treatment and preventing the onset of AIDS becomes increasingly effective. Though the AIDS stage is certainly the most resource demanding stage, further work should include multinational research into resource needs of pre-AIDS stages.

In three scenarios hospital bed needs in 1999 are projected to increase by up to 57% compared to 1995. This corresponds to 0.40% in 1995 and up to 0.65% in 1999 of all EU-beds currently available [85]. Even in scenario U, reflecting the unavoidable future burden of AIDS on hospital care in 1999, a growth in hospital care needs of over 20% is indicated compared to 1995. Associated to survival improvements, the share of outpatient contacts in total hospital contacts is projected to rise from 28 to 31% in scenario T. The validity of such results is significantly extended by the severity-staging used in this paper. Employment of this concept enables dynamic modelling of important model parameters, such as ppy inpatient days. Time—distance to the point of death has been used as the severity indicator. The relevance of this indicator for health care utilization and costs has long been recognized in the analysis of patient-based data across all diseases [76–84]. It has been used here to analyze the impacts of one specific disease on the health care systems. The indicator can obviously only be measured ex-post, and cannot be used to stage individual, living patients. In the scenario analysis presented, the ex-post measurement proved to be useful and feasible, because historical data on resource utilization developments preceding death were available for individual patients, and

because future AIDS prevalences and mortalities could be described by an epidemiological model.

4.3. Further application of the multinational AIDS-model

Our method involves the extrapolation of average results for France, Greece, Italy, The Netherlands, Spain and the UK to Belgium, Denmark, Germany, Ireland and Portugal. We could question the representativeness of our selected countries for the rest of the EU. The share in total person-years of the six EU-countries included in the scenario analysis is 84% of the whole EU in 1990, with an expected increase to 89% in 1999. The potential impact on the whole EU of the countries for which we have no resource utilization information is therefore only limited. For the 'unknown' part of the EU, Germany constitutes 50–75% of the person-years of AIDS. As an alternative we have evaluated the situation where ppy hospital resource need parameters in LS and CS are applied to neighboring countries. Generally, this lowers the resource needs by approximately 10% in 1990, 6% in 1995 and 4% in 1999 for both hospital beds and outpatient contacts. The decrease of this percentage in time supports the robustness of our EU scenarios based on data from six countries. In two of these six countries we have used data from one hospital only to describe the national situation. As has been shown for France [53] great differences between hospitals exist, implying that our estimates for Spain and the UK might not be representative. Further research is needed in these countries. Therefore, we should conceive the absolute level of our scenario results with great caution.

Our baseline set of three scenarios projects the future course of hospital care needs based on the most recent analyses of survival patterns and standardized multinational information on resource utilization. Recently, preliminary evaluations of new anti-retroviral combination triple therapy have given rise to speculations on drastic improvements of survival and corresponding prolongation of the chronic stages of HIV/AIDS [86]. The actual effect on survival is as yet highly uncertain and the effectiveness will depend on other factors, such as the acceptance, availability, patient and doctor compliance and costs of the new therapy. In particular, the costs are considered to be relatively high—approximately 15 000 ECUs per year of combination triple therapy. However, significant cuts in HIV/AIDS hospitalizations in consequence of the new therapy have been suggested [87] and might impact on hospital resource needs for HIV/AIDS in the EU. This impact will involve structural effects due to increases in HIV/AIDS prevalence and transient effects due to the sudden introduction of the new therapy. In particular, a transient drop in hospital resource needs might currently take place because of the delay in progression to the resource—intensive late stage of AIDS. A similar phenomenon was previously observed when pre-AIDS AZT-treatment was introduced in the early 1990s [88]. At the moment the standardized information to estimate the full impact on resource utilization patterns and costs is lacking, in particular at the multinational EU-level. As our scenario analytic design specifies the relevant parameters involved in the impact of the new therapy, it does provide the setting for a 'what-if'

investigation into this impact on the short-term. Table 3 shows a range for the change in hospital bed needs in 1999, assuming extensions of HIV/AIDS survival due to combination triple therapy of 3 and 5 years. As a first variant, ppy inpatient days estimates for the chronic AIDS stage (CS) are used for the years gained by the new therapy. As chronic-AIDS-stage's figures might not be representative here we have included lower levels of ppy inpatient days, in line with reported levels for pre-AIDS stages [11]. Table 3 suggests that a larger number of patients will be alive and in treatment than the reference scenario indicates, bed needs vary between levels of +15 and −35% of the reference scenario. Momentarily, these indicative results are investigated in depth by using the French and UK databases [47,53]. As assessments of the cost-effectiveness of new therapies is becoming more and more the vogue [89], our reference scenario is crucial in providing the point of departure to measure the impact of the new combination triple therapy.

The scenarios on the health care impact of AIDS presented provide information that can be used to support health policy decisions in the field of AIDS. First, scenario results give an order of magnitude of future health care needs in terms of total hospital beds, outpatient contacts and the patient-mix to be cared for. In addition to hospital capacity planning, the multinational EU-scenarios also provide background information for the further planning of EU AIDS research and prevention programs. At the national level and even at lower levels, the scenarios provide an indication of the change in severity-mix that can be expected within total hospital need for AIDS patients, which under certain circumstances has been shown to vary significantly and which can pose new management tasks. International comparison has further made clear that future analyses, either at the national or at lower levels, must account for severity-mix in order to avoid bias in any projections. Future research work could further refine the staging-mechanism in case of AIDS, and would certainly require to continue, extend and validate the national databases used. This paper has presented scenario information for health policy making at the EU-level and at the national levels on the case of AIDS. It is also obvious that comparable information on other diseases which are in the special focus of EU policy, such as cardiovascular diseases and cancer, is lagging behind as compared to the information now available for AIDS.

Table 3
Potential consequences of combination triple therapy in 1999: percentage changes in HIV/AIDS prevalence and bed needs compared to the reference scenario

Survival increase	3 years			5 years		
	100%	50%	25%	100%	50%	25%
Prevalence (%)	+50	id.	id.	+69	id.	id.
Bed needs (%)	+14	−15	−30	+18	−19	−37

Different assumptions refer to therapy-related increases in HIV/AIDS survival of 3 years and 5 years with inpatient days needs similar (100%) to those in the chronic AIDS-stage or lower (50 and 25%).

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