Health care consumption for somatic patients following a brief outreach alcohol intervention

ANNE-SOPHIE SCHWARZ [1,2 *]
MARIE KRUSE [3]
ANETTE SØGAARD NIELSEN [1,2]
BENT NIELSEN [1,2]
JES SØGAARD [1,2,3]

[1] Unit of Clinical Alcohol Research, Clinical Institute, University of Southern Denmark, Denmark
[2] Psychiatric Department, University Function, Region of Southern Denmark
[3] Danish Centre for Health Economics, University of Southern Denmark, Denmark

Abstract: This study explores health and social care consumption in two groups of patients with risk of alcohol use disorder (AUD), following a brief outreach alcohol intervention in a general hospital setting in Denmark. The Relay intervention aims to decrease health care contacts and thus primarily, in the long run, to reduce health care costs and secondarily to reduce labour market consequences and social costs for patients with alcohol problems. The study took place in somatic hospital departments with high prevalence of alcohol related injuries and illnesses. Patients admitted to the hospital between October 2013 and June 2016 were screened using the Alcohol Use Identification Test (AUDIT) and everyone scoring 8 points and above were randomised to either intervention (Relay group) or control group (TAU group). The patients (n=561) were followed for 12 months after discharge from the hospital. Data was gathered on somatic and psychiatric hospital admissions, GP visits and other primary health care visits as well as the costs associated with the health care contacts. In addition, data on social costs and productivity was gathered. All data was gathered from the Danish registers using personal identification numbers. We modelled the association using generalised linear modelling and investigated the costs further by performing a quantile analysis. We found no statistically significant difference in health care costs, social costs or productivity between the two groups. A longer follow-up is needed to fully investigate effects of the Relay intervention on changes in patients' health behaviour and subsequently on health care costs.

JEL classification: I

Key words: RCT, alcohol use disorder, health care consumption, register study, brief outreach intervention

**** Correspondence to:*** Anne-Sophie Schwarz, Unit of Clinical Alcohol Research, J.B. Winsløws Vej 20, Indgang 220B, 5000 Odense, Denmark. E-mail: annesophie-sch@hotmail.com
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1 Introduction

Excessive alcohol consumption is associated with health problems and social harms such as personal problems, family problems, problems at work, accidents and crimes (Rehm et al., 2009). In Denmark, the majority of the adult population consumes alcohol (The Danish Health Authority and Statens Serum Institut, 2015), and for 14 to 20 percent of the population the consumption develops to a harmful level with problems for the individual and their relatives (Gottlieb Hansen et al., 2011).

Morbidity and social harms related to alcohol problems represent a major economic burden to society (Rehm et al., 2009, Roerecke and Rehm, 2013). In a cross-country European study, Anderson et al estimated that the direct costs associated with alcohol use disorders accounted for 1.3 percent of the European Gross Domestic Product (GDP) and productivity costs add twice that amount to total costs (Anderson and Baumberg, 2006). Costs related to alcohol dependence add up to EUR 1,591–7,702 per patient in hospital costs alone (Laramee et al., 2013).

If the economic burden of alcohol use disorders, (AUD) is indeed as significant as evidence suggests we should expect that successful treatment and prevention of AUD would reduce those costs. Unfortunately, there is a discrepancy between the number of people suffering from AUD and the number seeking and receiving alcohol treatment in Denmark. In 2011, an estimated 20 percent (close to 900,000 individuals) of the adult Danish population were heavy drinkers. A total of 14 percent had a harmful alcohol use and 3 percent were dependent drinkers (Gottlieb Hansen et al., 2011). But at any given time, only about 15,000 patients receive treatment at a public alcohol treatment centre (Schwarz et al., 2018a). Around 20,000 people receive prescription medicine for their alcohol problem, and an unknown number of people receive other treatment from their GP (The Danish Health Authority and Statens Serum Institut, 2015).

Methods of systematically screening, brief intervention and referral to treatment (SBIRT) are frequently used methods for treatment and prevention of alcohol problems. Brief alcohol interventions have been carried out world-wide and are found to have efficacy at decreasing alcohol consumption (O'donnell et al., 2013, Nilsen et al., 2008, McQueen et al., 2011, Glass et al., 2015). In terms of increasing the use of alcohol related services the evidence is less clear (Glass et al., 2015) and the evidence is also not clear in terms of whether brief alcohol interventions have an effect on resource utilization and thus economic costs to society (McCambridge and Saitz, 2017).

In order to add to the evidence base for the effect of brief interventions aimed at persons with AUD, we designed a randomized controlled trial as an outreach brief intervention. The Relay Study (Schwarz et al., 2016) is one of the RESCueH studies which is a group of five randomized interventions aimed at developing and evaluating practice-oriented methods for alcohol treatment (Nielsen et al., 2016).

In this article, we estimated health care costs, social costs and labour productivity costs following the Relay Study in both the Relay group and the TAU group during a 12-month period following discharge.

The Relay intervention aims to motivate patients to change their alcohol behaviour. It is measured by differences in health care costs and contacts with the health care sector. Additionally it is measured by differences in productivity and social costs (Barbosa et al., 2010).

1.1 Hypothesis

According to previous studies we would expect to find lower health care costs in the Relay group compared with the TAU group (Parthasarathy et al., 2001, Estee et al., 2010). Because

of the randomized design, we assume that any difference between the two groups is attributable to the intervention. However, in the short run health care costs may be higher in the Relay group than in the TAU group due to patients becoming more health conscious and hence more health care consuming following the intervention. Therefore, we cannot make a short-term hypothesis in terms of health care consumption; it may be either way. We also hypothesize that labour productivity is higher in the Relay group due to a decrease in injury and illness following the intervention, also in the short run.

1.2 Aim

To explore resource utilization in two groups of patients with risk of AUD, following a referral intervention in a general hospital setting.

2 Methods and materials

2.1 Sample

Patients admitted to gastrointestinal, neurological or orthopaedic departments at Odense University Hospital or to the emergency department at Aabenraa Hospital in the inclusion period October 2013 to June 2016 of the Relay Study. Odense University Hospital is the third largest hospital in Denmark and covers all medical specialties. Aabenraa Hospital is a general community hospital in the southernmost and rather rural part of the country. It has a capacity of 560 beds and 10 inpatient wards, plus emergency and ICU functions. Upon admission to one of the two hospitals, patients were offered to fill out a lifestyle questionnaire with the Alcohol Use Disorder Identification Test (AUDIT) (Babor et al., 2001) embedded as well as a consent form. Afterwards, patients scoring 8 points and above on AUDIT (which was part of the lifestyle questionnaire) were included according to the inclusion criteria's (O'Flynn, 2011). Protocol and description of the full Relay Study is published separately (Schwarz et al., 2016).

2.2 Setting

In Denmark, health care is primarily delivered by the five regions whereas the public alcohol treatment is delivered by 98 municipals and separately from the hospitals. Patients seeking treatment for AUD are free to choose between municipal alcohol treatments centres free of charge. The municipalities are obliged to offer the patients treatment within 14-days of contacting the treatment facility (Becker et al., 2012). In addition, private providers offer AUD treatment paid by private health insurance and user-payments. The extent of these, however, is unknown but as the private health care sector in Denmark is generally small, the private AUD treatment is disregarded in this study.

Relay group

Outreach alcohol therapists from the alcohol treatment clinics in Odense and Aabenraa went to the departments at the somatic hospitals on randomly allocated intervention days to offer patients included in the study that particular day the Relay Model, which consisted of a brief intervention (BI) dealing with their alcohol use and receiving a brochure with information about the alcohol treatment. The duration of the BI was 20 minutes; it was based on the principles of motivational interviewing (Miller, 1983) aimed at motivating patients to reduce their alcohol consumption. Alcohol therapists were trained in motivational interviewing, and to ensure a high quality, some of the conversations between staffs and patients were recorded, and these were sporadically checked for adherence. In addition to the BI, patients scoring 16 points and above on the AUDIT test also received a referral to

the local public alcohol treatment center by means of an attendance contract including a specific appointment for showing up for alcohol treatment. Should the patients fail to show up at the agreed-upon time, they received two reminders at two-week intervals offering a new appointment (Schwarz et al., 2019).

Treatment

In general, in somatic hospitals, nurses and doctors are required to address unhealthy alcohol use. However, this does not always happen due to time constraints and fear of stigma (Hellum et al., 2016). Thus, TAU most often consisted of no intervention in relation to the patients' alcohol use, or at most the patients receiving a brochure about the community-based alcohol treatment centre as the nurses themselves described it (Schwarz et al., 2019).

2.3 Definitions

Alcohol use disorders

The groups of persons with alcohol problems were defined using the Alcohol Use Disorder Identification Test (AUDIT) in which patients score from zero to 40 points depending on their answers. The cut-off scores and risk categories were adapted from NICE clinical guideline 115 (National Collaborating Centre for Mental Health et al., 2011). Patients with scores below 8 points are in the low risk group, patients scoring 8-15 are in the medium risk group and have a risky alcohol consumption, and patients scoring 16 points and above have a harmful drinking pattern or alcohol dependence and are in the high-risk group (O'Flynn, 2011).

2.4 Costs

We analysed costs from the societal perspective and defined costs as including all those related to health care, social services and productivity costs. The costs were compared between our two groups that are similar in all other aspects except the randomisation to intervention or TAU. This means that we can attribute the difference between the groups to the difference in the intervention they received. In the sections below, these categories are elaborated and defined further.

Social services

Information on the patients' municipal resource use was gathered only for patients residing in Odense, (87 percent of the included patients). Municipal data included use of social services such as relief measures consisting of for instance a municipal contact person; temporary housing aid; employment help in the form of courses etc. and municipal health care services such as rehabilitation and treatment of alcohol problems and drug problems.

Most social services are paid for by the residents' municipality irrespective of which municipality provide the service. General unit prices available from Odense municipality were applied to value the municipal services. Information on use of municipal services was reported as mean number of contacts with relevant social services and mean cost of social service. The contacts with social services lasted anywhere between a few hours and several weeks.

Health care costs

Health care costs were analysed using register-based data via the secure research servers at Statistics Denmark and The Danish Health Data Authority. The health care registers at the

Danish Health Data Authority comprise the Danish National Patient Register (Lynge et al., 2011) with information on in-and out-patient visits to the hospitals (somatic and psychiatric); the Causes of Death Register (Helweg-Larsen, 2011), and the Danish National Health Service Register (Sahl Andersen et al., 2011) with data on contacts with GPs and other primary health care services. In addition, we gathered information from the Danish National Prescription Register (Kildemoes et al., 2011) on the patients' use of prescription medicine from Statistics Denmark.

To value somatic and psychiatric health care costs, the Danish diagnosis related group (DRG)-system (Ankjær-Jensen et al., 2006) was used. DRG is a case-mix system with nationally developed tariffs covering both in- and outpatients. To value prescription medicine, national harmonised marked prices were used (Møller Pedersen, 2003) and for primary care nationally negotiated tariffs were used. All information on unit costs is available from Statistics Denmark. For each patient, we calculated their individual health care costs based on the information from the registers. In the Danish registers, a price is set for each contact making it possible for us to find the precise health care costs for each individual patient during the 12-month follow-up.

Productivity costs and other costs

Other register-based information was retrieved from Statistics Denmark and cover demographic information as well as criminal activity, labour marked affiliation and income. Unfortunately, the register with information on criminal activity has a 2-year delay on updates in Statistics Denmark, and thus the newest available data on crime at the time of writing is from 2016 hence making the 12-month follow-up impossible. Therefore, the crime component must be postponed to a later analysis.

To value productivity costs, we collected information about changes to the patients' employment status on a weekly basis in the Danish Register for Evaluation of Marginalisation (DREAM-database) (Hjollund et al., 2007). First, we found the number of patients who changed status identified as their first change: either from being employed to receiving a transfer income and the other way around from receiving a transfer income to being employed. We accessed information on the patients' weekly employment status through DREAM. Next, we counted how many weeks the patients in the two groups had been either in employment or received transfer income and calculated the productivity cost. We valued gainful employment by the mean hourly labour income of Danes. Information on the mean hourly income of 313.94 DKK (which includes all costs to employers) of Danes in the industry in 2016 was gathered from Statistics Denmark (Statistics Denmark, 2016). The productivity was then calculated as gain in productivity (income from those going from receiving transfer income to being employed) where we subtracted the productivity loss from those who went from being employed to receiving a transfer income.

2.5 Statistics

Data on patients was collected during a period of 12-month from the Danish registers, the clinical database in Odense as well as through data gathered from the municipal of Odense.

For prescription medicine, each prescription is descripted in detail and has its price attached. We first made a description of the raw cost data and upon finding that the data was not normally distributed we used the method of generalised linear modelling with a log link to investigate if there were any significant differences between costs in the two groups. We then modelled health care costs, social cost and productivity costs by setting up five different models where we controlled for covariates. The reason for setting up four different models was that we expected that the patients' past costs would have an effect on the current cost

and the same was the case for age and gender. In addition, the AUDIT score was found to be statistically significantly different between the two groups and we therefore set up a model controlling for this. Model 1 is the unadjusted model, model 2 is adjusted for age and gender, model 3 for costs in the year before the intervention and model 4 for audit scores and model 5 corrected for all the mentioned covariates. In addition, we performed a subgroup analysis in which we looked at the dataset divided into AUDIT 8-15, AUDIT 16+, and one where we only looked at the patients from the urban area: Odense. In addition to the above analysis, quantile regression was performed to investigate health care costs further (J. Angrist and J.S. Pischke, 2008). Using the method of quantile regression made it possible to investigate differences in percentiles in the dataset to see if any levels of health care costs were significantly different in the two groups. Data on health care costs was divided into percentiles starting at 10th percent and ending with the 90th percentile.

All costs and expenditures were valued using available unit costs and the reported costs are the mean costs for each group. All costs are in 2018 DKK (1 EUR = 7.44 DKK) and adjusted over time using the Consumer Price Index (Statistics Denmark, 2018).

All calculations were conducted on the secure research server at Statistics Denmark, ensuring data confidentiality. All datasets were merged using the encrypted social security number, such that identification of specific individuals was not possible. All analyses were performed in STATA and SAS 9.3 ®.

3 Results

A total of 6,102 patients were admitted to the departments during the inclusion period. Of these 2,568 patients were excluded according to the exclusion criteria (Schwarz et al., 2016) and a total of 3,534 patients completed the lifestyle questionnaire (58 %) (See figure 1). We included 609 patients into the study with 333 patients in the control group and 276 patients in the Relay group. A total of 48 patients, 30 patients in the TAU group and 18 patients in the Relay group were lost to follow-up due for different reasons such as invalid personal identification number and no registered hospital admission at the time of the interview. This left 561 patients who were included in the final analysis.

The patients were primarily male in both groups (74% and 73%) with a mean age of 52 years in the Relay group and 53 years in the TAU group (Schwarz et al., 2018b). Most patients were residing in Odense (90% in Relay group and 86% in TAU group). We found a significant difference in the AUDIT scores between the two groups (p=0.001) with 39% of the Relay group having AUDIT scores of 16+ and 27% in the TAU group.

Figure 1: Flowchart

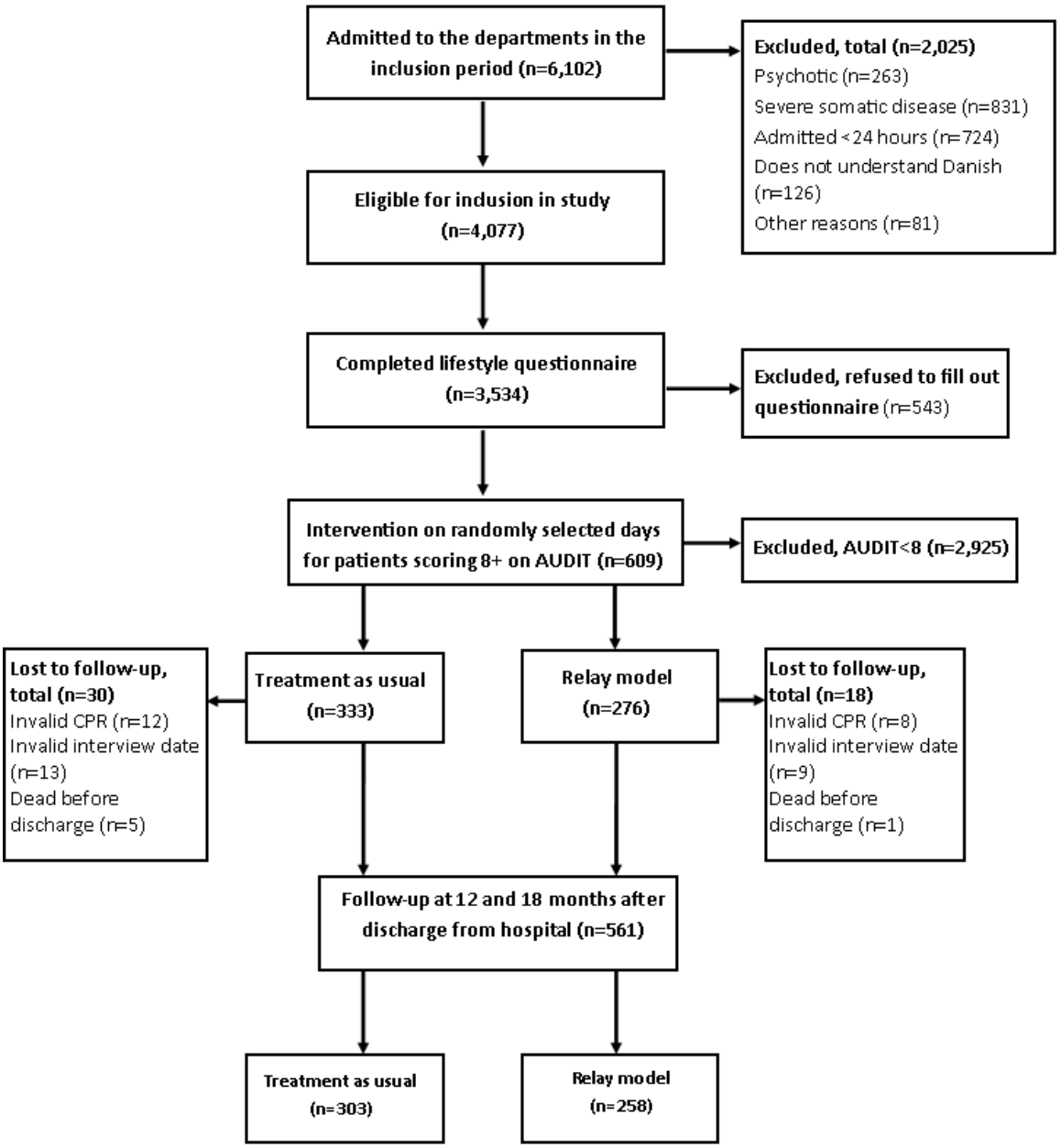

Table 1: Characteristics of study participants at baseline (n=609)

	Relay group (n=276)	TAU (n=333)	p value
Female n [%]	71 [26]	90 [27]	0.72
Age mean [SD]	53 [11]	52 [11]	0.52
AUDIT score n [%]			
8 to 15	168 [61]	244 [73]	0.001***
16+	108 [39]	89 [27]	
Area n (%)			
Urban (Odense)	237 [90]	244 [86]	0.11
Rural (Aabenraa)	26 [10]	41 [14]	
Smoking status			
Never	47 [17]	84 [25]	0.09
Former	79 [29]	97 [29]	
Current	148 [54]	151 [45]	
Physical activity status			
Active	63 [23]	89 [27]	0.63
Moderate	145 [53]	165 [51]	
Inactive	64 [24]	70 [22]	
Diet status*			
Healthy	85 [31]	115 [35]	0.33
Unhealthy	191 [69]	218 [65]	

*According to the Danish Dietary Recommendations (Ministry of Environment and Food of Denmark, 2015)

When looking at the raw data we observed that patients in the Relay group had more somatic admissions and more somatic and psychiatric outpatient contacts 12-months after discharge, see table 2, though the difference was not significant. The mean productivity was positive in both groups, meaning more patients returned to work for a longer time as opposed to being on transfer income but the number of persons working was highest in the TAU group. The mean social contacts were not different and the biggest difference between the two groups was in terms of receiving relief measures. Neither difference in productivity nor social contacts were statistically significantly different.

The mean duration of somatic and psychiatric hospital stays was the same for the two groups (4 days for somatic and 7 days for psychiatric) but the range was quite different. In the Relay group, the patients had somatic stays lasting between 0 and 65 days and for the TAU group the stays were between 0 and 150 days. The picture was similar for psychiatric stays (0-62 for intervention and 0-123 for control group). Similarly, patients in the Relay group who received alcohol treatment (n=16) received alcohol treatment for an average of 124 days and patients in the TAU group (n=9) were in alcohol treatment for 328 days on average with a range of 1 to 248 in the Relay group and 1 to 525 in the TAU group.

Table 2: Mean number of contacts divided into health care, social services and productivity for12 months after discharge (n=561)

		Relay model (n=258)	TAU (n=303)	p-value
Health care	Somatic inpatient	1.19	0.86	0.06
	Somatic outpatient	11.07	9.22	0.15
	Psychiatric inpatient	0.03	0.04	0.82
	Psychiatric outpatient	0.69	0.52	0.52
	Primary care	34.78	35.00	0.91
	Prescription medicine	24.11	22.77	0.52
Labour marked affiliation	Number of persons who are working	239	278	0.70
	Number of persons receiving transfer income	19	25	0.70
		Relay model (n=232)	TAU (n=258)	
Social services (Odense)	Alcohol treatment	0.27	0.14	0.27
	Drug treatment	0.11	0.24	0.30
	Vocational training	.	0.06	.
	Rehabilitation	0.03	.	.
	Relief measures	0.20	0.26	0.36
	Housing	0.08	0.07	0.59

Table 3: Mean costs divided into health care, social service and productivity costs for 12 months after discharge (n=561)

	Mean cost (DKK) (7.44 DKK = 1 Euro)				
			Relay model (n=258)	TAU (n=303)	p-value
Health care	Mean per patient		91,519	70,956	0.11
		Somatic inpatient	22,056	18,035	0.31
		Somatic outpatient	43,629	35,356	0.27
		Psychiatric inpatient	2,263	2,683	0.80
		Psychiatric outpatient	15,576	7,236	0.06
		Primary care	3,635	3,695	0.86
		Prescription medicine	4,360	3,951	0.49
Productivity	Mean per patient		75,873	77,692	0.87
			Relay model (n=232)	TAU (n=258)	
Social services (Odense)	Mean per patient		5382	8332	0.77
		Alcohol treatment	818	463	0.37
		Drug treatment	442	951	0.37
		Vocational training	.	923	.
		Rehabilitation	94	.	.
		Relief measures	2662	2415	0.91
		Housing	1365	3581	0.87

The data is highly skewed which becomes obvious when comparing the mean of health care costs (70,956 in TAU group and 91,520 in Relay group) with the medians (25,411 in TAU group and 27,353 in Relay group) (See table 3). Therefore, we used generalised linear modelling with log link to model differences in costs between the two groups as opposed to traditional regression analysis. In addition, we choose to adjust for a number of different variables such as AUDIT score as we found statistical differences between the groups even though they had been randomised to the two groups.

Table 4: Generalised linear modelling of health care costs at 12-months follow-up as a dependent variable in five different models in the Relay study (n=561)

	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**
Constant	11.17 [10.4;11.9] (<.0001)	10.94 [8.8;13.0] (.0001)	7.41 [2.2;12.6] (0.005)	10.75 [9.2;12.3] (<.0001)	10.51 [8.0;13.1] (<.0001)
Treatment	0.25 [-0.7;1.2] (0.61)	0.24 [-0.7;1.2] (0.63)	0.43 [-0.6;1.4] (0.40)	0.20 [-0.8;1.2] (0.70)	0.18 [-0.8; 1.2] (0.71)
Age	.	0.01 [-0.01;0.03] (0.58)	.	.	0.007 [-0.02;0.03] (0.62]
Gender	.	-0.09 [-1.2;1.0] (0.88)	.	.	-0.03 [-1.1;1.1] (0.97]
Health care cost (Year before intervention)	.	.	0.46 [-0.1;1.0] (0.12)	.	
AUDIT score	.	.	.	0.33 [-0.7;1.3] (0.52)	0.29 -0.7;1.3] (0.56)
Goodness of fit (AIC)	15749	15669	15150	15774	15753

Note: The first rows are coefficients as well as 95% CI and in the second row are p-values. The treatment variable measures the logarithmic difference in treatments. All coefficients are log-transformed and should be interpreted as percentage differences.

The Relay group had higher mean health care costs than the TAU group which was mainly due to more somatic and psychiatric outpatient visits, however we did not find a statistically significant difference in health care costs in the two groups at follow-up (see table 4) in any of the first four models (p-value for model 1, p=0.61). In the unadjusted model, we found a 25% difference in health care costs and the difference is 20% when adjusting for AUDIT scores but as mentioned, none of the differences are statistically significant (see table 4). In the fifth model we also did not find a statistically significant difference in the cost for the treatment groups (p=0.71). The health care costs in the year before were removed from the final version of the fifth model, as its slope coefficient was zero.

When we modelled the different subgroups, we did not find any statistically significant differences. The difference in total social costs was also not statistically significant (p= 0.98). No significant difference was found in productivity between the TAU and the Relay group (p=0.96) (see supplementary material for table with results).

We performed subgroup analysis where we looked first at the patients who scored 8-15 on AUDIT and next at the patients who scored 16+. We did not find a statistically significant difference in either subgroup.

In the next subgroup analysis, we looked only at the group from Odense (87 percent of the sample). The mean health care costs were much higher than for the entire group (98139 DKK for Relay group and 75852 DKK for TAU group), but the difference was not statistically significant (p=0.62). In the quantile analysis of the 10-90 percentiles of the health care costs we did not find any statistically significant differences (see table 5). However, for the 90% percentile, the p-value was 0.12 and thus the difference here was the closest to being statistically significant. When performing an OLS regression model with health care costs as a function of treatment group we also did not find a statistically significant association (p=0.11), and when we controlled for AUDIT score the p-value became even higher (p=0.1794) suggesting that part of the association can be explained by differences in AUDIT scores.

Table 5: Health care costs at 12-months follow-up in the Relay Study as a function of treatment allocation, in total and divided into percentiles (n=561)

	b	95%CI	p-value
All patients	20564	[7899;33229]	0.11
Including AUDIT score*	17116	[4385;29847]	0.18
Percentile analysis			
10th percentile	-1080	[-2896;737]	0.24
20th percentile	-502	[-2945;1941]	0.69
30th percentile	893	[-2701;4488]	0.63
40th percentile	2034	[-4044;8113]	0.51
50 percentile	1959	[-8240;12157]	0.71
60 percentile	7380	[-9239;23998]	0.38
70 percentile	5093	[-19005;29192]	0.68
80 percentile	13028	[-28023;54078]	0.53
90 percentile	78106	[-19305;175517]	0.12

Note: b is the coefficient for the Relay group – i.e. the mean cost-difference between the Relay group and the TAU group. *AUDIT is included as a dummy variable that is one when patients have AUDIT 8-15 and 0 when they have AUDIT 16+.

4 Discussion

This study investigated the cost related to the Relay Model. The Relay Model is a Danish version of the SBIRT (Screening, Brief Intervention and Referral to Treatment) consisting of outreach visits by alcohol therapists and an intervention grounded in MI and with the addition of a referral contract.

We found that the mean health care costs were higher in the Relay group compared with the TAU group with a difference of 20,564 DKK, but when we took into account the skewed distribution of the data, the difference was not statistically significant (p=0.61) and

mainly accounted for by the top ten percent health care consumers. No significant difference was found in social costs between the groups and no difference was found in productivity. Overall, we could not confirm any of our hypotheses and we did not find an effect of the Relay intervention on health, productivity and social care consumption. SBIRT models are especially known to be good at decreasing alcohol consumption in primary care during a follow-up of maximum 12-months and demonstrated in efficacy-studies (Kaner et al., 2007). Now obviously, this is a completely different setting and type of outcome than what was investigated in the Relay Study. The literature on SBIRT in other settings than general practice, especially general hospitals, has produced less clear results compared with primary care (Simioni et al., 2015, Mdege et al., 2013) and we wanted to investigate if the use of outreach staff and the addition of a referral contract would generate different results.

Recently, Palzer et al. and Pringle et al. found a positive effect of SBIRT on health care utilization. The target group in both studies were, however, not just heavy drinkers or patients suffering from alcohol use disorders, but also patients suffering from all kinds of substance use disorders. Therefore, the authors cannot ascertain if the effect comes from the individuals misusing drugs, alcohol, or both (Paltzer et al., 2017, Pringle et al., 2018). Further, one study was set in an emergency room setting and the other mainly in primary care clinics.

Bray et al (Bray et al., 2011) looked at studies with health care utilization as primary outcome measure and divided the 29 studies, they identified, into which setting it was carried out in: primary care, emergency department or non-emergency hospital setting. They found that brief interventions may reduce health care cost, but the evidence is inconclusive. Therefore, they recommended that more SBIRT studies with health care utilization as primary outcome measure be made as well as more transparency in the cost methodology.

A review of studies set in emergency rooms (Barata et al., 2017) found evidence of a small reduction in alcohol use for low or moderate drinkers as well as a reduction in negative consequences and a reduction in emergency room visits following brief interventions in emergency room setting. The review is based on a total of 35 very heterogeneous studies, where the studies used different screening methods to identify patients with AUD as well as using different methods of carrying out their brief interventions: either cognitive behavioural therapy, motivational interviewing or a combination of the two, and the number of sessions, varied as well. Barata et al. recommend that future studies look more into the possibility of targeted interventions.

Another review looked more broadly at heavy alcohol users admitted to general hospital wards (McQueen et al., 2011) and found a short term (less than 12 months) reduction in alcohol consumption resulting from the brief intervention. The pattern found was similar to the one in the review by Barata et al. McQueen et al. recommend that future studies have alcohol consumption as primary outcome, a one-year follow-up and use the CONSORT for both design and reporting (McQueen et al., 2011).

In the Relay Study, we purposely choose not to measure the patients' alcohol consumption at follow-up, though it is used in many other SBIRT studies as mentioned previously. The reason being that it would have required further contact with the patients and our priority was to set up an effectiveness study that mirrored what is possible in daily routine. Thus, we wanted to minimise research contact with the patients as much as possible. Therefore, the national and municipal registers were used for follow-up. In addition, the studies presenting effective results of SBIRT on alcohol consumption usually have short time horizons (12 months or less) and once the time frame is expanded the effect disappears (DiClemente et al., 2017).

When comparing the newer results from SBIRT it suggests that the effect of health care utilization is not present for AUD, but more research is needed to provide evidence that

is more conclusive especially given the different settings, which are complicating comparisons.

We cannot rule out that some differences could have been statistically significant as our study was underpowered (Schwarz et al., 2016). According to our power calculation in the protocol, we should have included 1000 patients (500 in each group) but we only ended up with 561 patients and this could very well explain why we failed to find statistically significant results. In addition, we found that a statistically significant larger percentage of the patients in the Relay group had a high AUDIT score (above 16) compared with the control group. As Kjellberg et al. (Jakob Kjellberg and Camilla Aavang Poulsen, 2014) found that these patients have more contact with the health care sector and this might have influenced our study results. Though we did not have many exclusion criteria, there were still about 800 patients, who were too ill to fill out the lifestyle questionnaire and as such, we might have missed some of the heaviest patients in terms of health care costs.

When it comes to studies in the health economic area our sample is perhaps a bit small, however, the sample was gathered through a clinical trial and in this context, and our population is actually quite big. It could of course be the case that our results had changed had we indeed reached the full sample size required by our power calculation.

Further, we found that the difference of 20,563 DKK was carried by individual patients in the highest consumption percentile and thus there is no logical reason to assume that the difference is anything but a random coincidence that has nothing to do with our intervention. As we did not interview the patients at follow-up, we do not know if their alcohol consumption has changed. There is a possibility that the patients with alcohol problems have begun to address their overall health due to the intervention and as such increased their contacts with the health care sector.

Unfortunately, there is a delay in some of the social registers such as those related to crime and is was therefore not possible to include costs related to crime in the analysis, though this would indeed have been very relevant (Barbosa et al., 2010)

By using the social security number to follow the patients in registers we had a very good follow-up rate with less than 8 % lost to follow-up. Social security numbers also allowed us to follow the actual registered utilization of resources for every patient involved in the study without having to ask the patients to remember how many times they had been to the doctor and without relying on average costs for bigger groups.

When data on the 5-year follow-up is available, we would expect to find larger differences between the groups since the current time horizon of 12 months is quite possibly too short to capture all the benefits from changes in the patients' behaviours.

5 Conclusion

We found no short run effect of the outreach alcohol intervention on health care, productivity and social costs. A longer follow-up is needed to fully investigate the effects of the intervention on changes in the patients' health behaviour on health care costs.

Ethics

Formal informed consent was not required from the Regional Scientific Ethical Committees of Southern Denmark as the study was considered a register study that did not entail an intervention (Project ID: S-20130084).

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References

Anderson, P. and Baumberg B. (2006). Alcohol in Europe. *London: Institute of Alcohol Studies*.

Ankjær-Jensen, A., Rosling, P. and Bilde, L. (2006). Variable prospective financing in the Danish hospital sector and the development of a Danish case-mix system. *Health Care Management Science, 9, 259-268.*

Babor T. F. et al. (2001). AUDIT: The alcohol use disorders identification test: Guidelines for use in primary health care.

Barata, I. A. et al. (2017) Effectiveness of SBIRT for alcohol use disorders in the emergency department: a systematic review. *Western journal of emergency medicine, 18, 1143.*

Barbosa, C., Godfrey, C. and Parrot, S. (2010) Methodological assessment of economic evaluations of alcohol treatment: what is missing? *Alcohol and alcoholism, 45, 53-63.*

Becker, U., et al. (2012). Alkoholbehandling i kommunerne [Danish] [Online]. Danish Medical Association. Available: http://www.si-folkesundhed.dk/upload/alkoholbehandling_i_kommunerne_2012_003.pdf [Accessed 05-03 2018].

Bray, J. Cowell, A. and Hinde, J. (2011). A systematic review and meta-analysis of health care utilization outcomes in alcohol screening and brief intervention trials. *Medical care, 49, 287.*

Cowell, A. J., et al. (2010). Conducting economic evaluations of screening and brief intervention for hazardous drinking: Methods and evidence to date for informing policy. *Drug and alcohol review, 29, 623-630.*

DiClemente, C. C., et al (2017). Motivational interviewing, enhancement, and brief interventions over the last decade: A review of reviews of efficacy and effectiveness. *Psychology of Addictive Behaviors, 31, 862.*

Estee, S., et al. (2010). Evaluation of the Washington state screening, brief intervention, and referral to treatment project: cost outcomes for Medicaid patients screened in hospital emergency departments. *Medical Care, 48, 18-24.*

Glass, J. E., et al. (2015). Specialty substance use disorder services following brief alcohol intervention: a meta‐analysis of randomized controlled trials. *Addiction, 110, 1404-1415.*

Gottlieb Hansen, A. B. et al. (2011). The number of persons with alcohol problems in the Danish population. *Scandinavian Journal of Public Health, 39, 128-136.*

Hellum, R., Bjerregaard, L. and Nielsen, A. (2016). Factors influencing whether nurses talk to somatic patients about their alcohol consumption. *Nordic Studies on Alcohol and Drugs, 33, 415-436.*

Helweg-Larsen, K. (2011). The Danish register of causes of death. *Scandinavian Journal of Public Health, 39, 26-29.*

Hjollund, N. H., Larsen, F.B. and Andersen, J. H. (2007). Register-based follow-up of social benefits and other transfer payments: accuracy and degree of completeness in a Danish interdepartmental administrative database compared with a population-based survey. *Scandinavian Journal of Social Medicine, 35, 497-502.*

Angrist, J. and Pischke, J. S. (2008). Mostly Harmless Econometrics, *Princeton University Press.*

Kjellberg, J., Poulsen, C. A. (2014). Samfundsøkonomiske omkostninger forbundet med alkoholoverforbrug [In Danish] [Online]. KORA. Available: https://www.kora.dk/media/2831801/trygny.pdf [Accessed 05-03 2018].

Kaner, E. F., et al. (2007). Effectiveness of brief alcohol interventions in primary care populations. *The Cochrane Library.*

Kildemoes, H. W., Sørensen, H. T. and Hallas, J. (2011). The Danish national prescription registry. *Scandinavian Journal of Public Health, 39, 38-41.*

Laramee, P., et al. (2013). The economic burden of alcohol dependence in Europe. *Alcohol Alcohol, 48, 259-69.*

Lynge, E., Sandegaard, J. L. and Rebolj, M. (2011). The Danish national patient register. *Scandinavian journal of public health, 39, 30-33.*

McCambridge, J. and Saitz, R. (2017). Rethinking brief interventions for alcohol in general practice. *BMJ: British Medical Journal (Online), 356.*

McQueen, J., et al. (2011). Brief interventions for heavy alcohol users admitted to general hospital wards. *The Cochrane Library.*

MDege, N. D., et al. (2013). Interventions for reducing alcohol consumption among general hospital inpatient heavy alcohol users: a systematic review. *Drug and alcohol dependence, 131, 1-22.*

Miller, W. R. (1983). Motivational interviewing with problem drinkers. *Behavioural and Cognitive Psychotherapy, 11, 147-172.*

Ministry of Environment and Food of Denmark (2015). The Official Dietary Guidelines [Online]. Available:https://www.foedevarestyrelsen.dk/english/Food/Nutrition/ The_dietary_recommendations/Pages/default.aspx [Accessed 29-05 2017].

Møller Pedersen, K. (2003). Pricing and reimbursement of drugs in Denmark. *The European Journal of Health Economics, 4, 60-65.*

National collaborating centre for mental health, National institute for health and clinical excellence (2011). Alcohol use disorders: The NICE Guideline on the Diagnosis, Assessment and Management of Harmful Drinking and Alcohol Dependence, *RCPsych Publications.*

Nielsen, A. S., et al. (2016). The RESCueH programme: testing new non-pharmacologic interventions for alcohol use disorders: rationale and methods. *European addiction research, 22, 306-317.*

Nilsen, P., et al. (2008). A systematic review of emergency care brief alcohol interventions for injury patients. *Journal of substance abuse treatment, 35, 184-201.*

O'Donnell, A., et al. (2013). The impact of brief alcohol interventions in primary healthcare: a systematic review of reviews. *Alcohol and alcoholism, 49, 66-78.*

O'Flynn, N. (2011). Harmful drinking and alcohol dependence: advice from recent NICE guidelines. *Br J Gen Pract, 61, 754-756.*

Paltzer, J., et al. (2017). Substance use screening, brief intervention, and referral to treatment among medicaid patients in wisconsin: impacts on healthcare utilization and costs. *The journal of behavioral health services & research, 44, 102-112.*

Parathasarathy, S., et al. (2001). Association of outpatient alcohol and drug treatment with health care utilization and cost: revisiting the offset hypothesis. *Journal of Studies on Alcohol, 62, 89-97.*

Pringle, J. L., et al. (2018). Screening, Brief Intervention, and Referral to Treatment in the Emergency Department: An Examination of Health Care Utilization and Costs. *Med Care, 56, 146-152.*

Rehm, J., et al. (2009). Global burden of disease and injury and economic cost attributable to alcohol use and alcohol-use disorders. *The Lancet, 373, 2223-2233.*

Roerecke, M. and Rehm, J. (2013). Alcohol use disorders and mortality: a systematic review and meta‐analysis. *Addiction, 108, 1562-1578.*

Sahl Andersen, J. De Fine Olivarius, N. and Krasnik, A. (2011). The Danish national health service register. *Scandinavian Journal of Public Health, 39, 34-37.*

Schwarz, A., Nielsen, B. and Nielsen, A.S. (2018a). Changes in profile of patients seeking alcohol treatment and treatment outcomes following policy changes. *Journal of Public Health, 26, 59-67.*

Schwarz, A., Nielsen, B., Nielsen, A. S. (2018b). Lifestyle factors in somatic patients with and without potential alcohol problems. *Journal of Public Health, 1-7.*

Schwarz, A., et al. (2019). Making a bridge between general hospital and specialised community-based treatment for alcohol use disorder. A pragmatic randomised controlled trial. *Drug and alcohol dependence, 196, 51-56.*

Schwarz, A., et al. (2016). Relay model for recruiting alcohol dependent patients in general hospitals-a single-blind pragmatic randomized trial. *BMC health services research, 16, 1.*

Simioni, N., Cottencin, O. and Rolland, B. (2015). Interventions for increasing subsequent alcohol treatment utilisation among patients with alcohol use disorders from somatic inpatient settings: a systematic review. *Alcohol and Alcoholism, 50, 420-429.*

Statistics Denmark (2018). Statistikbanken, tabel PRIS111.

Statistics Denmark (2016). Statistikbanken, tabel LONS40.

The Danish Health Authority and Statens Serum Institut (2015). Alkoholstatistik [Danish] [Online]. Available: https://www.sst.dk/da/udgivelser/2015/~/media/AD0E935AE31446C4AA09250B270A780B.ashx [Accessed 05-03 2018].

World Health Organisation (2010). Best practice in estimating the costs of alcohol - Recommendations for future studies [Online]. Available: http://www.euro.who.int/__data/assets/pdf_file/0009/112896/E93197.pdf [Accessed 05-03 2018].

Appendices

Table A1: Grouped resources and their accompanying source

Resource group		Source
Hospital services	Somatic hospital contacts (in- and outpatient)	The Danish National Patient Register +DRG
	Psychiatric hospital contacts (in- and outpatient)	The Danish National Patient Register +DRG
Medicine	Use of prescription medicine	The Danish National Prescription Registry
Primary care	General practitioner, specialist, dentist, physiotherapist, psychologist, others	The Danish National Health Service Register
Crime	Contact with judicial system	Arrests and prison time registers in Statistics Denmark
Social services	Treatment for alcohol problem	Municipal register and journals*
	Treatment for drug problem	Municipal registers
	Vocational training	Municipal registers
	Rehabilitation	Municipal registers
	Relief measures	Municipal registers
	Housing	Municipal registers
Productivity	Net productivity because of change in employment (gain – loss)	DREAM database and Statistics Denmark

Note: Using "Best practice in estimating the cost of alcohol – Recommendations for future studies" (World Health Organization, 2010)**.** *There is a 2-year delay on the National Alcohol Treatment Register and therefore this information is gathered from the municipal register in Odense and from the journals in the alcohol treatment centre in Aabenraa.

Table A2: Generalised linear modelling of productivity at 12-months follow-up as a dependent variable in five different models in the Relay study (n=561)

	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**
Constant	9.65 [6.6;12;8] (<.0001)	11.58 [-1.9;25.1] (0.0929)	8.81 [4.3;13.3] (0.0001)	12.81 [-41.9;67.5] (0.6463)	10.62 [6.7;14.5] (<.0001)
Treatment	-0.12 [-5.0;4.8] (0.9605)	-0.56 [-6.4;5.2] (0.8504)	1.80 [-1,8;5.4] (0.3314)	0.22 [-3.9;4.3] (0.9182)	0.67 [-0.7;2.0] (0.3399)
Age		-0.01 [-13.1;10.8] (0.7935)			-0.02 [-0.04;0] (0.1153)
Gender		-1.17 [-13.1;10.7] (0.8476)			0.53 [-0.8;1.9] (0.4386)
Productivity cost (Year before intervention)			0 [0;0] (0.0195)		0 [0;0] (<.0001)
AUDIT score				-2.94 [-57.8;51.9] (0.9161)	-0.53 [-2.8;1.8] (0.6485)
Goodness of fit (AIC)	15641	15628	15641	15647	15640