

Health Economic Evaluation of the Psychiatric Emergency Response Team (PAM) in Stockholm County

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Abstract

Background: The Psychiatric Response Team (the PAM unit) started as a suicide prevention project during the spring of 2015 to handle acute psychiatric patients previously handled by the police. Since 2017, the PAM has been a permanent service within the health care organization of Stockholm County.

Method: Health economic estimates, based on different scenarios, were designed to investigate the economic evaluation of the PAM unit from both a health-care and a societal perspective. Another aim was to present an economic model that can be applied and developed in future studies to evaluate suicide-prevention projects. Potential savings achieved by the PAM unit were examined by measuring direct and indirect costs based on three different scenarios: restrictive, likely and optimistic. Costs were compared to the potential savings from changes in processes using the PAM unit. Estimates of potential savings from production losses were made using the friction-cost and human-capital methods. An estimate of human value was made using figures from previous studies in traffic-injury prevention. Different theoretical health economic methods of calculation are presented.

Results: Total cost for the PAM unit during its first two years of operation was 13.2 million Swedish kronor (SEK). Comparatively, direct savings from a health-care perspective were estimated at 2.8-5.1 million SEK, while direct savings from a societal perspective were estimated at 5.9-10.6 million SEK. The estimate of indirect savings differs depending on approach adopted: from 1.0-1.5 million SEK (friction-cost) to 52.0-103.9 million SEK (human-capital). Further, if estimates of human value are included, there are additional savings ranging from 52.3 to 82.1 million SEK.

Conclusion: The direct cost saving of the PAM unit, estimated on different scenarios, does not make it viable from a purely economic perspective. However, there are large indirect cost savings from avoidance of future production losses and savings in human value. The rescuing of a single patient from suicide by the PAM unit during one year would, under most estimated scenarios, justify the total cost of the intervention.

Background

Mental health problems, including suicide, have a major impact on the lives of individuals, and impose a large economic burden on society. People with mental health problems are less likely to be employed, and even if they are working, are more likely to suffer from a work disability and often have fluctuating productivity at work (1, 2). Moreover, suicide is one of the leading causes of premature death in the world; there were around 788 000 deaths from suicide worldwide in 2015. This corresponds to an annual global age-standardized suicide rate of 10.7 per 100 000 persons (3). During 2016, there were a total of 1 478 suicides in Sweden, 1 015 males and 463 females. In Stockholm County there were a total of 294 suicides, one-third of whom were females (4). Despite the economic burden of suicide, there are relatively few studies that have sought to quantify the costs related to it (5). At the same time, there are only a few economic evaluations of interventions aimed at the prevention of suicidal behaviour, and those that do exist are commonly based on secondary data and have numerous limitations. However, earlier studies do indicate that such interventions may be cost-effective and/or cost-saving (6, 7).

The costs deriving from a suicide are of mainly three types: direct, indirect, and human. Costs are calculated as the values of alternative uses of resources if the suicide did not occur, which can be estimated from budget lines, market prices, and the like. The direct costs are those that arise in connection with the suicide itself, and involve the resources that are immediately consumed: for the police, emergency health care services, property damage, health care, autopsy, etc. Indirect costs concern losses of productivity, and can be both waged and unwaged. In addition to direct and indirect costs, an estimate of the human cost in itself is sometimes made. This cost element is intangible, and its value can be

hard to estimate. The Swedish National Board of Welfare and other similar agencies have provided figures on the maximum willingness to pay for a quality adjusted life year (QALY) (8).

The Swedish Civil Contingencies Agency (MSB) has, for example, estimated the average total cost, including direct, indirect, and human costs, of a suicide in Sweden at 17.9 million Swedish kronor (SEK) (8).

Stockholm County, with around 2.2 million inhabitants, has one psychiatric emergency department (PED) located centrally in Stockholm. The PED provides round-the-clock psychiatric emergency services, and had close to 22 000 patient consultations in 2017. There is also a separate substance-use Emergency Department (ED) located in the same hospital building. It handles drug-induced psychosis and acute alcohol-related medical conditions like abstinence and alcohol-related delirium, and other acute symptoms caused by narcotic substances.

Handling psychiatric emergencies, such as mental health crises in a prehospital setting, is both challenging and complex for emergency medical services (EMS) personnel due to insufficient training (9, 10) and limited direct access to specialist psychiatric services (11). Alternative response systems for psychiatric emergencies have been developed and evaluated in some countries, and the use of specialized psychiatric response organizations as part of law enforcement and/or EMS has received a positive overall reception from personnel and organizations involved (12–19). Previous studies have also shown that an early response unit with specialist knowledge of handling patients in psychiatric emergencies may help achieve a preferred outcome (12). Despite this, no economic evaluation of these interventions has been conducted.

In the spring of 2015, the Psychiatric Response Team (PAM) project started in Stockholm County. It received government funding for a period of two years. The main purpose of the PAM team is to respond to emergency calls concerning persons in severe mental ill-health or behavioural distress, with a focus on patients at acute risk of suicidal behaviour. The PAM vehicle is staffed by two specialized psychiatric nurses and a paramedic, and collaborates with police, ambulance and rescue services. It operates 14 hours a day (2am to 2 pm), seven days a week. Vehicle response is usually initiated by a call from the public or other emergency services to the Emergency Call Centre (ECC) in Stockholm. Every call received by the ECC is indexed, and an appropriate response is decided upon. If a call is identified as reporting a mental health crisis suitable for the PAM unit, the vehicle is dispatched to the incident in question. Every incoming call is assessed on a three-grade priority scale with one being the highest priority level.

When the two-year project was about to end, during the spring of 2017, a decision was made to make it permanent. This was due to positive responses from the police department, health care organizations, patients and patient organizations, and Stockholm County's public health care. Since April 2017, the PAM has been a permanent service within the health care organization of Stockholm County.

The principal aim of this study is to perform a health economic evaluation of the PAM unit in Stockholm County during the first two years of its operation, from 1st of April 2015 to 31st of March 2017. A health economic approach, estimating costs and benefits on the basis of different scenarios, was used to investigate economic feasibility from both a health-care and a societal perspective. A further aim is to present a model for making economic estimates within suicide prevention, which can be applied and developed for similar future investigations.

Method

Data Analytic Methods

Data on every patient contact handled by the PAM unit were collected, and have been analysed for its two first years of operation, between 1st of April 2015 and 31th of March 2017. The data used have been collected from a number of

sources: the electronic medical records used in Stockholm County, the Stockholm County ECC, the Police Department of Stockholm, and the independent logbook used by PAM staff. Data for the first year have been published (14), while data for the second year were collected during the winter and spring of 2017/2018 and are now being prepared for publication.

First, given that the PAM unit enables immediate psychiatric assessment of a patient at the scene of a crisis, cost savings at health-care level can be achieved through the avoidance of multiple use of resources. A simplified care process, and also a decreased use of care, enables potential cost savings in health care services, and also savings related to other societal actors, such as the police and rescue services.

Second, there are potential cost savings from a societal perspective, with a focus on the prevention of suicides, based on a number of specific cases handled by the PAM unit. Direct, indirect and human costs are all addressed. Further, the cost of a forensic autopsy has been included in the calculations (SEK 24 800 in 2016) (20). Due to the uncertainty of the costs used in our calculations, three different cost scenarios/estimates are calculated where appropriate: a restricted estimate, an optimistic estimate, and a likely estimate. Two methods have been used for estimates of gross earnings: the friction-cost method (21, 22) and the human-capital method (23).

Where applicable, published data have been used, and costs indexed at 2016 level using data from Statistics Sweden's (24) consumer price index (CPI). The discount rate is three percent, which is the rate generally applied to the health sector in Sweden (25). To simplify calculation of the cost estimates, the average yearly costs for the two years of operation have been used. The costs considered in this study are summarized in Table 1.

Table 1
Health care and societal cost estimations for 2016 in SEK *.

Service	Unit of measurement	Costs 2016	Source
Visit to the Psychiatric Emergency Room	Per visit	3 981	Stockholm County Council (SCC)
Operation of an ambulance	Per hour	1 553	EMS (SCC)
Cost of death by suicide	Total cost	18 057 963	MSB, 2015
Total cost of PAM	Per year	6 689 254	SCC
Cost PAM including driver and nurses	Per hour	1 858	SCC
Operation of a police car with two officers incl. 20 km of driving	Per hour	1 864	Stockholm Police Department
Cost of rescue services	Cost per mission	2 786	MSB, 2009
Forensic autopsy	Cost per case	24 800	RMV, 2017
*Older costs have been recalculated to 2016 years costs using CPI.			

Pam Service Results

During its first two years of operations there were 3 252 requests to PAM, of which 2 703 were handled by the unit. During the first year of operation, 98% of all requests had level-one or level-two priority. On average, 1 hour 12 minutes was used per case. Table 2 shows baseline characteristics of the patient cohort for the attended cases, and Table 3 illustrates data from the ECC for the PAM. In 35% of cases, the patient was left at home after a medical assessment by

PAM staff. In 24% of cases, the patients were taken to the PED for further assessment by the attending emergency-room physician. In 8% of cases, the ambulance service took over the handling of the patient.

Table 2
Baseline characteristics of cohort handled by PAM.

Demographics*	
Number of individuals	2041
Male	43%
Female	56%
Sex unknown	0.5%
< 18 years	9%
18–29 years	26%
30–39 years	18%
40–49 years	15%
50–59 years	15%
60 < years	16%
Age unknown	1.3%
Contact with PAM	
One occasion	1770
Two occasions	168
Three occasions or more	103
Admissions	
Total	1770
Psychiatric inpatient care	168
Substance use inpatient care	103
Suicide risk assessment	
Minimal risk	9%
To some degree	62%
High	15%
*A person is only included once, even if they have multiple contacts with PAM	

Table 3
Data from ECC for PAM during the first two years of operation.

General	
Requests	3253
Attended cases	2703
Average requests per day	4.5
Average attended cases per day	3.7
Priority (ECC)	
1 (High)	45%
2 (Medium)	53%
3 (Low)	2%
ECC index	
Severe suicide threat	1093
Suspicion of severe psychiatric illness	978
Acute crisis	651
Severe suicide attempt	166
Suspicion of intoxication/overdose	62
Other	302
Average response times	
Request to arrival	27 min
Request to arrival priority 1	14 min
Total time per case	72 min

After assessment by the PAM staff, and in some circumstances testing of alcohol level by breathalyser, a total of 16% of the patients were taken directly to the substance use ED, rather than stopping at the PED, due to the influence of alcohol and/or narcotic substances. In 42% of the total cases, EMS collaborated with the PAM unit. The police department was involved in 44% of the cases attended, and the rescue services in 7%. In 38% of the cases, the PAM unit worked alone. The outcomes of the cases handled by the PAM unit for the first two years of operation are presented in Table 4.

Table 4
Outcomes of cases handled by PAM during the first two years of operation.

Outcomes	
No acute action after initial assessment	35%
Admitted to PED	24%
Admitted to substance use ED	16%
Job taken over by EMS	8%
Admitted to child psychiatric care	4%
Completed suicide upon arrival	7
Other	8%
Unknown	8%
Cooperation with other departments	
EMS	42%
Police	44%
Rescue service	7%
No involvement	38%

Health care sector cost assessment

A total of 946 patients (35%) were left at home after a medical assessment by PAM staff. Before the PAM was in operation most of these patients would have been driven to the PED by the police, or in some cases by EMS.

In a likely scenario we would assume that 90% of these people would have been taken to the PED before the PAM was in operation, while the rest (10%) would have been left at home by the police or EMS. In an optimistic scenario from a cost-saving perspective we assume that all patients would have been transported to the PED. In a restrictive scenario, we estimate that 515 (70%) patients would have been transported to the PED.

A total of 432 (16%) patients were taken directly to the dependency ED. Before the PAM, the police and EMS would have transported many of these patients, under the influence of alcohol or narcotics, to the PED instead, and then the patients would have been transferred to the dependency ED, meaning multiple visits.

In a likely scenario we would estimate that 70% of these patients would have been taken to the PED first, with the rest (30%) being transported directly to the dependency ER. In an optimistic cost-saving scenario we would expect 90% of these cases to have been taken to the PED initially, with only 10% being transported directly to the dependency ED. Under a restrictive cost-saving scenario, we would expect 50% of the cases to have been transported to the PED, and 50% taken directly to the dependency ED by the police and EMS.

The EMS and PAM collaborated in 1 135 of the cases (42%). Although the EMS were relieved from dealing with patients, this scenario means an extra cost since two units deal with the same patient for some time. Usually, EMS personnel are relieved quite quickly, and we estimate this extra cost to have arisen in three scenarios (total 919 cases): the ambulance being relieved after 10% of average time used (1 h 12 minutes) as an optimistic scenario, 20% of

average time as a likely scenario, and 30% as a restrictive scenario. However, in 216 cases (8%), the PAM referred the patient for further handling by EMS, usually due to the need of acute somatic intervention. This entails an extra cost since two units work together for some time. In a likely scenario, we assume that 20% of the average time (1 h 12 minutes) spent on every case is used by PAM staff, with further assessment and transportation taken care of by EMS so that the PAM unit can be used on other missions. In optimistic and restrictive estimates of time working together from a cost perspective, the estimated percentages of time would be 10% and 30%, respectively. The various scenarios and costs are presented in Table 5.

Table 5
Health sector costs for PAM in SEK for different cost saving scenarios.

# of cases	946 (35%)		432 (16%)		216 (8%)		919 (34%)		7 (0.3%)	
Scenario	Patients taken to PED instead of left at home (35%)*		Patients taken directly to the Dependency ED (16%)*		EMS & PAM working together but EMS handles patient (8%)*		EMS & PAM working together. PAM handles patient (34%)*		Autopsy costs for saved suicide cases	
	Percentage	Cost (+)	Percentage	Cost (+)	Time working together	Cost (+)	Time working together	Cost (+)	Autopsy cost (+)	Total cost saving
Restrictive	70%	2 623 636	50%	855 792	30%	142 379	30%	505 516	176 204	2 830 534
Likely	90%	3 373 247	30%	1 198 109	20%	94 919	20%	337 677		4 138 759
Optimistic	100%	3 748 052	10%	1 540 426	10%	47 460	10%	168 839		5 072 179
Restrictive, likely and optimistic cost saving scenarios during the first two years of operation. *To simplify average cost is used for the two years.										

The costs of autopsy avoided for the seven patients rescued due to the intervention of PAM during an ongoing suicide attempt are also presented in the table. However, these costs are quite small due to the limited number of cases. We treat these costs as health-care costs in this study.

Societal cost assessment

The major costs of death by suicide are indirect, mainly consisting of lost years of income. The benefit of an intervention can be assessed by examining how many cases can be avoided and the potential economic benefits of that avoidance in relation to the cost of the intervention. Suicide is a rare occurrence with multifactorial causes. Seven patients were clearly saved from death by suicide by a PAM intervention (Table 6).

Table 6
Patients saved by PAM intervention (during two years) with expected life years left.

Patient	Context	Intervention by PAM	Expected life years left*
Female - 22 Y/O	Lethal intoxication	Brought to hospital	62
Male - 28 Y/O	Jump from balcony	Grabbed and saved by staff	53
Male - 60 Y/O	Hanging by neck	Cut down by staff	23
Female- 57 Y/O	Lethal intoxication	Life rescue intervention, brought to hospital	28
Male- 17 Y/O	Lethal intoxication	Brought to hospital	63
Male- 40 Y/O	Lethal blood loss due to self-inflicted wound	Brought to hospital	41
Female- 45 Y/O	Jump into stream	Grabbed and saved by staff	40

*Statistics Sweden, Life Expectancy in Sweden 2011–2015. Life tables at national and county level (19).

The cost of operation of a police car with two officers is SEK 1 864 per hour including 20 km of driving (at 2016 prices). Before the setting-up of the PAM unit, the police handled most of these cases on their own, including both assessment of the patient at the scene and transportation to hospital when deemed necessary, which occurred in most cases.

After the PAM started, the police were still involved in 1 189 (44%) of the cases. However, time used per case by the police has decreased, and the police are made more quickly available for other missions. If we assume, in a likely scenario, that the time of the average police intervention decreases from 1 hour and 12 minutes (the same as the average time used by the PAM per case) to 20 minutes, 42 minutes are saved on each mission. In an optimistic and restrictive scenario, we assume that the police intervention time is reduced to 12 and 42 minutes, respectively (Table 7).

Table 7
Police saving costs for PAM in SEK for different scenarios.

# of cases	1 189 (44%)		1 514 (56%)		189 (7%)		
Scenario	Police/PAM cooperation		Previous police involvement		Rescue services involvement		
	Reduced time	Cost (+)	Involvement cover	Cost (+)	Reduced time	Cost (+)	Total cost saving
Restrictive	20 min (28%)	733 889	60%	2 002 477	50%	311 283	3 047 649
Likely	42 min (58%)	1 520 198	75%	2 503 096			4 334 578
Optimistic	60 min (83%)	2 175 456	90%	3 003 715			5 490 455

Restrictive, likely and optimistic cost scenarios, and reduction of use of rescue services during the first two years of PAM operation.

During the rest of the cases, the police were not involved. After initiation of the PAM unit, we can estimate a previous police-involvement coverage of 60% in a restrictive scenario, 75% in a likely scenario, and 90% in an optimistic scenario. We assume that the time needed for each police intervention is the same as for the PAM unit, which is on average 1 hour and 12 minutes (Table 7).

The time involvement of rescue services, dispatched for serious suicide alarms from the ECC (189 cases, 7%), is estimated to decrease by 50% on average due to the creation of the PAM unit.

The earlier study from Sweden (8) on the societal cost of suicide includes both loss of expected gross earnings and losses due to missing housework and voluntary work. The calculations made were based on earlier studies (26, 27), examining the ways in which the total value of lost earnings can be calculated with regard to various factors, such as employment rate and salary level.

With data on patient's age at time of rescue from suicide, the specific values of potential productivity losses for the remaining years have been calculated, in relation to both gross earnings from employment and household/voluntary work. Earlier published data on the values of employment and household/voluntary work in different age/sex categories in Sweden (Table 8) (28), indexed according to the CPI at 2016 prices(24) and discounted by three percent (25), have been used.

Table 8
Value of production loss (SEK) per month due to household/voluntary work (HV) and employment (E) (18).

Age	Women (E)	Men (E)	Women (HV)	Men (HV)	Total Men	Total Women
0–14	0	0	0	0	0	0
15–17	0	0	0	0	0	0
18–29	28 415	31 013	14 366	9 956	42 782	40 969
30–49	33 286	40 634	18 610	12 370	51 896	53 004
50–64	33 394	41 892	17 911	13 553	51 305	55 445
65–80	0	0	22 225	17 780	22 225	17 780
>80	0	0	19 188	18 742	19 188	18 742
Costs are index regulated in 2016 cost (14).						

Using the human-capital method, the potential productivity loss is estimated in three scenarios. First the patient dies at an age 20 years earlier than expected (29). Second, the patient is fully productive throughout the expected lifespan (Note that these two scenarios include the values of both gross earnings through employment and household/voluntary work). The third scenario includes estimated gross earnings from employment only up to retirement age, which is 65 in Sweden, but does not include the estimated value of household/voluntary work.

The friction-cost method estimates the value of the potential production loss up until the employer has been able to replace the person in question. Two scenarios are calculated, one with only employment-production estimated, the other with household/voluntary work included. We estimate the replacement time required to be 6 months, and take account of the replacement's reduced productivity (80% of that of a regular employee) on the basis of figures for short-term leave (22). In both methods we use 2016 as the year of the potential suicides to facilitate calculation.

Estimation of the human cost of suicide in this study is based on the informal value of a QALY in Sweden, which is defined as a high of SEK 500 000 (30). This number is also used in the study by MSB of the cost of suicide in Sweden (8).

For the estimates of human-cost savings, the same scenarios are used as in the estimation of the potential loss of production, i.e., 20 years loss of life and death at expected age, respectively, for the human-capital method, the friction-cost method and human value (Table 9).

Table 9
Values of potential productions loss.

Patient	Human-capital method			Friction cost method		Human value cost	
	Production loss w. 20 life years lost	Production loss w. expected life years	Production unit retirement due to employment	Production loss due to employment	Production loss due to employment & household/voluntary	20 life years lost	Expected life years
Female-22 Y/O	12 167 614	14 374 592	8 177 349	136 392	205 349	11 850 680	14 000 171
Male-28 Y/O	10 209 045	13 540 182	8 249 670	148 862	254 419	10 382 896	13 187 495
Male-60 Y/O	1 881 988	10 123 672	2 302 237	201 082	246 264	1 414 306	8 221 804
Female-57 Y/O	1 872 152	11 552 311	2 812 987	160 291	246 264	3 509 846	9 382 054
Male-17 Y/O	11 790 175	14 454 334	10 104 384	0	0	11 990 951	14 077 836
Male-40 Y/O	9 804 695	14 891 410	8 490 790	195 043	254 419	7 707 512	11 706 200
Female-45 Y/O	9 264 977	14 394 770	5 942 540	159 773	249 101	7 438 737	11 557 386
Total	56990 646	93 331 271	46 079 956	1 001 443	1 455 816	54 294 928	82 132 947
Calculations using human-capital, frictions-cost methods and estimation of human value costs in 2016 years value (SEK). Discount rate 3 percent (15).							

Total summary estimates of cost savings (at 2016 prices) for the different scenarios and methods are presented in Table 10. As noted, the range is large, with values depending on the method used, the different assumptions made, and if estimations of human value are included. The direct costs account for a minor part of the total sum. The numbers presented should be compared with the total cost of the PAM unit during the first two years of operation, totalling at SEK 13 183 675 in 2016 years cost with a three percent discount rate.

Table 10
Total estimated cost savings for different scenarios.

Total estimated cost savings			
Direct costs	Restrictive	Likely	Optimistic
Health care costs	2 830 534	4 138 759	5 072 179
	Restrictive	Likely	Optimistic
Police costs	3 047 649	4 334 578	5 490 455
Total direct costs	5 878 183	8 473 337	10 562 634
Indirect costs			
Human capital method (HC)	46 079 956	56 990 646	93 331 271
Friction method (FM)	1 001 443		1 455 816
Human value (HV)	54 294 928		82 132 947
Total cost			
Total HC excl. HV	51 958 139	65 463 983	103 893 905
Total FM excl. HV	6 879 626		12 018 450
Total HC incl. HV	106 253 067	119 758 911 *	186 026 852
Total FM incl. HV	61 174 554		94 151 397
Total PAM cost	13 183 675		
Calculations on total estimated cost savings in the different scenarios are based on 2016 years value in SEK.			
* Include restrictive human value estimation.			

Discussion

Main findings

In this scenario-based health economic study of the PAM unit in Stockholm County, the costs of the unit during its first two years of operation are compared to the potential savings from changes in the processes enabled by the PAM unit. An estimate of potential savings from production losses due to the rescue of patients from suicide has also been included using different methods of calculations.

During its first two years of operation the PAM unit handled 2 703 cases. The total cost of the PAM unit for the first two years of operation was SEK 13.2 million (at 2016 prices and using a three percent discount rate). In comparison, the direct potential health care savings were estimated at SEK 2.8–5.1 million. The societal costs savings were estimated to be between SEK 3.0–5.0 million, amounting to a total saving of SEK 5.9–10.6 million in direct costs during the two years of operation.

The estimated potential saving due to indirect costs depends on the method of estimation and whether or not human value is included. Using the friction-cost method the potential savings were estimated to be in the range SEK 1.0-

1.5 million. The human-capital method gave an estimate of potential savings in the range SEK 52.0-103.9 million. Estimates of human-value savings came to SEK 52.3–82.1 million.

The direct cost saving itself does not make the PAM unit viable from an economic point of view given the cost of the unit, but if indirect costs are considered there are huge cost savings.

Methods of economic evaluation

The figures and data used for the estimation of the health-care and societal cost savings were based on data collected during the first two years of operation of the PAM unit, numbers from involved authorities, and earlier published data. The discount rate used was three percent. Ideally, the rate should match reality and applied to data from which the effect of price and cost inflation has been removed (31). A discount rate of three percent is commonly used in the Swedish health care system (25). Note that the choice of discount rate will have a major impact on the estimated amount of savings given the number of years involved in the human-value and human-capital calculations. Older costs have been recalculated to 2016 values using the CPI from Statistics Sweden (24) to adjust prices for inflation. However, using the CPI has weaknesses because it is not an index that measures all types of production and consumption in the economy. The different types of services and products included are also given different weights (importance).

To simplify the calculations, average costs over two years have been used where applicable. Estimating exact costs are very difficult, and therefore up to three different cost estimates have been used in order to give a more realistic account of the possible range of cost savings. The most realistic estimate can be defined as the one closest to a “real-life” scenario. The possibility of baseline data being outside the assumed range cannot completely be ruled out, but is deemed unlikely on the basis of experiences of the first year of operation and no fundamental changes of operation mode (24).

Using different economic methods to evaluate interventions within mental health care is usually complicated by the wide range of impacts mental conditions have on society as a whole. The first question to address is where and how mental health care is provided. Generally speaking, provision is usually within health care services, but this may not always be the case as providers and settings can differ between societies. Other costs should, if possible, be taken into account. These could, for example, be costs in the criminal justice system, or social-care costs for patients in need of facility-specific provision as well as community-based social care. Also, informal care (as anyone who looks after an acquaintance in need of support due to mental health issues is aware) should be taken into consideration if possible. For example, people with some mental diagnoses, such as a psychotic disorder, are more likely to commit violent crime, twice that of the general population (32–34), with the increased cost falling on the criminal justice system.

Production losses stem from a person not being able to work, due to factors such as disability, reduced productivity, sick leave or early death (with loss of future earnings). There is no consensus on how best to measure loss of production (35). Two main methods are commonly employed to value production loss in health economic evaluation: the human-capital and friction-cost methods (36).

In this study, we have used both methods to value the potential future earnings of the patients saved from suicide by the PAM unit. The value of production loss, with regard to both employment and household/voluntary work, is based on figures from Jarl et. al. for different sex and age categories (28). These figures have been indexed at 2016 values using the CPI from Statistics Sweden (24).

The friction-cost method focuses on the time and costs of the replacement of an absent worker. We used six months as a replacement time and considered a 20% reduction in the worker’s productivity rate (the elasticity adjustment factor) (22). Note that the number of months used ranges between 2 and 6 in different studies. In general, there seems still to

be a lack of consensus on what time-and-elasticity adjustment factor to use, as the choice depends on the specific setting of the study (37).

Six months seems a reasonable amount of time to assume in Sweden, and is usually needed due to a recruitment process that includes job-advertising and to most people having a three months' period of notice. The elasticity factor used in this study is in line with earlier studies (37). As noted, it is only the hours not worked and only one friction period that are considered. This is not unproblematic because the person who replaces the absent worker may in reality be in work somewhere else, and needs, unlike an unemployed person, to be replaced in turn, creating a new friction period. Thereby, in comparison with the human-capital method, which has been criticized for overestimating the value of production loss (21), the friction-cost approach usually generates much lower estimates, and may instead underestimate the cost. For example, a replacement chain may occur, where the "sick" person will often be replaced by an employed person. That worker must in turn be replaced, and so on (38).

The human cost method estimates the value of lost future earnings due to illness or premature death. The figures obtained will depend on several different factors, such as age, gender, employment rate, and education. It is well-known that patients with mental health disorders have a reduced life expectancy and increased mortality, due to both suicide and somatic disorders (39), and mental illness is also connected to a lower employment rate, which in turn creates a lower production value (40). It is therefore likely that a person with a history of attempted suicide is affected by factors predisposing them to be less effective in the workforce and community, thereby making their income lower than average.

Different scenarios

It is optimistic to expect that all the patients in this study would have reached estimated life expectancy and be fully productive throughout their life span, thereby justifying the use of average production levels. For example, a recently published study concluded that men with a suicide attempt at 20 years of age had an estimated reduced life expectancy of 18 years, while the reduction for a 50 year-old male was estimated at 10 years. For women with a suicide attempt at the same ages, life expectancy would be shortened by 11 and 8 years, respectively (41). To account for this problem, different scenarios have been used, with estimates of the values of future production in relation to a decreased life expectancy of 20 years, and with the patient being productive only until the age of retirement, excluding the value of household and voluntary work throughout the lifespan.

The value of human cost has been included in this study, but this is not always the case in studies of the cost of suicide due to the difficulties in cost estimation. The most common method used for estimating the human value is to find the value of a "statistical life", e.g., from the traffic sector (40). The value used in this study is SEK 500 000, which is the informal value of a QALY in Sweden and has been used in previous studies (8, 30). Two scenarios were estimated for the potential value of human cost savings: one where the patients have 20 years of life years lost, and one where the patients reach their full life expectancy. One important argument against this way of estimating human value is that all years are given the same value; that is, account is not taken of all life years not being completely healthy, especially at an older age, and also of possible differences in the initial states of health between individuals (42). However, making a comparison, it is interesting to see that estimates of the human value of a lost life due to suicide in previous studies, from SEK 10.9 million (MSB, 2015) to SEK 13.2 million (31, 40) are similar to the estimated value in this study, which ranges from SEK 7.5 to 11.5 million, all at 2016 prices.

The potential direct cost saving enabled by the PAM unit is significant in relation to the total cost of the unit. This is due to the relief provided to other emergency services and through a more effective care process, with PAM staff making a qualified medical assessment of the patient in a pre-hospital setting; and also being able to leave the patient at home,

thereby avoiding unnecessary transportation to hospital and/or avoiding multiple assessments by different actors within the health care organization.

However, it is the value of discounted future earnings together with the estimation of potential loss of human value that makes for the largest potential savings from the PAM unit's interventions. These estimates are based on specific cases where human lives have been saved by the intervention of the PAM unit in emergency cases. It may also be possible that the PAM unit's interventions have saved more lives, but any conclusion on this cannot be drawn from available data and would require a study design that is not practically viable. A thorough investigation of the total number of potential deaths from suicide saved due to the work of the PAM unit is beyond the scope of this study, and would require a control group that would not be susceptible to a PAM intervention. Further, the total number of identified cases would probably be too small to reach statistical significance; and, even if the PAM unit had interacted with a person and discouraged a suicide at a specific moment, the averted suicide attempt could occur again later in time.

It can also be argued that, if the PAM unit had not rescued the patients it has, the police department or EMS might have done so. Even if police and rescue services had intervened in time in some of these cases, one single patient saved would justify the existence of the PAM unit. Another thing to note is that many of the cases highly prioritized by the PAM are not always the highest priority for other emergency services. In general, this makes their response time longer than that of the PAM unit, which gives suicide alarms top priority. A longer response time, even of just a few minutes, may result in a lethal outcome in these cases.

Although dealing with a high-risk population, suicide is still a very rare occurrence in relation to the total number of patients involved. Accordingly, in evaluating any possible cases, pure coincidence has to be ruled out, which, in reality, may be impossible due to the small number of occurrences.

At the same time, because of the amount of the cost saving of each rescued individual in terms of human value and the value of potential future earnings in comparison with the cost of the PAM unit, one (additional) patient saved from suicide a year could justify the entire annual cost of the unit.

Conclusions

This study presents a theoretical method of performing a health economic evaluation of a mental health intervention, and may serve as an idea for further developing the assessment of mental health interventions. The results of this study suggest that investment in the PAM unit produces direct cost savings through a change in the health care process of patients in need of acute psychiatric intervention, and also by making resources available for other tasks of the police, ambulance and rescue services that traditionally have been dealing with this patient group. However, the direct cost saving itself, estimated on a number of different scenarios, seems not to be sufficient from a purely economic point of view in comparison with the alternative cost of the PAM unit. This is not uncommon in health care where interventions rarely pay for themselves but are funded because of their impacts on health, well-being and, in some cases, life expectancy. In any case, the introduction of the PAM unit was almost cost-efficient even when only taking the direct cost saving into account. However, when the huge cost of human suffering, which is associated with suicide, is included in the estimates of human value, and made part of the economic evaluation, the PAM becomes highly cost-efficient. Other values, such as the increased quality of pre-hospital assessment and patients' experiences, and patients' no longer being handled by law enforcement officers and instead being taken care of by specialist nurses, are difficult to assess from an economic perspective and are beyond the scope of this paper. In the future, other potential long-term cost savings should be investigated, such as those derived from better outcomes for the patients that have been taken care of by the PAM unit instead of other services. When assessing indirect costs, it is quite clear that which theoretical framework is chosen for making estimates really does matter. There are large cost savings from

the avoidance of future production losses and also savings involving human value. Including these costs, the saving of a single patient from suicide during one year could already justify the existence of the PAM unit.

Abbreviations

PAM

Psychiatric Emergency Response Team

SEK

Swedish kronor

QUALY

Quality Adjusted Life Year

MSB

The Swedish Civil Contingencies Agency

PED

Psychiatric Emergency Department

ED

Emergency Department

EMS

Emergency Medical Services

ECC

Emergency Call Centre

CPI

Consumer price index

Declarations

Ethics approval and consent to participate: Not applicable to this study

Consent for publication: Not applicable

Availability of data and materials: The datasets from the current study are available from the corresponding author on reasonable request.

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