

# Changes over time of the diagnostic and therapeutic characteristics of patients of a psychiatric intensive care unit in Austria

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## ABSTRACT

**Objective:** The aim of this repeated cross-sectional study was to compare patients from a psychiatric intensive care unit (PICU) over >30 years regarding their diagnostic and therapeutic characteristics.

**Method:** Three samples including 100 consecutive inpatients each from the Viennese PICU were submitted to a chart review: sample no. 1 from the years 1985/86, no. 2 from 1995/96 and no. 3 from 2007/08.

**Results:** Changes in referral modes were associated with a decrease of patients with substance induced disorders and an increase of patients with affective disorders over time. The rate of admissions after accidents and suicides was stable. The use of cranial MRI increased, while intravenous psychopharmacotherapy and parenteral nutrition decreased. Involuntary admission occurred in 43% and in 37% of patients physical restraints were necessary. We saw a shift from tricyclic antidepressants to SSRIs and SNRIs from sample 1 to 3. Likewise, we observed the emergence of atypical antipsychotics and a reduction of use of typical neuroleptics mainly from sample 2 to 3. The percentage of patients receiving benzodiazepines increased over time, while the mean dosage of benzodiazepines decreased. 7% of patients received electroconvulsive therapy.

**Conclusions:** The changes over time in our samples reflect the medical progress made during the last decades. Future studies should focus on evaluation of efficacy of psychiatric intensive care using standardized measurements.

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## 1. Introduction

Severely and critically ill psychiatric patients, but also psychiatric patients with severe somatic comorbidities, often after suicide attempts and accidents need intensive medical care and mental health nursing. At the General Hospital in Vienna (Medical University of Vienna), such patients are taken care of at a specialized psychiatric intensive care unit (PICU) and it is one of the few facilities of this kind in Austria [1]. The unit is designed as an eight-bed ward with two patient rooms and is equipped with vital sign monitoring at each bed. The PICU is unlocked and patients can be individually restrained with medical restraints at the bedside when needed. The staff has special training in terms of dealing with self-harm and aggressive behavior of the patients. The ratio of nurses to patients is about 1:1.5 in the daytime and 1:4 in the night. Two psychiatric consultants and two residents are responsible for the unit. During the nights a designated attending psychiatrist is responsible for the ward. Formal rounds and interdisciplinary meetings with a complete review of all prescribed treatments and diagnostic tests are

conducted daily. Psychotherapy, physiotherapy and occupational therapy are available for the patients.

Admission of patients to the Viennese PICU is either via the psychiatric outpatient clinic, psychiatric wards, other medical departments of the General Hospital of Vienna (mostly intensive care, emergency medicine, and trauma surgery) or from other hospitals. Diagnostically, all psychiatric conditions (also including substance abuse disorder and acute exacerbation of chronic mental disease, dementia or mental retardation) can be found at the PICU, if they possess a life-threatening character or if they require intensive treatment and nursing due to comorbid diseases. The treatment of schizophrenic and manic psychosis, catatonia, delirium and eating disorders with life-threatening loss of weight is a particular focus of this ward. Admission is also possible for patients with acute physical disease with severe mental disorder which complicates somatic treatment. Physicians at the PICU have to act at the interface between psychiatry and somatic medicine and cooperate continuously with colleagues from other specialties [2]. Normally the ward is designated for adult patients, but in exceptional cases adolescents (aged 14 years and above) can be transferred from the Department for Child and Adolescent Psychiatry. In contrast to other PICUs operating elsewhere in Europe [3,4] the Viennese PICU is a low-security ward and does not have an exclusive forensic focus. However,

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patients from a forensic ward or prison can be admitted and are then typically guarded by members of the penitentiary police. It is noteworthy, that not all patients admitted to this PICU are involuntarily committed. The service of this ward is well liked within the hospital and occupancy rates are very high (approximately 95%). Typically, patients have a shorter stay at the PICU during the acute phase of their illness, followed by treatment on an acute adult psychiatric ward.

Over the last decades, medical and pharmacological developments have changed the face of healthcare. However, little is known about whether these improvements were implemented in clinical care at the PICUs and how they affected the way patients were treated. The aim of the present study was to describe and to compare clinical features of patients as well as diagnostic and therapeutic procedures of the PICU in Vienna over a period of >30 years. We hypothesized that the medical progress, especially regarding novel diagnostic procedures and psychopharmacotherapy would be reflected in the medical care that patients received at this ward. Specifically, we hypothesized an increase in neuroimaging and a shift from older to newer substance groups. We did not a priori hypothesize any changes in the diagnoses of our patients as the purpose of the Viennese PICU has remained unchanged during the time frame of this study.

## 2. Method

We performed a comprehensive chart review in a total of 300 inpatients who had been treated at the PICU of the Department of Psychiatry and Psychotherapy (Medical University of Vienna) located at the General Hospital of Vienna. This is a repeated cross-sectional study, and the sample comprised three cohorts, each consisting of 100 consecutive patients: Sample no. 1 was from 1985 to 1986, sample no. 2 from 1995 to 1996, and sample no. 3 from 2008 to 2009. Some characteristics of sample no. 3 have already been published before [1]. Due to limitations of the archival system, a small number of charts of consecutive patients of sample 1 and 2 were not available. These cases were skipped and the next patient was included. Diagnoses of patients were established and documented according to the ICD-10 [5] (ICD-9 codes in sample 1 were translated to ICD-10 codes). Dates for market authorization of drugs were retrieved from the Austrian medicinal product index [6]. The Ethics Committee of the Medical University of Vienna gave approval to this study.

The R Project for Statistical Computing (version 3.5.1) [7] together with the packages *dunn.test* [8] and *ggplot2* [9] was used for statistical analysis and presentation. Univariate non-parametric tests were used to examine differences in regard to study samples. Our primary outcome

parameters regarding changes in diagnostic and therapeutic methods were the use of cranial CT, cranial MRI and functional neuroimaging, the use of tricyclic antidepressants, SSRI, SNRI, and second generation atypical antipsychotics. Further clinical outcomes were length of stay and the duration of involuntary hospitalization. The significance level of these tests was corrected by using the Bonferroni method (corrected p-level 0.0056). When the global test (Kruskal-Wallis H test or chi-squared test) between all three samples was significant, further pairwise comparisons (Dunn's test, chi-squared test) were conducted (corrected p-level of these post-hoc tests 0.00186). All other statistical comparisons were conducted in the sense of an exploratory data analysis ( $p \leq 0.05$ , significance level for these post-hoc tests  $p \leq 0.0167$ ).

## 3. Results

First, it should be noted that the number of beds and the staffing of the Viennese PICU did not change during the three periods of sampling. The sex ratio was not significantly different between the three samples of patients treated at the ward ( $\chi^2_{(2)} = 1.147$ ,  $p = 0.564$ ; 50.3% females in the total sample). The length of stay on the PICU increased from sample 1 to 3 ( $14.4 \pm 16.5$  vs.  $18.9 \pm 14.8$ ;  $z = -3.575$ ,  $p = 0.0002$ ; Table 1).

Distribution of primary diagnoses showed a decrease of substance induced disorders (ICD-10: F1) from sample 2 to 3 (46% vs. 22%;  $\chi^2_{(1)} = 11.787$ ,  $p = 0.0006$ ) and an increase of patients with affective disorders (ICD-10: F3) from sample 1 to 3 (20% vs. 38%;  $\chi^2_{(1)} = 7.018$ ,  $p = 0.0081$ ; Fig. 1). Rates of accidents (mean rate: 5.3%;  $\chi^2_{(2)} = 4.093$ ,  $p = 0.129$ ) and suicide attempts (mean rate: 21.3%;  $\chi^2_{(2)} = 1.470$ ,  $p = 0.480$ ) associated with admission to the PICU did not change significantly over time. Suicide attempts by jumping from height were lower in sample 2 (4%) than in sample 1 (16.7%;  $\chi^2_{(1)} = 7.377$ ,  $p = 0.0066$ ) and increased again in sample 3 (25%;  $\chi^2_{(1)} = 16.132$ ,  $p = 0.0001$ ; Table 2).

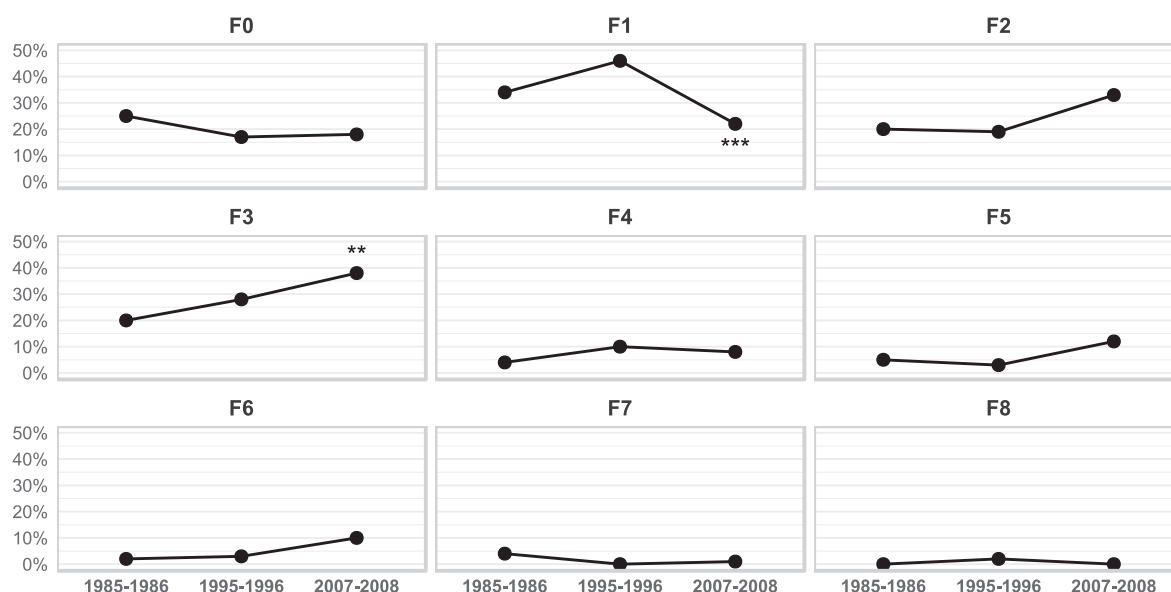
There was no statistically significant difference in rates of patients with an involuntary hospitalization (total sample: 43.3%;  $\chi^2_{(1)} = 4.588$ ,  $p = 0.101$ ) or physical restraints (36.7%;  $\chi^2_{(1)} = 2.612$ ,  $p = 0.271$ ). The length of involuntary admissions ( $18.6 \pm 15.0$  days;  $W = 774$ ,  $p = 0.369$ ) and the duration of use of physical restraints ( $10.6 \pm 10.8$  days;  $W = 173$ ,  $p = 0.053$ ) did not differ between sample 2 and 3 (Note: no data available for sample 1 due to insufficient documentation; Table 3).

Patients in the third sample were more likely to have cranial magnetic resonance imaging (MRI) than patients in the first (13% vs. 0%;  $\chi^2_{(1)} = 11.847$ ,  $p = 0.0006$ ). Cranial computed tomography (CT; mean rate: 29.3%;  $\chi^2_{(2)} = 4.470$ ,  $p = 0.107$ ), functional neuroimaging (i. e.

**Table 1**

Demographic variables, mode of admission/discharge and length of stay of the sample presented separately for the three cohorts. The symbols  $\uparrow$  and  $\downarrow$  indicate a significant increase or decrease from the previous time periods. The last column lists the two cohorts with a significant test result followed by the  $p$ -value (e. g. 1–3: test between sample 1 and 3) or n. s. in case of a non-significant test. The primary outcome parameters are highlighted with bold font type.

	1: 1985-1986	2: 1995-1996	3: 2008-2009		p-Value
Female: male (n)	46:54	53:47	52:48		n. s.
Age at admission (years: $\mu \pm$ SD, range)	40.6 $\pm$ 16.1 [17.7–82.3]	40.2 $\pm$ 14.1 [17.5–83.2]	45.7 $\pm$ 17.8 [15.6–85.7]		n. s.
<b>Duration of stay (days: <math>\mu \pm</math> SD, range)</b>	14.4 $\pm$ 16.5 [1–93]	15.8 $\pm$ 20.2 [1–179]	18.9 $\pm$ 14.8 [1–100]	$\uparrow$	1–3: 0.0002
Mode of admission					
From home or outpatient clinic	39%	27%	19%	$\downarrow$	1–3: 0.0031
From other psychiatric ward within hospital	5%	6%	15%		n. s.
From non-psychiatric ward within hospital	26%	44%	32%		n. s.
From external institution	30%	23%	34%		n. s.
Mode of discharge					
To home	33%	26%	29%		n. s.
To other psychiatric ward within hospital	28%	45%	44%		
To non-psychiatric ward within hospital	13%	9%	9%		
To external institution	24%	20%	17%		
Escaped	1%	0%	0%		
Deceased	1%	0%	1%		



**Fig. 1.** Diagnostic distribution of the three cohorts of the sample according to the ICD-10. Significant difference (\*\*\*)  $p < 0.001$  between sample 2 and 3 regarding the F1 category (substance induced disorders) and significant difference (\*\*)  $p < 0.01$  between sample 1 and 3 regarding the F3 category (affective disorders).

functional MRI, single-photon emission computed tomography, positron emission tomography; 5.3% of the total sample;  $\chi^2_{(2)} = 3.301$ ,  $p = 0.192$ ), and other imaging techniques (i. e. skull x-ray, myelography; 2.7%;  $\chi^2_{(2)} = 11.045$ ,  $p = 0.004$ ; post hoc tests: n. s.) did not change significantly over time. The use of electroencephalography (EEG) in patients of the PICU increased from sample 1 to 3 (35% vs. 53%;  $\chi^2_{(1)} = 5.864$ ,  $p = 0.016$ ) and 2 (29%) to 3 ( $\chi^2_{(1)} = 10.934$ ,  $p < 0.001$ ; Table 3).

We observed less intravenous psychopharmacotherapy from sample 1 to 3 (64% vs. 31%;  $\chi^2_{(1)} = 20.531$ ,  $p < 0.0001$ ) and from sample 2 (61%) to 3 ( $\chi^2_{(1)} = 16.928$ ,  $p < 0.0001$ ) and also a trendwise reduction of central venous catheters from sample 2 to 3 (28% vs. 14%;  $\chi^2_{(1)} = 5.093$ ,  $p = 0.024$ ). Parenteral nutrition was also employed less frequently in the last sample compared to sample 1 (8% vs. 25%;  $\chi^2_{(1)} = 9.291$ ,  $p = 0.0023$ ) and sample 2 (22%;  $\chi^2_{(1)} = 6.628$ ,  $p = 0.0100$ ). There were no significant changes over time in the use of oxygen therapy, nasogastric tubes and urinary catheters. The duration of use did not differ significantly between the samples for central venous catheters, nasogastric tubes and parenteral nutrition. However, the length of use did increase between sample 1 and 3 for urinary catheters ( $9.5 \pm 14.0$  vs.  $13.7 \pm 9.9$  days;  $z = -3.232$ ,  $p = 0.0006$ ; Table 3).

PICU patients were more frequently treated with antipsychotics in sample 3 compared to sample 1 (89% vs. 63%;  $\chi^2_{(1)} = 17.133$ ,  $p < 0.0001$ ) with a trendwise increase already between sample 1 and 2

(79%;  $\chi^2_{(1)} = 5.464$ ,  $p = 0.019$ ). From sample 2 to 3 we saw a sharp decline of usage rates for several typical neuroleptics, i. e. chlorprothixene, dixyrazine, haloperidol, levomepromazine, and thioridazine. In parallel to this, there was an increase of patients treated with second generation atypical antipsychotics from sample 2 to 3 (5% vs. 83%;  $\chi^2_{(1)} = 120.31$ ,  $p < 0.0001$ ), i. e. aripiprazole (available in Austria since 2004), olanzapine (available since 1996), quetiapine (available since 2000), and risperidone (available since 1993) – see Table 4A for details. Phase-prophylactic treatment increased over time from 14% to 49% and finally 37% (sample 1 vs. 2:  $\chi^2_{(1)} = 26.787$ ,  $p < 0.0001$ ; sample 1 vs. 3:  $\chi^2_{(1)} = 12.739$ ,  $p = 0.0004$ ). The use of individual mood-stabilizing drugs is shown in Table 4B.

There was an increase of antidepressant prescriptions from sample 1 to 3 (29% vs. 51%;  $\chi^2_{(1)} = 10.127$ ,  $p = 0.0015$ ). From sample 1 to 3 less patients received treatment with tricyclic antidepressants (27% vs. 5%;  $\chi^2_{(1)} = 16.406$ ,  $p = 0.0001$ ) while there were more patients treated with selective serotonin reuptake inhibitors (SSRI: fluoxetine available in Austria from 1988, citalopram from 1991, paroxetine from 1993, sertraline and fluvoxamine from 1996, escitalopram from 2002) from sample 1 to 2 (0% vs. 15%;  $\chi^2_{(1)} = 14.126$ ,  $p = 0.0002$ ) and 1 to 3 (23%;  $\chi^2_{(1)} = 23.778$ ,  $p < 0.0001$ ). Between sample 2 and 3 we saw the emergence of selective serotonin and norepinephrine reuptake inhibitors (SNRI: 0% vs. 12%; milnacipran available from 1998, venlafaxine from 1999, duloxetine from 2004;  $\chi^2_{(1)} = 10.727$ ,  $p = 0.0011$ ). Other antidepressants, e. g. mianserin, mirtazapine, and trazodone showed an increase from sample 1 to 2 (3% vs. 19%;  $\chi^2_{(1)} = 11.491$ ,  $p = 0.0007$ ) and from sample 1 to 3 (33%;  $\chi^2_{(1)} = 28.489$ ,  $p < 0.0001$ ; Table 4C).

Benzodiazepines were prescribed more frequently in sample 3 compared to sample 1 (84% vs. 64%;  $\chi^2_{(1)} = 9.382$ ,  $p = 0.002$ ). Interestingly, the maximum mean daily dosages used ( $\pm$  standard deviation; milligram diazepam equivalent) progressively decreased from sample 1 to sample 3 ( $103.1 \pm 165.0$ ,  $30.3 \pm 22.4$ ;  $z = 4.815$ ,  $p < 0.0001$ ) and from sample 2 ( $59.9 \pm 58.6$ ) to 3 ( $z = 4.007$ ,  $p < 0.0001$ ). For details on use of further psychopharmacologic substances please refer to Table 4D. The usage rates for electroconvulsive therapy (ECT) did not change significantly over time (mean rate 7%;  $\chi^2_{(2)} = 2.765$ ,  $p = 0.251$ ; Table 4D).

#### 4. Discussion

PICUs have been known to operate since the 1970s [10]. Most of the reports describing PICUs are from the UK [3,4,11–25], North America

**Table 2**

Association of the admission with an accident or suicide attempt. The symbols  $\uparrow$  and  $\downarrow$  indicate a significant increase or decrease from the previous time periods. The last column lists the two cohorts with a significant test result followed by the p-value (e. g. 1-3: test between sample 1 and 3) or n. s. in case of a non-significant test.

	1: 1985-1986	2: 1995-1996	3: 2008-2009	p-Value
Accident	9%	3%	4%	n. s.
Suicide attempt	18%	25%	21%	n. s.
Poisoning	61.1%	68%	45%	n. s.
Jumping from height	16.7%	4%	25%	1-2: 0.0066 2-3: 0.0001 n. s.
Cutting/piercing with sharp object	11.1%	12%	20%	n. s.
Vehicular impact	5.6%	8%	5%	n. s.
Hanging	5.6%	4%	0%	n. s.
Firearm	0%	4%	0%	n. s.
Self-immolation	0%	0%	5%	n. s.

**Table 3**

Diagnostic and general therapeutic modalities. The percentage of patients and the length of the procedure in days is given with mean  $\pm$  SD and the range in square brackets where appropriate. The symbols  $\uparrow$  and  $\downarrow$  indicate a significant increase or decrease from the previous time periods. The last column lists the two cohorts with a significant test result followed by the p-value (e. g. 1–3: test between sample 1 and 3) or n. s. in case of a non-significant test. The primary outcome parameters are highlighted with bold font type.

	<b>1: 1985–1986</b>	<b>2: 1995–1996</b>	<b>3: 2008–2009</b>	<b>p-Value</b>
<b>Involuntary hospitalization</b>	39%	39%	52%	n. s.
	?	17.3 $\pm$ 14.6 [1–68]	19.5 $\pm$ 15.4 [1–80]	n. s.
Physical restraints	33%	34%	43%	n. s.
	?	9.1 $\pm$ 11.0 [1–58]	13.5 $\pm$ 10.2 [1–39]	n. s.
<b>Cranial CT</b>	27%	24%	37%	n. s.
<b>Cranial MRI</b>	0%	4%	13%	$\uparrow$ 1–3: 0.006
<b>Functional Neuroimaging</b>	2%	7%	7%	n. s.
EEG	35%	29%	53%	$\uparrow$ 1–3: 0.0155 2–3: 0.0009
Other imaging techniques	7%	0%	1%	n. s.
Oxygen therapy	13%	22%	15%	n. s.
Intravenous psycho-pharmacotherapy	64%	61%	31%	$\downarrow$ 1–3: <0.0001 2–3: <0.0001
Central venous catheter	20%	28%	14%	n. s.
	11.1 $\pm$ 8.6 [4–35]	11.2 $\pm$ 9.6 [2–49]	9.2 $\pm$ 8.6 [2–36]	n. s.
Nasogastric tube	25%	25%	17%	n. s.
	7.5 $\pm$ 9.5 [1–38]	10.9 $\pm$ 14.9 [1–61]	10.1 $\pm$ 7.0 [2–31]	n. s.
Parenteral nutrition	25%	22%	8%	$\downarrow$ 1–3: 0.0023 2–3: 0.0100
	9.0 $\pm$ 10.8 [1–48]	10.6 $\pm$ 7.4 [2–24]	10.1 $\pm$ 5.2 [3–15]	n. s.
Urinary catheter	41%	46%	47%	n. s.
	9.5 $\pm$ 14.0 [2–86]	15.2 $\pm$ 27.0 [1–179]	13.7 $\pm$ 9.9 [2–50]	$\uparrow$ 1–3: 0.0006

[26–32], and Australia [33–38]. In the German-speaking countries there exist one report from Germany detailing the initiation of a PICU [39], another article specifically describing a refeeding program for anorectic patients [40], and one report from Switzerland on the frequency of seclusions depending on locking the door of the ward [41]. While there have been comparisons of PICU patients before and after organizational changes [31,41] or specific interventions [15,33,42] and over shorter periods of time [24,30,43], the present study is to our best knowledge the first systematic investigation of changes of clinical properties of PICU patients over several decades.

The patients of our samples were different from those from other PICUs in regard to several variables: Our results do not show gender differences regarding admitted patients, while on other PICUs an excess of male patients was noted [3,4,11,13,16–18,20,22,27–29,31,33,35,38]. Patients' age was in the 40s here and even showed a trendwise increase over time, while other PICUs mostly admitted younger patients with ages in their 30s [3,4,11,13,16–19,21,26,27,29–31,34,35]. Length of stay increased over time from 14 to 19 days, which was longer than the average duration of stay reported for many PICUs elsewhere (about or below one week) [18,26,29–31,34,35,38,42] but there are also descriptions of units with a duration of stay comparable to our results [17,41,44] or wards with longer admissions [3,4,11,13,19,21,24,28,40]. These demographic differences of the patient population might exist because the Viennese PICU is integrated in a general hospital and focuses on cooperation with somatic intensive care units besides caring for severely ill psychiatric patients from other psychiatric wards. However, it should also be pointed out that the unique nature and specific form of organization of this PICU possibly reduces the generalisability of our results.

Patients with substance induced disorders were the largest diagnostic group in sample 1 and 2 here. This is in line with some reports where patients with alcohol and drug problems (ICD-10: F1) form a significant part of PICU patients [3,13,16,20–22,26,27,33]. However, the F1 category decreased in sample 3, where patients with affective disorders and schizophrenic and delusional disorders became the largest and second largest diagnostic groups. Reports on PICUs indicate that schizophrenic and manic patients typically form the largest group of their patients [3,11,13,16–19,21–23,25,26,28,30,31,33–35,38,41,42,44,45]. These diagnoses were also important in our sample, but it has to be considered that the subgroup of patients with affective disorders not only included manic patients but also patients with severe psychotic

depression and stupor. About 10% of our patients had a diagnosis of personality disorder. This rather low rate of personality disorders is in line with several reports [3,14,17–19,21,26,35,42,44,45], but there are also PICUs with higher rates (mostly about 20%) [4,11,13,28,31]. However, the high severity of the primary psychiatric diagnosis (e. g. delirium, catatonia, stupor) might have made it impossible to accurately diagnose personality disorder during the stay at the PICU.

Accidents and suicide attempts were involved in about 25% of the admissions of the Viennese PICU. The means for suicide attempts in our patients differed from those means published for suicides in Austria, which is likely due to the differential lethality of those means. Suicides in Austria are most frequent by hanging in both gender, followed by poisoning in women and shooting with firearms in men [46]. Here, suicide attempts were most frequently carried out by poisoning, followed by cutting/piercing with a sharp object and jumping from height. Except from some fluctuations in the latter group (reduction in sample 2 and further increase in sample 3) means for suicides in our sample were fairly stable.

About 45% of all patients in our sample were involuntarily admitted to our PICU. Medical restraints had to be used in 80–85% of these patients. In 1991 the Austrian civil commitment law (Unterbringungsgesetz) [47] entered into force and replaced the legal regulations dating from the year 1916. One of the implications of this new law was that it imposed stricter documentation procedures and judicial review of involuntary commitments and the use of (physical and other) restraints. In fact, it was not possible to accurately determine the exact duration of involuntary stays and restraints in the first sample (1985–1986) because of poor documentation. Despite these legal changes we could not see a significant change in involuntary commitments and the use of restraints. The slight non-significant numerical increase in sample 3 compared to sample 2 might be due to the changes in patients' diagnoses delineated above.

When looking at changes regarding the diagnostic procedures, it is evident that diagnostic methods like modern neuroimaging were adopted upon availability, which is in line with our hypotheses. Still, the rate of cranial MRIs seems to be low in the last sample (13%), which is most likely due to the short stay on the PICU and the waiting time for MRIs in subacute cases. Many patients would have had a cranial MRI later on, while being admitted on another ward after discharge from the PICU. In sample 3 intravenous psychopharmacotherapy declined. We believe that this was mainly caused by changes in the

**Table 4**  
(A–D). Psychopharmacologic treatment (percentage of patients). The symbols ↑ and ↓ indicate a significant increase or decrease from the previous time periods. The last column lists the two cohorts with a significant test result followed by the p-value (e. g. 1–3: test between sample 1 and 3) or n. s. in case of a non-significant test. The primary outcome parameters are highlighted with bold font type.

Table 4A. Antipsychotic treatment.						
	1: 1985-1986	2: 1995-1996		3: 2008-2009		p-Values
Antipsychotics total	63%	79%		89%	↑	1-3: <0.0001
Chlorprothixene	28%	28%		0%	↓	1-3: <0.0001
						2-3: <0.0001
Clotiapine	0%	13%	↑	0%	↓	1-2: 0.0006
						2-3: 0.0006
Dixyrazine	9%	16%		0%	↓	1-3: 0.0064
						2-3: 0.0001
Haloperidol	36%	37%		20%	↓	2-3: 0.0122
Levomepromazine	8%	18%		1%	↓	2-3: 0.0001
Prothipendyl	19%	19%		12%		n. s.
Sulpiride	0%	5%		0%		n. s.
Thioridazine	3%	8%		0%	↓	2-3: 0.0115
Tiapride	1%	7%		0%		n. s.
Clozapine	7%	2%		6%		n. s.
Second gen. atypical antipsychotics	0%	5%		83%	↑	1-3: <0.0001
						2-3: <0.0001
Amisulpride	0%	0%		1%		n. s.
Aripiprazole	0%	0%		16%	↑	1-3: 0.0001
						2-3: 0.0001
Olanzapine	0%	0%		25%	↑	1-3: <0.0001
						2-3: <0.0001
Quetiapine	0%	0%		44%	↑	1-3: <0.0001
						2-3: <0.0001
Risperidone	0%	5%		32%	↑	1-3: <0.0001
						2-3: <0.0001
Sertindole	0%	0%		1%		n. s.
Ziprasidone	0%	0%		3%		n. s.

Table 4B. Mood stabilizers.						
	1: 1985-1986	2: 1995-1996		3: 2008-2009		p-Value
Mood stabilizers total	14%	49%	↑	37%	↑	1-2: <0.0001
						1-3: 0.0004
Lithium	3%	6%		6%		n. s.
Carbamazepine	10%	45%	↑	1%	↓	1-2: <0.0001
						1-3: 0.0131
						2-3: <0.0001
Oxcarbazepine	0%	0%		2%		n. s.
Valproic acid	3%	3%		15%	↑	1-3: 0.0066
						2-3: 0.0066
Lamotrigine	0%	0%		8%	↑	1-3: 0.0115
						2-3: 0.0115

Table 4C. Antidepressant treatment.						
	1: 1985-1986	2: 1995-1996		3: 2008-2009		p-Value
Antidepressants total	28%	35%		51%	↑	1-3: 0.0015
Tricyclic antidepressants	27%	11%		5%	↓	1-3: 0.0001
SSRIs	0%	15%	↑	23%	↑	1-2: 0.0002
						1-3: <0.0001
SNRIs	0%	0%		12%	↑	1-3: 0.0011
						2-3: 0.0011
Other antidepressants	3%	19%	↑	33%	↑	1-2: 0.0007
						1-3: <0.0001

Table 4D. Further psychopharmacologic treatment and use of electroconvulsive therapy (ECT).						
	1: 1985-1986	2: 1995-1996		3: 2008-2009		p-Value
Benzodiazepines		64%	70%	84%	↑	1-3: 0.0022
Max. daily dose of benzodiazepines (in mg diazepam equivalents)		103.1 ± 165.0 [3.0-1000.0]	59.9 ± 58.6 [10.0-400.0]	30.3 ± 22.4 [5.0-100.0]	↓	1-3: <0.0001
						2-3: <0.0001
Meprobamate		29%	42%	1%	↓	1-3: <0.0001
						2-3: <0.0001
Chloral hydrate		5%	21%	↑	2%	↓
						1-2: 0.0016
						2-3: 0.0001
Clomethiazole		0%	29%	↑	0%	↓
						1-2: <0.0001
						2-3: <0.0001
Nalbuphine		0%	11%	↑	17%	↑
						1-2: 0.0019
						1-3: <0.0001
Magnesium (for sedation)		0%	32%	↑	0%	↓
						1-2: <0.0001
						2-3: <0.0001
Gabapentin		0%	0%	2%		n. s.

Table 4 (continued)

Table 4D. Further psychopharmacologic treatment and use of electroconvulsive therapy (ECT).				
	1: 1985-1986	2: 1995-1996	3: 2008-2009	p-Value
Pregabalin	0%	0%	4%	n. s.
Topiramate	0%	0%	3%	n. s.
Piracetam	47%	37%	3%	↓ 1–3: <0.0001 2–3: <0.0001
Other substances (e. g. opioids and antidementive drugs)	16%	30%	51%	↑ 1–3: <0.0001 2–3: 0.0040
ECT	7%	4%	10%	n. s.

available psychotropic drugs. At the end of the 1990s, some tricyclic antidepressants and older neuroleptics, some of which were also available as intravenous preparations, were withdrawn from the market. Psychiatrists had to change their prescribing habits and turned to SSRI, SNRI and atypical antipsychotics, which were only available as peroral preparations in most cases.

Detailed reports on medication use at a PICU are rare [13,24,31,34,41], most studies only mention specific aspects of patients' medication [15,18,26,35,36,43,48]. Interestingly, we found that over time almost every category of psychotropic drugs showed an increase: The rate of patients with antipsychotics, antidepressants, and benzodiazepines increased from sample 2 to 3. This might in part be due to a different diagnostic composition between the samples. However, for antipsychotics the increase in prescription rates might also be caused by the broader use of quetiapine in sample 3, which was used as an unspecific sedative (mostly in lower dosages) for nearly half of the patients with different diagnoses. Quetiapine apparently replaced chlorprothixene for this purpose, which was frequently used until then. While the rate of use for benzodiazepines increased, the mean doses for this group of substances decreased over 30 years by about 70%. Particularly high doses in sample 1 could be caused by the fact that the Viennese PICU had the option to provide artificial respiration during this time. Psychiatrists in later times had to be more careful, not to induce respiratory depression in their patients. Further reductions in dose in sample 3 might also have been caused by a tendency to combine lower doses of benzodiazepines with other substances, such as nalbuphine, atypical antipsychotics, and valproic acid. Interestingly, ECT was only performed in 10% or less of patients of our PICU. This is probably because ECT is also performed at other wards of the psychiatric department and is not per se a reason for referral to the PICU.

#### 4.1. Strengths and limitations

This study is strengthened by the fairly large samples and the stability of the organization of the ward, which reduces the variability between the three time points. In observational studies several sources of bias are possible [49]: our study has a low likelihood of selection bias as we had access to virtually all patient charts. However, we cannot completely rule out information bias, i. e. inaccurate documentation of patient factors and to a secondary extend measurement error. The study is further limited by the lack of a cross-diagnostic outcome factor apart from length of stay or length of involuntary hospitalization. Despite the fact that some studies have investigated outcomes at PICUs [28,33,41,42,50–52], there is a continuing need to examine the implications of the PICU setting in general and specific interventions (including coercive measures) on PICUs in the context of modern psychiatric treatments.

#### 4.2. Conclusions

Our study shows that there were some diagnostic shifts (i. e. more affective disorders and less substance induced disorders) within the patient population at the Viennese PICU. Despite changes in the Austrian legislation, the rates of involuntary commitments and use of restraints

did not change profoundly. As hypothesized, it seems that different medical and psychopharmacological innovations were readily adopted in clinical practice. Further studies should follow up latest trends in the clinical properties of PICU patients and focus on evaluating short and long-term outcomes of this seriously ill patient population. Installation of a PICU at a general hospital should be considered a valuable asset providing specialized care and treatment. In the absence of such a ward (most hospitals in the German-speaking countries do not have a PICU) critically ill patients such as patients with delirium or catatonia have to be treated at general intensive care units [53]. Finally, it has to be noted that a common international definition of what is meant by PICU is lacking. In the UK there exists a very thorough definition of the minimum required standards for PICUs [54]. However, as far as we know a similar official definition of PICU is not existent in any other country. Therefore, the development of national and ideally international PICU definitions would be useful to enhance comparability of the work of PICUs.

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