

Changes in the use of hospital resources from prison: A 16 year study

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Prison Castellon I

ABSTRACT

Objective: To describe hospital morbidity caused by the inmates of our prison over the past 16 years.

Material and methods: retrospective study of hospital admissions between 01-01-1994 and 31-12-2009, divided into four periods. Socio-demographic variables were collected: duration of stay and discharge diagnosis. Quantitative variables were described as means and medians and qualitative variables as absolute and relative frequencies. A mean comparison was performed on quantitative variables and qualitative proportions. For equal variances, an ANOVA test was performed with linear trend study of encoding the variable "period" with orthogonal contrasts. Without equality of variances, comparisons were made using the Kruskal-Wallis test, and tendencies by means of the nonparametric Jonckheere-Terpstra test. For qualitative variables we used the Pearson Chi-Square, evaluating the trend with the chi-square for linear trend.

Results: 625 patients generated 996 admissions with no temporal variation. The median age is 33 years, with an upward trend (29 years to 38, $p < 0.0001$). 47.9% were HIV + [(63.3% to 35.9%), $p < 0.0001$]. The average stay was 9.6 days (95% CI 8.8 to 10.4) [11.9 (10.0 to 13.9) 9.6 (8.8 to 10.4), $p = 0.002$]. The frequency of internal and year 1000 remained unchanged (111.6 to 87.9, $p = 0.366$). The days of hospitalization decreased (3066 to 2442, $p = 0.049$) and the average admitted per day (2.1 to 1.7, $p = 0.049$).

Conclusions: The use of hospital resources from prison is constant. The way they use it has changed along with the pathology that causes it. HIV is no longer the primary pathology.

Keywords: hospitalization; morbidity; hospital statistics; patient admission; trends; prisons; prisoners; Spain.

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INTRODUCTION

Hospital performance indicators (HPI) provide information on the activity performed by hospitals and allow contrasting this information between systems. In an enclosed system and isolated from the National Health System, such as Prison Health, these indicators represent a valuable tool in planning services and estimating their cost, both for the hospital and the sub-system. This circumstance becomes of paramount importance if we take into account that the imprisoned population has traditionally used hospital resources in higher proportions than the general population¹, especially as far as certain specialties are concerned, like infectious diseases² and psychiatry^{3,4}.

The Spanish imprisoned population has enormously changed throughout the last two decades. In 1990 it mainly consisted of male inmates of an average age of 29 years, with an HIV prevalence rate of 28.4% and with a history of injecting drug use (IDU) in 46.2% of cases⁵. Currently we are dealing with an older population — the group ranged between 31 and 60 representing 60% of the population — with an average age of 35.5 years and a HIV prevalence rate of 7%⁶.

Moreover, there have been important changes concerning the prevalence of other diseases such as the infection by HCV and the considerable increase of classical primary care pathologies, like diabetes, hypertension, cardiovascular events and dyslipidemia, or oncology pathology which already represents

5.2% of all hospitalization episodes (HE) occurred in prisons⁶. Last, the appearance of new very effective against HIV therapies has entailed the chronification of this disease and has led to reducing the use of hospital resources by imprisoned patients⁷.

All these factors could lead to the conclusion that there have been changes in the use of hospital resources by imprisoned patients, something which has been already remarked in some previous study⁶. Anyway, this a poorly researched aspect of Prison health care.

The main objective of this paper is to assess the reasons for hospital admission of people deprived of freedom, as well as HPI regarding the custody unit in our reference hospital (HCU), and to detect the changes that may have occurred in both in a long time series.

MATERIAL AND METHODS

This is a descriptive observational retrospective study of HE originated in inmates of the prison Castellon I in the reference hospital during the period comprised between 01-01-1994 and 31-12-2009. A HE was considered when an inmate was admitted to the hospital custody unit (HCU) and remained there for over 24 hours.

The main information resource was the hospitalization registry of the Prison of Castellon I, by reviewing the history of all patients who had been admitted to hospital at least once while hosted in our facility. From those registries, all clinical histories both from our center and from hospital, as well as hospital discharge reports were reviewed.

The prison of Castellon I is a medium sized facility which hosts both preventive and convicted inmates. During the study period it has undergone differences concerning the imprisoned population, with a minimum of 445 inmates in 1995 and a maximum of over 800 in 2009. The average stay of inmates is of about 3.5 years although this is tending to diminish ever since the opening of the prison of Albocasser in the autumn of 2008. The evolution of the prevalence of the main pathologies in inmates has run parallel to the evolution in the rest of the country. As far as the HIV infection is concerned we have gone from a prevalence of 24% in 1994 to an 8% in 2009, HCV which affected over 50% of inmates in 1994 had a prevalence rate of 24% by the end of 2009. There has also been an increase of classical primary care pathologies such as diabetes, hypertension, dyslipidemia and cardiovascular events.

Of all patients admitted to hospital the following variables were collected: age, gender, serological status for HIV and HCV, a history of drug abuse, injecting drug use (IDU), risk practices for HIV, admission and discharge dates to establish the duration of each HE and the main diagnosis upon discharge, which was codified according to the international classification of diseases ICD-9.

The following hospital use indicators were collected, calculated and analyzed: hospitalization episodes (HE) (total number of admissions, including repetitions) and modality (emergency or programmed), number of patients admitted to hospital, total days of hospital admission, frequentation (HE x 100/ inmates-year), length of stay (total days of hospitalization / HE), average daily admissions (total days of hospital admission/365 days), occupancy rate [stays / (available beds x 365) x 100], rotation index (discharges /available beds) and intrahospital mortality [(number of deceased/number of admissions x year) x 1000]. We assumed that the number of available beds in the HCU is four throughout the study period. To calculate the annual prison's population the arithmetic mean of inmates present the last day of each month of the corresponding year was calculated.

Initially a descriptive analysis of the variables was carried out by considering the mean and median values with their corresponding 95% confidence interval for quantitative variables. For qualitative variables, absolute and relative frequencies were considered.

As to compare and evaluate the trend of the main variables under study throughout time we divided the 16 year study into four equally long periods: first from 01/01/1994 to 31/12/1997; second from 01/01/98 to 31/12/2001; third from 01/01/2002 to 31/12/2005; and fourth from 01/01/2006 to 31/12/2009.

Means of quantitative variables and proportions of qualitative variables were compared. Previously the variance was confirmed by means of Levene's test; those variables for which equality of variances was assumed underwent an ANOVA test, with a linear trend study by coding the variable "period" with orthogonal contrasts. For those variables for which the equality of variance was not assumed the comparison was carried out by means of the Kruskal-Wallis test (K-W) and as to study the trend the nonparametric Jonckheere-Terpstra test (J-T) was used. Qualitative variables underwent Pearson's chi-square test by assessing the trend with the chi-square test for linear trend (χ^2 linear trend). Subsequently

by means of a study with logistic regression models we established potential differences between the main variables, according to seropositivity for HIV of patients needing hospital admission, as a relevant reason for hospitalization.

We analyzed by means of a linear regression model the trend of hospitalization events according to the time studied, by considering hospitalization events a dependent variable of the HIV serology in the patient concerned and different years under study, the independent variable. Data was processed with the software SPSS v.15 and in all cases an alpha significance level of under 0.05 was adopted.

Ethical considerations: the research's design received the perceptive administrative authorization by the Secretary General of Penitentiary Institutions of the Spanish Home Office, in accordance with the terms included in instruction 11/2005 on "Studies and research in the penitentiary field". Since it entailed the review of clinical histories with anonymous information it was not considered necessary to summon an Ethics Committee of Clinical Research.

RESULTS

Overall, 625 patients were hospitalized throughout the period: 573 (91.8%) were men. No significant differences were observed between men and women throughout the study period. The total median age

was 34 years with a clearly ascending trend, from 32 years in the first period to 36 in the last ($p < 0.0001$). 240 of those admitted to hospital (38.4%) were HIV positive, with a clearly descending trend: from 56.8% in the first period to 29.6% in the last ($p < 0.0001$) and 329 (52.6%) had a record of IDU, without any modification of trend ($p = 0.096$). Other clinical features of patients admitted to hospital, as well as statistical tests used are depicted in Table 1.

Table 2 shows specific data regarding overall hospital resources and their division per period. The total number of HE throughout the period was 996, without differences between sections ($p = 0.451$). HE had a mean length of stay of 9.6 days (95%CI: 8.8-10.4), with a descending trend ($p = 0.002$). Some hospital activity indicators, such as the number of admitted patients, occupancy index and rate, rotation index and frequentation x 1000 and year suffered no modifications throughout time but those referred to the use of hospital resources, like the daily average hospitalized patients, mean stay and hospitalization days presented a clearly descending trend. It is worth noting that in the first period one hospital bed was needed per every 276 inmates and in the last such need dropped to one bed per every 441 inmates. In-hospital mortality also fell throughout the study period, as well as emergency derivation as a reason for admission (see Table 2).

The main diagnosis upon discharge was that related to HCV infection (13.25% of the total), fol-

	Period 1994-1997	Period 1998-2001	Period 2002-2005	Period 2006-2009	Total Periods	Tests and Significance
Median age	32 years	32 years	34 years	36 years	34 years	KW $p < 0.0001$ J-T $p < 0.0001$
Male/Female	141/7	109/18	153/8	170/19	573/52	χ^2 Linear trend $p = 0.414$
HCV Patients	78 (52.7%)	79 (62.2%)	106 (65.8%)	95 (50.3%)	378 (57.3%)	χ^2 Linear trend $p = 0.024$
HIV Patients	84 (56.8%)	45 (35.4%)	55 (34.2%)	56 (29.6%)	240 (38.4%)	χ^2 Linear trend $p < 0.0001$
IDU	91 (61.5%)	55 (43.3%)	93 (57.8%)	90 (47.6%)	329 (52.6%)	χ^2 Linear trend $p = 0.096$
Sexual risk behaviors	57 (38.5%)	58 (45.7%)	40 (24.8%)	23 (12.2%)	178 (28.5%)	χ^2 Linear trend $p < 0.0001$

χ^2 Linear T.: Chi-square linear trend test; KW: Kruskal-Wallis test; J-T: Jonckheere-Terpstra trend test

Table 1: Some clinical features of patients admitted to hospital (n= 625)

	Period 1994-1997	Period 1998-2001	Period 2002-2005	Period 2006-2009	Total Periods	Tests and Significance
Hospitalization Episodes	256 (25.7%)	216 (21.7%)	265 (26.6%)	259 (26.0%)	996 (100%)	ANOVA P=0.451
Patients admitted	148 (23.7%)	127 (20.3%)	161 (25.8%)	189 (30.2%)	625 (100%)	ANOVA p=0.085
Emergency admissions	225 (87.2%)	187 (87.0%)	137 (51.3%)	152 (59.4%)	701 (70.4%)	χ^2 Linear T. p<0.0001
Average inmates	581	508	585	750	606	ANOVA p<0.0001
Occupancy Rate	52.5%	32.6%	36.7%	41.8%	40.8%	χ^2 Linear T. P=0.267
Rotation Index	16.0	13.5	16.6	16.2	15.6	ANOVA p=0.451
Frequency 1000 inmates/year	111.6	106.5	113.3	87.9	104.8	ANOVA p=0.366
Average admissions/day	2.1	1.3	1.5	1.7	1.6	ANOVA p=0.049
Mean length of stay (95%CI)	11.9 days (10.0 to 13.9)	8.9 days (7.6 to 10.1)	7.7 days (6.7 to 8.7)	9.8 days (7.8 to 11.8)	9.6 days (8.8 to 10.4)	ANOVA p=0.002
Median length of stay	7 days	6 days	4 days	4 days	5 days	KW p<0.0001 J-T p<0.0001
Total hospitalization days	3066	1903	2146	2442	9557	ANOVA p=0.049
Intrahospital Mortality rate (% and year)	20.5	11.5	4.7	5.8	2.6	ANOVA p=0.028
N. of deceased (%)	21 (8.1%)	10 (4.7%)	5 (1.9%)	6 (2.3%)	42 (4.2%)	χ^2 Linear T. p<0.0001

χ^2 Linear T.: chi-square Linear Trend; KW: Kruskal Wallis test;
 J-T: Jonckheere-Terpstra trend test; ANOVA: Fisher Analysis of Variance.

Table 2: Use of hospital resources per period and hospitalization episodes.

lowed by digestive pathologies (12.34%) and HIV infection (10.24%) while hospitalization causes which lead to longer stays were hematological diseases (20 HE with an average length of stay of 19.4 days) and tumors (42 HE and 13.8 days of mean length of stay). The rest of diagnosis upon discharge and the corresponding mean stays are depicted in Table 3.

Bivariate analysis reveals that HIV positive patients admitted to hospital were younger, had a history of IDU in a higher proportion, were admitted

more and overall caused longer lengths of stay, and deceased more frequently than HIV negative patients. No differences were found between genders (see Table 4). Among the reasons for admission the fact of being HIV positive significantly associated respiratory reasons for admission (p= 0.044; OR: 1.532; 95% CI: 1.011 to 2.322) (see Table 4).

The linear trend analysis reveals how hospitalization episodes for HIV positive patients show a clearly descending trend at a rate of -1.287 HE/ year (95%CI: -2.217 to -0.356; p=0.10), while in HIV negative pa-

	1994-1997		1998-2001		2002-2005		2006-2009		TOTAL	
	Episodes	Mean Stay	Episodes	Mean Stay	Episodes	Mean Stay	Episodes	Mean Stay	Episodes	Mean Stay
HCV infection	19	19	13	6.9	51	6.8	49	6.5	132	9.8
Diseases of the Digestive System	29	8.5	23	13.9	37	7.5	34	9.2	123	9.8
HIV infection	35	7.6	27	7.3	31	7.1	9	4.2	102	6.6
Diseases of the Respiratory System	19	13.3	23	7.8	20	4.9	39	18.9	101	11.2
Mental Disorders	26	11.7	22	10.5	19	6.5	3	5.3	70	8.5
Diseases of the Circulatory System	18	10.3	12	6.8	10	8	11	7.6	51	8.2
Injuries	16	8.7	14	6.2	13	7.9	7	9.3	50	8.0
Neoplasms	8	12.4	9	21.3	9	8.1	22	13	48	13.7
Diseases of the Musculoskeletal system	8	22.8	6	9.2	9	9	24	10.7	47	12.9
Infectious and parasitic diseases	7	14.3	7	12.4	6	7.6	11	13.4	31	11.9
Diseases of the genitourinary system	10	22.6	5	4.6	11	11.3	5	7.4	31	11.5
Accidental drug poisoning	8	9.1	8	5.9	8	10.8	5	4.8	29	7.7
Endocrine and metabolic diseases and immunity disorders	5	26.6	2	5	7	5	11	17.3	25	13.5
Symptoms, signs and ill-defined conditions	7	14.9	12	9.1	5	5.6	0	0	24	7.4
Diseases of the blood and blood-forming organs	11	8.9	3	20.3	3	11.3	3	37	20	19.4
Diseases of the skin and subcutaneous tissue	5	10.6	4	12.5	3	2.7	8	13.8	20	9.9
Trauma and Burns	7	8.3	7	9.4	6	7.7	0	0	20	6.4
Diseases of the Nervous System	4	12.5	5	5.2	6	5	4	9.3	19	8.0
Diseases of the eye and adnexa	6	11.7	7	12	2	3	2	20.5	17	12.1
Diseases of the ear and mastoid process	5	29.6	2	3.5	3	6	5	9.4	15	12.1
Diseases of oral cavity, salivary glands and jaws	0	0	0	0	3	9	2	12	5	5.3
Gynecological diseases	2	4.5	2	23.5	1	20	0	0	5	12.0
Obstetric causes	1	5	2	2.5	1	12	1	7.8	5	6.8
Tuberculosis	0	0	1	6	1	10	1	1	3	4.3
Unspecified causes	0	0	0	0	0	0	3	7	3	1.8
TOTAL	256	11.9	216	8.8	265	7.7	259	9.8	996	9.6

Table 3: ICD-9 Classification of diagnosis upon discharge in every period (arranged by number of episodes).

tients the opposite trend is observed at a rate of +1.472 HE/year (95% CI: 0.707 to 2.237; p=0.001). Figure 1 depicts the corresponding trend lines.

The same analysis referred to patients admitted every year shows that HIV positive patients present a descending linear trend but without statistical

significance, at a rate of 0.506 less patients admitted every year (95% CI: -1.080 to 0.068; p=0.080), while the opposite trend achieves statistically significant values in the case of HIV-negative patients (95% CI: 0.763 to 1.923; p<0.001). Figure 2 shows the corresponding trend lines.

Main Variables	HIV positive patients	HIV negative patients	Significance (p)	Exp (B)	95% CI Exp (B)
Median age upon admission (years)	33.0	34.0	<0.0001	0.963	0.950 to 0.977
Male	432 (90.6%)	483 (91.3%)	0.151	0.716	0.453 to 1.130
Female	45 (9.4%)	36 (6.9%)	0.151	1.398	0.885 to 2.207
Admissions (emergency)	367 (76.9%)	334 (64.4%)	<0.0001	1.848	1.399 to 2.422
Hospitalization episodes (HE)	477 (47.9%)	519 (52.1%)	<0.0001	0.968	0.982 to 0.990
Patients involved in HE	240 (38.4%)	385 (61.6%)	<0.0001	0.352	0.270 to 0.460
Total duration of hospitalization (days)	5204	4353	0.004	1.015	1.005 to 1.026
Frequentation % inmates-year	50.9	53.8	0.072	0.990	0.978 to 1.001
Mean daily admissions	0.9	0.7	<0.0001	5.061	3.355 to 7.635
Mean stay (days) (95%CI)	10.9 (9.6 to 12.29)	8.4 (7.3 to 9.4)	<0.0001	6.169	4.650 to 8.186
Intrahospital deceases	33 (6.9%)	9 (1.7%)	<0.0001	4.212	1.994 to 8.898
Intrahospital mortality rate (1000 inmates-year)	4.3	1.1	<0.0001	2.133	1.879 to 2.421
Injecting Drug Users	467 (97.9%)	153 (29.5%)	<0.0001	11.714	58.075 to 214.892
Sexual risk behaviors	218 (45.7%)	115 (22.2%)	<0.0001	2.957	2.247 to 3.891
Patients with HCV infection	450 (94.3%)	201 (38.7%)	<0.0001	15.673	10.739 to 22.876
Hepatic biopsies	42 (8.8%)	69 (13.3%)	0.025	0.630	0.420 to 0.945
Diagnostic if diseases of the respiratory system	58 (57.4%)	43 (42.6%)	0.044	1.532	1.011 to 2.322

Table 4: Bivariate analysis of the main variables according to HIV serology of HE.

DISCUSSION

We believe this to be the most comprehensive study on hospital morbidity of patients deprived of freedom and the use of hospital resources by this specific group carried out up to date. Special attention has been paid to the description of hospital performance indicators (HPI) and their evolution through time, since this data can provide valuable information for both managers and clinicians as to more appropriately plan the provision of services. Our results confirm that the use of hospital resources by people deprived of freedom has undergone profound changes. On one hand, there is a significantly reduced use of such resources by HIV+ patients, something which has been previously stated ⁷ and which is mainly due to an improved management of this infection since the introduction of Highly Ac-

tive Antiretroviral therapy (HAART) in 1996.^{8,9} This had led to a lower incidence of opportunistic diseases, a reduced need of using hospital resources for diagnostic or therapeutic purposes and an overall improved quality of life. HIV- positive inmates, who before used more hospital resources because the prescription of an appropriate antiretroviral therapy was conducted less than in the general population ¹⁰, now pursue hospital assistance much less since the prescription of such treatments is totally alike, both in quality and quantity, that of the general population ¹¹. Regarding HIV-negative inmates, they have recently tended to an increased use of hospital resources due to a series of factors: a) during the first half of the last decade the infection by HCV became an important reason for hospitalization because of the need to conduct biopsies to assess the hepatic status before initiating pegylated interferon and rib-

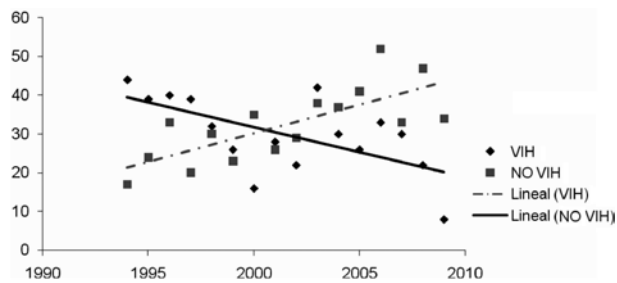


Figure 1: Trend of hospitalization episodes according to HIV serology

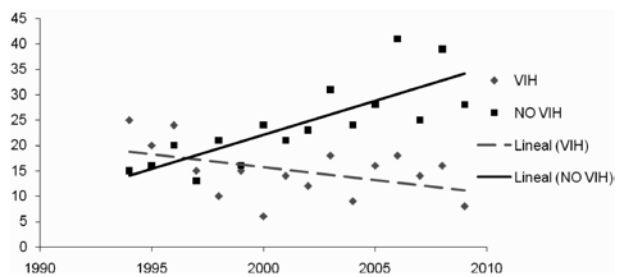


Figure 2: Trend of hospital admissions according to HIV serology.

avirin therapy. Only a few years later new measuring techniques such as hepatic elastography (Fibroscan®) were developed and are now available at Spanish prisons. Nevertheless that reason was, at least in our facility, an important reason for hospitalization at the time; b) the progressive ageing of the imprisoned population entails the appearance of pathology of the fifth or sixth decade such as cardiac pathologies and tumors; and c) there has been a progressive increase of programmed admissions to conduct hospital explorations or diagnostic and therapeutic interventions which compensate the reduction of emergency admissions which took place during the first sections of the period under study, mostly due to HIV-positive patients.

The evolution observed in our prison is mostly alike the data provided by the Secretary General of Penitentiary Institutions for the totality on prisons managed by it. In 2000 the infection by HIV represented the first cause for hospital admission among inmates while cardiovascular affections and neoplasms were the eighth and tenth causes respectively¹². In 2009 the main cause was represented by digestive diseases and secondly HIV infection, while cardiovascular diseases and tumors represented the fifth and sixth reasons for admission respectively¹³. This evolution coincides with a recently published study¹⁴, although HIV remains the main cause of hospitalization in such study. This may be due to design differences. Despite this evolution, HIV still

has a considerable influence on the use of hospital resources by inmates since it generated more hospitalization days, longer lengths of stay and more daily admissions than HIV-negative patients admitted to hospital.

The mean hospital stay of our patients has dramatically fell, nevertheless it is still higher than that obtained in Spanish general hospitals¹⁵ and for the overall imprisoned population who needs to be admitted to hospital at some point¹³. Anyway, it seems that inmates generate longer hospital stays, due to HIV infection² or to cardiovascular disease¹⁶ and other causes. This fact is difficult to explain. This circumstance may be related to the characteristic nature of the penitentiary institution. There is an important fiscalization of the penitentiary activity, both from a judiciary and administrative point of view, which can sometimes lead to an excessive prescription of diagnostic tests which may extend hospital stays.

The mean length of stay is usually regarded as an indicator of efficiency. We have once more observed its reduction in our patients, alike other studies previously published^{7,17}. This reduction, along with an increasing rotation index and stable occupancy rates imply an increase of activity and productivity, as long as there are no significant modifications of the available beds¹⁵. Three out of these four criteria are fulfilled in our series; we would have only needed to increase the rotation index to be more efficient; hence we would have needed an increased number of patients admitted to hospital. Actually, the evolution has been the opposite and a reduced need of hospital beds has been observed through time, something which can guide prison managers when planning the new Hospital Custody Units.

The most important limitation is that this research only concerns one prison. Although it is a long time series which reliably collects the evolution undergone we must be very cautious when extrapolating the results since these can be deeply influenced by the features of each center. It would be desirable that a similar study be conducted in several centers as to minimize this problem and so that valid statements on the overall Spanish penitentiary system could be concluded. We must also be cautious as far as the population size used as a denominator is concerned, since there is a great mobility among inmates. As to minimize this risk we have used the mean value of those hosted in the prison the last day of every month of the years under study.

To conclude: there has been a clear change through time regarding the use of hospital resources and its reasons by the population deprived of free-

dom. The need of such resources has diminished with time and the infection by HIV is no longer the main cause of hospital admission in this population. Penitentiary managers should be aware of these results when discussing the assignment of resources in this field.

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