Overcrowding in Psychiatric Wards is Associated With Increased Risk of Adverse Incidents

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Objective: To study the association between bed occupancy in psychiatric wards and rate of adverse incidents (AIs) including aggressive behavior and falls.

Methods: This is a retrospective study analyzing bed occupancy and AIs' data in 4 closed wards in a state psychiatric hospital in Israel over a 20-month period. Ward-level daily records were extracted from the hospital's electronic admission-discharge and AI registries, creating a log of 609 days for each of the 4 wards. Relationships between gross and net bed occupancy and AIs rate were calculated, in general and for each ward and type of incidents.

Results: Average gross occupancy was 106 ± 14.8% and net occupancy was 96.4 ± 15.6%. Gross occupancy >100% was recorded in 51% of days. Net occupancy was higher on days with at least 1 incident than on no-incident days (98.6 ± 14.8% vs. 95.7 ± 15.7%, $P < 0.0001$). AIs occurred in 18.6% of days in the lowest occupancy quadrant (up to 85% occupancy), compared with 26.7% of days in the highest occupancy quadrant (106% and above). Moreover, aggressive behavior-type incidents were significantly lower in the lowest occupancy quadrant days compared with the highest occupancy quadrant (8.3% vs. 14.1%, $P < 0.01$). Evidence of a dose-response effect of bed occupancy on AIs rate was found.

Conclusions: Overoccupancy is prevalent in psychiatric wards and is associated with an increased rate of aggressive AIs and falls. Policy makers should be convinced about the necessity to reduce overcrowding in psychiatric wards and to improve safety of in-patient facilities.

Key Words: psychiatric wards, overcrowding, adverse incidents, bed occupancy

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In the context of governmental efforts to contain rising health care costs, hospitals and other health providers have found themselves under tremendous pressure to provide more complex care to an increasing number of patients in busier wards with fewer staff.[1] Hospital bed occupancy rates of 85% have been widely recognized as optimal for efficient bed utilization and good patient outcomes, however, in real practice worldwide and in Israel, overcrowding in hospital wards is the rule and may threaten quality and safety of in-patient care.[2] Israel has the highest bed occupancy rate in the Organization for Economic Co-operation and Development (OECD) countries, with an average 98% rate throughout the year. In winter, however, bed occupancy rates in pediatric and internal medicine wards can reach 170%. The OECD's average bed occupancy rate is 76.9%, 64.4% in the United States and 48.6% in The Netherlands.[3]

Overcrowding in psychiatric hospitals is not an exception. It results from the dramatic decrease in psychiatric in-patient beds over the past decade, due to deinstitutionalization and reforms in psychiatric health care. During the Israeli reform of psychiatric hospitalizations between 1996 and 2006, the number of psychiatric beds declined by 50%.[4,5] As a result, there is a constant increase in psychiatric bed occupancy. According to the Central Bureau of Statistics, bed occupancy rate in psychiatric care in Israel in 2013 was 97.3%.[6] Between 1995 and 2011, the proportion of psychiatric care beds decreased from 1.21/100,000 to 0.46/100,000 (an almost 3-fold reduction), placing Israel far below the OECD average and slightly above the last 10 countries including the United States, Italy, and Canada.[3]

It is generally accepted that excessive bed occupancy, overcrowding, and excess staff workload in hospitals present a serious problem for both patients and staff.[7,8] They affect patient care by delaying treatment, impeding pain management, increasing nosocomial infections, and patient mortality and morbidity.[9,10] Others have found that overcrowding and high patient-to-nurse ratios are not only related to adverse patient outcome, but to increased staff burnout and job dissatisfaction and may well be associated with increased risk of depression and antidepressant use by staff.[7,11] Despite the intuitive conviction that adverse incidents (AIs) likelihood is most probably higher in times of increased bed occupancy, empirical data in this area are scarce in the medical literature.

In the field of psychiatry, conflicting results exists regarding the relation between increased patient density and the risk for violence and self-harm.[12,13] Most studies have concentrated on the influence of overcrowding on aggressive

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behavior. Palmstierna et al,[14] in Sweden, found a positive correlation during a 25-week follow-up in a 19-bed psychiatric acute-care unit between increased crowding and the likelihood of aggressive behavior, especially by schizophrenic patients. Ng et al,[15] in New Zealand, found that crowding is significantly associated with violent incidents, especially verbal aggression, in a 16-bed acute psychiatric unit in a general hospital during a 12-month period. In a large longitudinal study conducted by Virtanen et al[16] in Finland, monthly bed occupancy records for 90 psychiatric in-patient wards in 13 hospitals were collected for a period of 5 months. Evidence of a dose-response effect of overcrowding on violent assault on staff was found.

Possible explanations for this association were: impact of overcrowding in psychiatric facility on stress,[17–19] frustration due to forced socialization in a confined space,[20] and patients' inability to postpone wishes satisfaction.[21]

This study aimed to examine the relationship between day-to-day ward occupancy and incidence of AIs including different types of aggressive behavior and patient falls in several closed wards of an urban teaching state psychiatric hospital in Israel.

METHODS

Study Design and Population

The study is a retrospective study analyzing data from records of an urban teaching state psychiatric hospital. The hospital includes several wards: acute closed male ward, acute closed female ward, emergency unit, open ward, acute psychogeriatric ward, half-day-out unit, and 2 wards for continuous hospitalization: psychogeriatric and a closed chronic ward for a total of 175 beds. All acute wards are active admission wards on a 24/7 basis.

We investigated the influence of the degree of bed occupancy on the number of AIs during a 20-month period from the January 1, 2011 to August 31, 2012 in 4 psychiatric closed wards: acute closed male ward, acute closed female ward, acute closed psychogeriatric ward (both sexes), and chronic closed ward (both sexes) for a total of 101 beds. The closed ward setting was chosen on the assumption that patients with restricted freedom of movement might be more vulnerable to crowding potential consequences. Closed wards also presented the highest incidence of AIs according to the hospital annual registry. The first 3 wards were acute admission wards with high rates of admissions and discharges. Bed occupancy could exceed 100%. The chronic closed ward had a more stable bed occupancy that was limited by number of available beds and a lower rate of admissions and discharges. This ward was chosen as a control closed ward with a limited bed occupancy never exceeding 100%.

Data Extraction and Variables

Data on ward occupancy were extracted from electronic hospital admission and discharge registry including the number of hospitalizations and discharges for each ward, number of patients on vacations, and number of admissions not resulting in hospitalization in each ward on a daily basis.

The staff number for each of the nurse's 8-hour shifts and the number of physicians, and other multidisciplinary accompanying staff was constant during the study period and did not change according to ward occupancy. Missing staff members were usually replaced by members from the same ward pool, however, all nurses were familiar with all wards due to regular rotations between the different wards.

Independent Variables

Bed occupancy rate (gross and net), number of hospitalizations, number of discharges, and number of admissions without hospitalization.

Dependent Variables

The number and type of AIs in wards. Data concerning AIs were extracted from the Adverse-Incident Registry of the hospital, which contains descriptive accounts of all AIs occurring in any psychiatric ward of the hospital including type, time, location of each incident, patient's demographic data, data on patient physician's examination, and preliminary analysis of ward administration. It is a routine practice for the hospital psychiatric staff to fill in this log and send it during a 12-hour period following the event to the nurse management office, medical director of the hospital, and to the hospital Risk-Management Committee for further evaluation and risk prevention policy making.

Two major and most common types of incidents were investigated in this study: aggressive behavior (including physical aggression toward another patient or a staff member, verbal aggression, self-harm behavior, intentional damage to property) and patients falls (with and without physical personal injury).

We hypothesized that increased bed occupancy rate would be positively associated with the number of AIs. Regarding the type of AIs, due to differences in patient characteristics (psychopathology, severity, age, violence history, etc.) in different wards, we expected to observe a stronger association with aggressive incidents in the acute closed wards (male and female) and a stronger association with falls in the acute psychogeriatric ward (older and physically compromised patients).

Statistical Methods

Our unit of analysis was a "ward-day." During January 2011 to August 2012, we had 609 days for each of the 4 wards, summing to a total of 2436 ward-days. Each ward-day included data on all the independent variables (number of: beds, hospitalized patients, patients on vacation, net and gross bed occupancy rate, number of hospitalizations and discharges, number of admissions without hospitalization) and details of the dependent variable (the AIs on that day for the specific ward including type and time of the event).

"Net occupancy" was calculated as the number of patients currently present in the ward at midnight divided by the number of available beds in the ward, expressed as a percentage. "Gross occupancy" was calculated as the total number of all hospitalized patients, including those not actually present in the ward (vacation, medical evaluation in general hospital's emergency departments, etc.) divided by

the number of available beds in the ward, expressed as a percentage.

We used SPSS 20 software for Windows.

We performed 2 types of analyses to examine the association between bed occupancy and the number and type of AIs.

(1) Independent-sample *t* test was performed to determine whether the average occupancy was different in days with no ward-incidence compared with days with 1 incident or more. This analysis was also done for each incident type (aggressive incidences and falls) and for each ward separately. We assumed independence of the incidents between the wards.We used 1-way analysis of variance to test equality of means and linear trends in net and gross occupation when we categorized our dependent variables in 3 categories: no event, 1 event, or ≥ 2 events. To find which couple of categories was significant we used Sidak method for multiple comparison.
(2) We divided bed occupancy day-wards into quartiles according to percentage of bed occupancy (so that approximately 25% of days were included in each quartile). We used χ^2 test to compare the category yes/no event or the number of events (0, 1, ≥ 2) against occupancy quartile. Mantel-Haenszel test was used to check the significance of the trend found between occupancy quartile and events number. Using independent-sample *t* test, we also checked if the number of hospitalizations discharges or admissions without hospitalization were different in days with or without AIs.

RESULTS

Descriptive Analysis

Average gross occupancy for all wards was $106 \pm 14.8\%$ and net occupancy was $96.4 \pm 15.6\%$. Gross occupancy of >100% was recorded in 51% of days. Gross maximal bed occupancy was 158%. Table 1 describes ward occupation characteristics and type and events frequencies for each ward.

A total of 698 incidents were recorded during the 20-month study period. The most common incidents were physical violence between patients (290 events, 42%), followed by incidents of falls with no harm (163 events, 23%). Table 2 describes the different AIs types for each ward. Aggressive behavior was most common in the acute male and female wards and in the chronic ward, whereas falls were the most common in the psychogeriatric ward.

AIs happened in 580 ward-days (24% of ward-days): 488 days with 1 event and 92 days with ≥ 2 events. A total of 44% of incidents occurred during the morning shift, 41% during the afternoon shifts, and 15% during night shifts.

Ward occupancy was higher on days with 1 or more AIs compared with ward-days without an event for both net and gross occupancy. Mean net occupancy was $98.6 \pm 14.8\%$ on days with at least 1 event compared with $95.7 \pm 15.7\%$ on no-incident days ($P < 0.0001$). Gross occupancy was $107.7 \pm 14.8\%$ vs. $105.5 \pm 14.7\%$ ($P < 0.001$).

In addition to bed occupancy, a significant difference was found between number of hospitalizations and number of admissions without hospitalization in days with AIs compared with days without AIs (0.71 ± 1.13 vs. 0.6 ± 1.02, $P < 0.05$; 0.33 ± 0.79 vs. 0.23 ± 0.63, $P < 0.01$, respectively). Discharge numbers were not different in days with and without AIs.

Our analysis for each ward separately, showed similar results with higher average occupancy in days with at least 1 event compared with no events days. The results were significant in net occupancy for the acute female and male closed wards and the chronic closed ward ($102.5 \pm 15.0\%$ vs. $99.6 \pm 15.1\%$, $P = 0.03$; $105.5 \pm 19.0\%$ vs. $100.2 \pm 21.6\%$, $P = 0.01$; $91.3 \pm 9.4\%$ vs. $89.2 \pm 10.9\%$, $P = 0.04$, respectively).

Using 1-way analysis of variance for analysis of the number of events divided into 3 categories (0, 1, ≥ 2), we found a significant difference among the 3 groups for net and gross occupancy (Table 3). There was a linear dose-response trend between mean gross and net occupancy and the number of AIs ($P < 0.001$, $P < 0.0001$, respectively).

We divided ward-days occupancy into quartiles according to percentage of bed occupancy. The net occupancy quartiles were (% occupancy): up to 85, 86–95, 96–105, ≥ 106. χ^2 test comparing the category yes/no event against net occupancy quartile revealed a significant positive association ($\chi^2 = 12.97$, $df = 3$ $P < 0.005$) with a trend to a dose-response effect (Fig. 1A). The probability of AIs rose from

TABLE 1. Ward Characteristics of Bed Occupancy, Event Types, and Frequencies of Adverse Incidents

	Acute Closed Male Ward	Acute Closed Female Ward	Acute Psychogeriatric Ward	Chronic Closed Ward	Total
Beds number	24	12	32	32	100
Average net occupancy% ± SD	100.4 ± 15.1	101.2 ± 21.2	94.4 ± 9.4	89.6 ± 10.7	96.4 ± 15.6
Average gross occupancy% ± SD	117.1 ± 13.4	110.9 ± 18.3	98.8 ± 7.9	97.4 ± 4.6	106 ± 14.8
No. AIs	207	147	200	144	698
AI number/bed number	4.4	12.3	6.3	4.5	7.0
Ward-days without AI	442	486	444	484	1856
Ward-days with 1 AI	137	106	137	108	488
Ward-days with ≥ 2 AIs	30	17	28	17	92
Fall incidents (n)	52	71	156	26	305
Aggressive incidents (n)	155	76	44	118	393

AI indicates adverse incident.

TABLE 2. Distribution of Adverse Incidents Between Wards

Event Types	Acute Closed Male Ward	Acute Closed Female Ward	Acute Psychogeriatric Ward	Chronic Closed Ward	Total
Harmless falls	22	35	93	13	163
Harmful falls	30	36	63	13	142
Physical violence between patients	116	47	31	96	290
Physical violence against staff	19	3	17	11	50
Self-harm violence	5	6	5	1	17
Verbal aggression	5	0	0	0	5
Intentional harm to property	18	6	5	2	31
Total events	207	147	200	144	698

18.6% in days with net bed occupancy rate of $\leq$85%–26.7% with occupancy rates of $\geq$106%. Mantel-Haenszel test for trend was significant ($\chi^2=11.7$, $df=1$, $P=0.001$). Similar results with a significant trend were found for gross occupancy rate and adverse events ($\chi^2=4.55$, $df=1$, $P<0.05$).

Bed Occupancy and Type of AI

For all wards together, aggressive events were associated with higher gross and net occupancy (96.0 ± 15.7% vs. 99.2 ± 14.6%, $P<0.001$ for net occupancy; 105.6 ± 14.7% vs. 109.1 ± 15.3%, $P=0.0001$ for gross occupancy). χ^2 test comparing the category yes/no aggressive event against net occupancy quartile showed a significant positive association ($\chi^2=11.8$, $df=3$, $P<0.005$). Dividing day-wards occupancy into quartiles according to percentage of bed occupancy showed similar results for aggressive events. χ^2 test comparing the category yes/no event against net occupancy quartile showed a significant positive association ($\chi^2=11.78$, $df=3$, $P<0.01$) with a trend to dose-response effect (Fig.1B).

The probability of aggressive behavior rose from 8.3% in days with net bed occupancy rate of $\leq$85%, to 14.1% with occupancy rates of $\geq$106%. Mantel-Haenszel test for trend was significant ($\chi^2=10.46$, $df=1$, $P=0.01$).

Falls were associated only with net bed occupancy (96.16 ± 15.6% vs. 98.4 ± 15.1%, $P<0.05$).

AIs in Each Ward

In the acute closed male ward, net and gross occupancy were higher on days with aggressive events compared with days with no aggressive events (average 103.9 ± 13.9% vs. 99.6 ± 15.2%, $P<0.01$ for net occupancy), whereas there was no difference in mean occupancy on days with or without falls.

In the acute closed female ward, net and gross occupancy were higher on days with aggressive events compared with days with no aggressive events (average 107.7 ± 17.0% vs. 100.6 ± 21.5%, $P<0.05$) while there was no difference regarding falls.

In the acute psychogeriatric ward, bed occupancy was similar on days with or without aggressive events or falls.

In the closed chronic ward net occupancy in days with a fall event was higher compared with days with no falls (average 95.3 ± 6.7% vs. 89.4 ± 10.7%, $P<0.005$) but no difference was found for aggressive events.

TABLE 3. Bed Occupancy and Adverse Incidents Rate

Adverse Incidents	Mean Net Bed Occupancy (%)	Mean Gross Bed Occupancy (%)
No incidents days	95.7 ± 15.7	105.5 ± 14.7
1 adverse incident	98.3 ± 14.9	107.5 ± 14.9
≥2 adverse incidents	100.5 ± 14.5	109.0 ± 13.7
P	<0.001	<0.05

P for trend <0.0001.

DISCUSSION

Our findings of a mean 106% gross occupancy rate and 96% net occupancy rate in all closed wards stress the fact that overcrowding is a serious problem in this hospital. These rates far exceed the maximal 85% occupancy rate recommended for psychiatric and general hospitals which are optimal for patient and staff safety and outcome.[2,22,23]

We found a significant positive association between bed occupancy and rate of AIs in the 4 closed wards of an Israeli psychiatric hospital. This was found both for net and gross bed occupancy. Positive associations were more prominent for the net occupancy rate emphasizing the fact that actual presence of patients in the wards directly contribute to overcrowding. Moreover, we found a dose-response effect so that higher occupancy was associated with higher AIs rate. This trend suggests a causal link between overcrowding and increasing risk of AIs. To our knowledge, our study is the only study that replicates the dose-response pattern between overcrowding and aggressive incidents observed in Virtanen's large longitudinal study,[16] and has the advantage of being a real-time record-based AIs, rather than self-reported AIs which is prone to bias. Our study is the first to reveal a dose-response link between bed occupancy and overall AIs in closed acute and chronic psychiatric wards, including different types of aggressive behavior and falls.

In addition to bed occupancy, factors such as number of hospitalizations and admissions without hospitalization, which create excessive workload with direct or indirect influence on overcrowding, were significantly associated with AIs. These findings are in agreement with other previously published studies.[1,24]

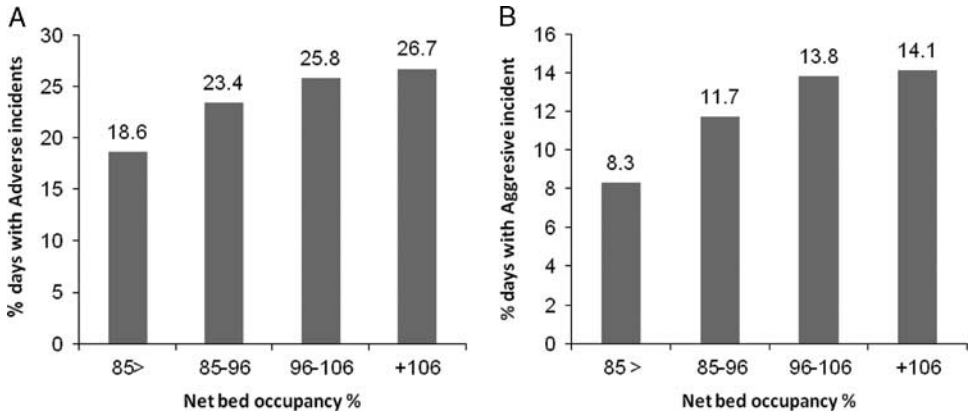

FIGURE 1. Adverse incidents according to bed occupancy quartile. Day-wards were divided into quartiles according to percentage of net bed occupancy. Percentage of days with an adverse incident (A) or aggressive incident (B) increased with increasing quartile occupancy. For adverse incidents $\chi^2 = 12.97$; $df = 3$; $P < 0.005$, Mantel-Haenszel test for trend $\chi^2 = 11.7$; $df = 1$; $P = 0.001$. For aggressive event $\chi^2 = 11.78$; $df = 3$; $P < 0.01$, Mantel-Haenszel test for trend $\chi^2 = 10.46$; $df = 1$; $P = 0.01$.

Bed Occupancy and Aggressive Behavior Incident

Our findings of a significant positive link between occupancy rate and violent incidents in all wards examined together and in 3 of 4 wards particularly, matches studies of positive association between overcrowding or excessive workload in psychiatric wards and incidence of violent events.[14–16] Evidence of a dose-response effect was found between aggressive events and net bed occupancy rate.

In the acute male and female wards, we found a significant association between bed occupancy and aggressive incidents but not to patient falls as expected from the wards nature which include patients less than 65 years of age. This fact can serve as another hint to the existence of causal link between overcrowding and patient aggressive behavior.

Bed Occupancy and Patient Falls

We have found a significant positive association between patient falls and bed occupancy rate in all wards studied together and in the chronic closed ward specifically. To our knowledge, this is the first study showing increasing risk of different, not only violent AIs with increasing bed occupancy in different wards of adult psychiatric hospital.

Patient falls are considered to be a leading source of AIs in hospitals and can result in serious injury, increased hospital stay, and increased costs.[25–28] In accordance with our findings, ward overcrowding can be added to other previously known risk factors for patient falls such as old age, female sex, gate impairments, and altered cognition.[29–32] In spite of the highest incidents of patient falls in the acute psychogeriatric ward we did not find a significant correlation between patient falls and bed occupancy rate in this ward. Possible explanation can be a relatively "low" bed occupancy rate in this ward compared with other acute admission wards and stronger influence of other factors than those studied in this research. Another explanation can be found in common literature findings that most falls in geriatric wards occur during night-time shifts and are associated with toileting-related activities that are probably less compromised by overcrowding.[32]

The chronic closed ward was the only ward where higher occupancy rate was found on days with a fall event. This could be related to other confounding factors aggravating influence of overcrowding in this ward, such as severity of patients psychopathology, high prevalence of old and physical compromised patients, restricted physical space of the ward, where even relatively "low" bed occupancy rate is enough to influence incidents rate.

According to our findings, bed occupancy >106% was associated with a 40% increase in AIs. If all wards had net bed occupancy up to 85% as desired, 130 (18.6%) AIs would be economized per year and if bed occupancy was up to 100%, 32 AIs would be cut down.

The dramatic decrease in psychiatric in-patient beds led to overcrowding and increased AIs. Further significant decrease in psychiatric bed number could lead to the threatening situation observed in the United States, where a critical bed reduction in the context of deinstitutionalization led to transinstitutionalization. Lack of psychiatric beds and insufficient integrated community-based mental health care resulted in overcrowding of emergency departments, streets, and prisons by mentally ill patients discharged from state psychiatric hospitals.[33]

Limitations

Our study has several limitations: it is a retrospective study, thus a causal relationship cannot be concluded, however, in occupational setting a randomized controlled study is not practically feasible. In addition, we did not succeed in finding a psychiatric ward with "normal" bed occupancy not exceeding 85%, which could serve as an adequate control ward. Our study was a single-center study, creating another limitation. However, similar results were found for the 4 independent wards. Our study extended over a relatively long time period and examined a large amount of beds minimizing the risk of a nonrelated transient environmental cause affecting both overcrowding and aggression.

Bed occupancy rate is a single factor among a wide range of additional factors potentially increasing the risk of adverse events in psychiatric hospitals. Patient related factors (age, sex, diagnosis, severity of symptoms, violence history, and social and economic status), staff related factors (staff experience, staff-patient interactions, etc.), environmental factors (ward structure, amount of personal space) could also contribute to AIs rate.[34–39] This is suggested by the low correlation but strongly significant coefficients.

Our results are in line with studies performed in psychiatric hospitals in the acute setting.

Further studies are needed to characterize the impact of overcrowding itself versus staff-patient ratio on AIs rate and whether their relative contribution differs between psychiatric and nonpsychiatric wards.

Despite the intuitive appeal that AIs and medical errors should occur more often with increased bed occupancy in nonpsychiatric hospitals, few published studies have shown this association mainly in the context of emergency departments. Sprivulis et al[40] found a significant association between high hospital occupancy rate in Australian emergency departments and increase in patients' mortality. In a large state general hospital in Australia, Boyle et al[28] found that higher daily hospital occupancy rate increased the probability of severe AIs. Weissman et al[1] in a study of 4 general US hospitals with daily measured workload and AIs found that number of admissions and patient-to-nurse ratio, but not bed occupancy rate, were strongly associated with the occurrence of potentially preventable, severe AEs. More studies are needed to confirm the generalizability of our findings to a wider context, such as nonacute psychiatric care and general, nonpsychiatric wards.

CONCLUSIONS

Our study confirms previous studies that overcrowding in psychiatric wards can be dangerous and can lead to an increased number of AIs, such as violence and falls. Unfortunately, high bed occupancy and overcrowding in psychiatric hospitals in Israel and other countries are not an exceptional phenomenon but rather a "normal operation of systems under economic, social, and political pressure to produce more with less."[41]

The final stage of mental health reform in Israel includes responsibility transfer for mental health care to the health maintenance organizations. This will strengthen psychiatric community services, enable more patients to satisfy their needs in the community, and probably will decrease hospitalization rate. However, successful implementation of such reform can proceed over years and must include sufficient integrated community-based mental health care. Implementation should also create enough alternative hospitalization/long-term care in psychiatric institutions for patients with severe chronic psychiatric disease who need chronic support. Therefore, an important contribution of this study would be to convince health care providers and policy makers of the necessity to take emergency measures aimed at reducing overcrowding in psychiatric hospitals and making in-patient facilities safer for patients and staff.

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