Modeling the Potential Impact of Changing Access Rates to Specialist Treatment for Alcohol Dependence for Local Authorities in England: The Specialist Treatment for Alcohol Model (STreAM)

ALAN BRENNAN, PH.D.,[a,]* DANIEL HILL-McMANUS, B.SC.,[a] TONY STONE, B.SC.,[a] PENNY BUYKX, PH.D.,[a] ABDALLAH ALLY, PH.D.,[a] ROBERT E. PRYCE, PH.D.,[a] ROBERT ALSTON, M.SC.,[b] ANDREW JONES, PH.D.,[b] DONAL CAIRNS, M.SC.,[b] TIM MILLAR, PH.D.,[c] MICHAEL DONMALL, PH.D.,[b] TOM PHILLIPS, PH.D.,[d] PETRA MEIER, PH.D.,[a] & COLIN DRUMMOND, M.D.[d]

[a]University of Sheffield Modelling Team and Public Health Research Team, School of Health and Related Research, University of Sheffield, Sheffield, England

[b]University of Manchester Research and NDTMS Data Analysis Team, Division of Population Health, Health Services Research & Primary Care, University of Manchester, Manchester, England

[c]Division of Psychology & Mental Health, University of Manchester, Manchester, England

[d]King's College London Clinical and Evidence Review Team, Addictions Department, National Addiction Centre, Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, England

ABSTRACT. Objective: We modeled the impact of changing Specialist Treatment Access Rates to different treatment pathways on the future prevalence of alcohol dependence, treatment outcomes, service capacity, costs, and mortality. **Method:** Local Authority numbers and the prevalence of people "potentially in need of assessment for and treatment in specialist services for alcohol dependence" (PINASTFAD) are estimated by mild, moderate, severe, and complex needs. Administrative data were used to estimate the Specialist Treatment Access Rate per PINASTFAD person and classify 22 different treatment pathways. Other model inputs include natural remission, relapse after treatment, service costs, and mortality rates. "What-if" analyses assess changes to Specialist Treatment Access Rates and treatment pathways. Model outputs include the numbers and prevalence of people who are PINASTFAD, numbers treated by 22 pathways, outcomes (successful completion with abstinence, successfully moderated nonproblematic drinking, re-treatment within 6 months, dropout, transfer, custody), mortality rates, capacity requirements (numbers in contact with community services or staying in residential or inpatient places), total treatment costs, and general health care savings. Five scenarios illustrate functionality: (a) no change, (b) achieve access rates at the 70th percentile nationally, (c) increase access by 25%, (d) increase access to Scotland rate, and (e) reduce access by 25%. **Results:** At baseline, 14,581 people are PINASTFAD (2.43% of adults) and the Specialist Treatment Access Rate is 10.84%. The 5-year impact of scenarios on PINASTFAD numbers (vs. no change) are (B) reduced by 191 (-1.3%), (C) reduced by 477 (-3.3%), (D) reduced by almost 2,800 (-19.2%), and (E) increased by 533 (+3.6%). The relative impact is similar for other outputs. **Conclusions:** Decision makers can estimate the potential impact of changing Specialist Treatment Access Rates for alcohol dependence. (*J. Stud. Alcohol Drugs, Supplement 18,* 96–109, 2019)

RÉSUMÉ. Objectif : Modéliser l'impact de la variation des taux d'accès aux différentes trajectoires de traitements spécialisés, sur la prévalence future de la dépendance à l'alcool, l'impact du traitement, le volume de services, les coûts et la mortalité. **Méthode :** Au sein des administrations régionales, les nombres et la prévalence de personnes ayant 'potentiellement besoin d'être évaluées pour un traitement dans les services spécialisés en dépendance à l'alcool' (PBÉTSSDA) sont estimés en fonction de niveaux de besoins dits légers, modérés, sévères et complexes. Les taux d'accès aux traitements spécialisés par personne ayant PBÉTSSDA sont estimés en fonction de 22 trajectoires différentes de traitements et sont classifiés à partir de données administratives. Les autres données intégrées dans le modèle incluent la rémission naturelle, la rechute après le traitement, les coûts de services et les taux de mortalité. Les analyses de différents scénarios permettent d'estimer les changements dans les taux d'accès aux traitements spécialisés et aux trajectoires de traitement. Les résultats du modèle incluent : le nombre et la prévalence des personnes ayant un PBÉTSSDA, le nombre de personnes traitées dans les 22 trajectoires, les résultats (avoir complété avec succès et abstinence, la réussite avec atteinte d'une consommation modérée non problématique, retourner en traitement dans les 6 mois, abandon, transfert, détention), les taux de mortalité, besoins en termes de capacité (nombre de personnes en contact avec les services dans la communauté, ou qui bénéficient des services dans un centre résidentiel ou en centre hospitalier), le coût total des traitements et les économies générales en soins de santé. Cinq scénarios sont illustrés : (a) pas de changement; (b) atteinte des taux d'accès au 70e percentile à l'échelle nationale ; (c) augmenter l'accès de 25%; (d) augmenter l'accès aux taux de l'Écosse; (e) réduire l'accès de 25%. **Résultats :** Initialement, 14 581 personnes présentaient un PBÉTSSDA (2,43% des adultes) et le taux d'accès aux traitements spécialisés est de 10,84%. L'impact sur 5 ans des scénarios sur le nombre de personnes présentant un PBÉTSSDA (par rapport à aucun changement) est : B) réduit de 191 (-1,3%); C) réduit de 477 (-3,3%); D) réduit de presque 2800 (-19,2%); E) augmenté de 533 (+3,6%). Un impact similaire est observé sur les autres résultats. **Conclusion :** Les décideurs peuvent estimer l'incidence potentielle de la variation des taux d'accès aux traitements spécialisés pour la dépendance à l'alcool.

RESUMEN. Objetivo: Modelado impacto del cambio de velocidades de acceso de tratamiento especializado para diferentes vías de tratamiento sobre la prevalencia del futuro de la dependencia del alcohol, los resultados del tratamiento, capacidad de servicio, costos, y la mortalidad. **Métodos:** Los números de la Autoridad Local y la prevalencia de personas que potencialmente necesitan evaluación y tratamiento en servicios especializados para la dependencia del alcohol (PINASTFAD) se estiman según las necesidades leves, moderadas, graves y complejas. La tasa de acceso de tratamiento especializado por persona PINASTFAD se estima y de 22 vías de tratamiento diferentes se clasifican a partir de datos administrativos. Otras variables del modelo incluyen la remisión natural, la recaída después del tratamiento, los costos de servicio y las tasas de mortalidad. Los análisis "¿y si?" Evalúan los cambios en las tasas de acceso al tratamiento y las vías de tratamiento del especialista. Los resultados del modelo incluyen: números y prevalencia de personas que son PINASTFAD, números tratados por 22 vías, resultados (finalización exitosa con abstinencia, consumo no problemático moderado con éxito, nuevo tratamiento dentro de los 6 meses, abandono, transferencia, custodia), tasas de mortalidad, requisitos de capacidad (números en contacto con los servicios de la comunidad, o estancias en lugares residenciales o de hospitalización), los costos totales de tratamiento y ahorros de salud generales.Cinco escenarios ilustran la funcionalidad: (a) sin cambios; (b) lograr tasas de acceso en el percentil 70 a nivel nacional; (c) aumentar el acceso por + 25%; (d) aumentar el acceso a la tasa de Escocia; (e) reducir el acceso por -25%. **Resultados:** Al inicio del estudio, 14,581 personas son PINASTFAD (2,43% de los adultos) y la tasa de acceso al tratamiento especialista es del 10,84%. El impacto de 5 años de los escenarios en los números de PINASTFAD (versus ningún cambio) es: B) reducir por 191 (-1.3%); C) reducir por 477 (-3.3%); D) reducir por casi 2800 (-19.2%); y E) aumento por 533 (+ 3.6%). El impacto relativo es similar para otros productos. **Conclusión:** Los responsables de la toma de decisiones pueden estimar el impacto potencial de cambiar las tasas de acceso de tratamiento especializado para la dependencia del alcohol.

ALCOHOL DEPENDENCE causes a substantial burden on individuals and wider society, including an increased risk of mortality and costs to health services (World Health Organization [WHO], 2014). In many countries, assessment and structured treatment pathways exist, and national guidelines such as those the National Institute for Health and Care Excellence (NICE) in England set out recommendations for different groups of clients (National Collaborating Centre for Mental Health, 2011). Within the published literature, the most complete approach to modeling the system impact of changing access rates to alcohol treatment services was undertaken by Rush (1990). This followed four steps: (1) determine the geographic area and population size, (2) estimate the number of problem drinkers and alcohol-dependent drinkers (i.e., in-need population), (3) estimate the number of individuals that should be treated in a given year (i.e., demand population), and (4) estimate the number of individuals that require service from each component of the treatment system.

Our research was commissioned by the U.K. Department of Health Policy Research Programme (Brennan et al., 2016). Variations in service provision were known to exist within England and also between U.K. countries. For example, recent investments in Scotland mean that annual numbers of treatments provided per overall population were approximately three times higher than in England (for details of the calculation, see p. 241 of Brennan et al., 2016). Our research objective was to extend the Rush framework to develop a capacity model—the Specialist Treatment for Alcohol Model (STreAM) Version 1.0—which estimates the number of people potentially in need of assessment for and treatment with specialist treatment services for people with alcohol dependence, estimates the number of people currently accessing those services, and quantifies the effects of changing Specialist Treatment Access Rates in England.

The methods to estimate Local Authority prevalence of alcohol dependence are reported in detail elsewhere (see chapter 4 of Brennan et al., 2016). Our approach extended that of the 2004 Alcohol Needs Assessment Research Project (ANARP) (Drummond et al., 2005). ANARP focused on levels of alcohol use, measured using Alcohol Use Disorders Identification Test (AUDIT) score categories (Babor et al., 2001). Extending this, we developed statistical models following three steps. Step 1 used the Adult Psychiatric Morbidity Survey (APMS) 2007 (McManus et al., 2009). We developed a regression model of the probability that an individual has an AUDIT score in one of four bands (0–7, 8–15, 16–19, ≥20). Covariates were age, gender, Index of Multiple Deprivation (IMD) quintile, and the rate of person-specific hospital admissions with a diagnosis code of alcohol dependence (ICD-10 codes F10.2, F10.3, F10.4, F10.5, or F10.6 either as a primary or secondary diagnosis). Step 2 used the APMS to model the probability that the Severity of Alcohol Dependence Questionnaire (SADQ; Stockwell et al., 1979) is in one of four bands (0–3, 4–15, 16–30, ≥31)—with the same covariates as in Step 1 plus the AUDIT band (0–7, 8–15, 16–19, ≥20). We then defined people who are "potentially in need of assessment and specialist treatment for alcohol dependence" as those with an AUDIT score of at least 20 or those with an AUDIT score of 16–19 and a score of at least 16 on the SADQ. We also defined three severity subgroups based on SADQ 4–15 (mild), SADQ 16–30 (moderate) and SADQ ≥31 (severe) and separated into gender and four age groups (18–24, 25–34, 35–54, ≥55 years). Step 3 made a final adjustment for the estimated number of homeless people, using data on people registered as homeless in each Local Authority (Ministry of Housing, Communities & Local Government, 2018) and evidence on the proportion of homeless people with alcohol dependence (Gill et al., 1996). Throughout this article we use an acronym for this population of interest for our modeling—people who are "potentially in need of assessment and specialist treatment for alcohol dependence" (PINASTFAD). The PINASTFAD prevalence for a particular geographical area is therefore defined as the estimated number of people who are PINASTFAD divided by the adult (age ≥18 years) population for that geography. We estimated PINASTFAD prevalence for England and for each of the 151 Upper Tier

Local Authorities, with results showing 7-fold variation (chapter 4 of Brennan et al., 2016).

The National Drug Treatment Monitoring System (NDTMS), which provides data on clients' specialist treatment for alcohol dependence, was then used to define and quantify Specialist Treatment Access Rates (see Chapters 5 and 6 of Brennan et al., 2016). The NDTMS is a national administrative database that records data on clients' specialist alcohol treatment. "Treatment journeys" are defined by linking together a client's several structured treatment episodes if they overlap in time or are separated by fewer than 22 days between discharge and the next treatment start date. For example, a client might spend some time in an inpatient facility together with community support soon afterward. We define and use two main Specialist Treatment Access Rates. The denominator in each case is the number of people who are PINASTFAD. The first rate used in the model is the Starting Specialist Treatment Access Rate, defined with the numerator as the number of people who have a start date for their treatment journey during the National Health Service (NHS) administrative year (e.g., April 1, 2013–March 31, 2014). If the same person starts two different treatment journeys (e.g., one in April and another separate one later in December), this person is counted only once in this calculation. The second rate used is the Experiencing Specialist Treatment Access Rate, defined with the numerator as the number of people who experience contact with specialist treatment at any time during April 1, 2013, to March 31, 2014 (i.e., including people whose episode started before but ended after April 1, 2013). Again, if a person experiences two different treatment journeys, he or she is counted only once. We separate analyses of specialist treatment access rates by gender and four age groups (18–24, 25–34, 35–54, and ≥55 years). We also define three severity subgroups using the NDTMS. Unfortunately, the NDTMS does not record either AUDIT or SADQ. We defined severity subgroups using the data collected in the NDTMS at the beginning of structured treatment (i.e., "What was the number of units you consumed in a typical drinking day in the previous 28 days?"). We defined three severity bands using 0–15, 16–30, and ≥31 units. The results of these Specialist Treatment Access Rate calculations showed substantial variations, with an 11-fold variation across Local Authorities (reported in chapter 6 of Brennan et al., 2016).

This article describes the STreAM Version 1.0, which estimates the potential impact of changing Specialist Treatment Access Rates from current levels, either in England or at the Local Authority level. We describe the model structure, its inputs, and the evidence on which it is based. We then demonstrate the model's functionality and outputs using an illustrative case study showing the potential impact of five scenarios for changing Specialist Treatment Access Rates in one exemplar Local Authority (Leeds).

Method

Model overview

The STreAM model examines, for a particular Local Authority geographical area, the overall adult population and the dynamics of the number of people who are PINASTFAD. For most of the model, simple arithmetic is used. Therefore, the number of people who are PINASTFAD in a future period equals the current number plus new people becoming PINASTFAD minus the people who stop being PINASTFAD. This is all calculated by examining the number of people receiving specialist treatment, successful treatment completion rates, natural remission without treatment, and relapse rates after earlier successful treatment. The model also has inputs for general population demographics, mortality rates, increased mortality risk for people who have alcohol dependence, and aging effects, including new 18- to 19-year-olds entering the model each year. In addition to the number of people, the model also examines resources required to treat clients in different settings (community, residential, and inpatient), and the costs of commissioning such services.

Basic input data on the potentially-in-need population

The adult population structure for a Local Authority is obtained from national population estimates (https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates; accessed March 27, 2018). The methods to estimate the number of PINASTFAD were summarized in the introduction and are reported in detail elsewhere (chapter 4 of Brennan et al., 2016). Table 1 shows the population of slightly more than 600,000 adults and the estimated number of people who are PINASTFAD (14,581, thus an overall prevalence rate of 2.43%) for our exemplar Local Authority as well as the breakdown by age, gender, and severity.

Data on current specialist treatments and percent successful completion rates

Table 1 also shows the summary baseline NDTMS data for our exemplar Local Authority, with a total of 1,580 individuals starting a new treatment journey, meaning that the Starting Specialist Treatment Access Rate (i.e., the proportion of people who are PINASTFAD gaining treatment access) was overall 10.84%. This varies substantially by age, gender, and severity group. Chapter 5 of Brennan et al. (2016) and its appendices detail the specification of NDTMS analyses used.

In the model, clients currently treated in the Local Authority are classified into 1 of 22 different pathways, which are defined using NDTMS data on setting (community, residential, inpatient), type of treatment (psychosocial only, use

TABLE 1. Summary of key model inputs for one Exemplar Local Authority (LA)

		Male				Female			
	All	18–24	25–34	35–54	≥55	18–24	25–34	35–54	≥55
A: Population									
age ≥ 18	600,830	49,070	56,789	97,948	87,621	51,295	56,882	98,356	102,869
B: Estimated numbers of people who are potentially in need of assessment and specialist treatment for alcohol dependence ("PINASTFAD")									
Total	14,581	3,533	3,982	3,052	1,121	1,555	443	700	197
Mild[a]	7,572	1,591	1,904	1,664	738	805	284	444	142
Moderate[b]	5,626	1,540	1,671	1,152	314	607	117	200	25
Severe[c]	1,145	372	377	206	39	113	12	26	0
Severe & complex[c]	238	30	30	30	30	30	30	30	30
C: Number of individuals starting a new treatment journey 2013/2014 (NDTMS)									
Total	1,580	48	214	612	139	36	126	302	103
0–15 units/week[e]	550	17	76	144	39	16	50	135	73
16–30 units/week[f]	426	16	61	185	50	8	18	73	15
≥31 units/week[g]	208	5	26	108	23	0	21	20	5
Complex needs[h]	396	10	51	175	27	12	37	74	10
D: Starting specialist treatment access rate (no. of new journeys divided by no. of people who are PINASTFAD), %									
Total	10.84	1.36	5.37	20.05	12.40	2.32	28.46	43.16	52.37
Mild [(e / a)]	7.26	1.07	3.99	8.65	5.28	1.99	17.61	30.41	51.41
Moderate & severe [(f + g) / (b + c)]	9.36	1.10	4.25	21.58	20.68	1.11	30.23	41.15	80.00
Moderate & severe + complex [(f + g + h) / (b + c + d)]	14.70	1.60	6.64	33.73	26.13	2.67	47.89	65.31	54.85

E: Completed journeys according to pathway (4 broad categories), %

	Community psychosocial	Community pharmacology	Residential	In-patient	Total
Exemplar LA	43	49	7	1	100
National	77	14	2	7	100
Difference	-34	35	5	-6	–

F: Completed journeys according to outcome, %

	All success	Success (abstain)	Success (non-problematic drinking)	Dropout	Transfer	Died	Total
Exemplar LA	61	35	26	32	6	1	100
National	47	33	14	45	6	1	100
Difference	14	2	12	-13	0	0	–

Notes: NDTMS = National Drug Treatment Monitoring System.

of withdrawal and/or relapse prevention pharmacotherapy), and other factors (detailed definitions are in section 5.3 of Brennan et al., 2016). Here, we report results in which these 22 pathways are aggregated into four groups: community-based psychosocial treatment only, community-based psychosocial treatment with pharmacotherapy for withdrawal support and/or relapse prevention, residential treatment, and inpatient treatment. Section E of Table 1 shows the proportion of the treatment journeys undertaken within each of these four groups and compares our exemplar Local Authority with the national average—showing lower use of psychosocial-only pathways, a greater use of community-

based pharmacological treatment, more residential-based and less inpatient-based care than the national average.

The NDTMS records six different treatment outcomes as follows: successful completion of the treatment journey with abstinence, successful completion of the treatment journey with moderated nonproblematic drinking, re-treatment within 6 months, dropout, transfer to another service, or taken into custody. Section F of Table 1 shows the treatment outcomes for our exemplar Local Authority versus the national average—showing higher rates of success with moderated non-problematic drinking and lower dropout before treatment completion rates.

Modeling natural remission without specialist treatment

Table 2 shows the model input parameters affecting the dynamics of prevalence. Evidence on natural remission comes from the long-term U.S. National Epidemiologic Survey on Alcohol and Related Conditions (NESARC) studies (Table 2, Part A). We differentiate remission to becoming an abstainer (26%) from remission to drinking at moderate levels (74%) (see Table 1 of Dawson et al., 2009). We estimate an overall average remission rate of 9.1% per annum from NESARC (given 1,172 clients dependent at baseline, 3 years later there were 76 in abstinent remission plus 216 in non-abstinent remission). Evidence that remission rates are lower for older ages (Table 4 of Dawson et al., 2005) is used to estimate a relative hazard of remission by age group: 1.36 for 18–24, 1.1 for 25–34, 0.85 for 35–54, and 0.69 for ≥55 years; hence, our estimated remission rates by age are 12%, 10%, 8%, and 6%, respectively. We were unable to identify differential remission rates for different severity of dependence groups and have assumed they are equal for mild, moderate, severe, and complex needs groups.

Modeling relapse after specialist treatment

Table 2, Part B shows relapse rates for formerly dependent current abstainers and formerly dependent current moderate drinkers. We used a previously published statistical model of NESARC data (see Table 4 of Dawson et al., 2007), which predicts recurrence of DSM alcohol dependence conditional on age and current drinking status. From this we derived single-year age band probabilities of relapse and then averaged these into the four age groups in our model. We were unable to find relapse evidence by severity of dependence and thus assume that the proportion of relapsed people flowing into each dependence severity group is pro rata to the baseline proportion of people in the mild, moderate, severe, and complex needs groups from our prevalence estimates (i.e., specific to each Local Authority).

There are no directly available data on the number of people in the formerly alcohol-dependent state at the start of the model run. We estimate this as follows: We do have (a) the baseline prevalence estimates of alcohol dependence according to the AUDIT/SADQ score (Table 1) and (b) our literature-derived relapse and remission rates (Table 2). We use both of these together to derive the size of the former dependent groups, making one further assumption. We assume that the relative size of the dependent and formerly dependent groups can only change via relapse and remission and that they are in equilibrium. We then calculate the size of the formerly dependent groups such that, when relapse/remission rates are applied, the number leaving the dependent group and transitioning to formerly dependent is exactly equal to the number entering the dependent group from the formerly dependent group. This is likely to be a reasonable assumption if prevalence trends are gradual and if we are looking ahead a small number of years.

Modeling new incidence, aging, and mortality each year

To account for new incidence and aging, as each year is modeled, a new set of 18- to 19-year-olds prevalent with the same rate of alcohol dependence as the subgroup of 18- to 24-year-olds at baseline (Table 1, Part B) is incorporated. Some people also age into the next age group cohort each year (e.g., 1/10th of the people in the 25–34 age subgroup transfer to the 35–54 subgroup every year).

Mortality rates for the general population in each age/gender group are calculated using 2012 Office of National Statistics (2013) death registrations and population estimates. To adjust mortality for current alcohol dependence we use German evidence that annualized death rates given dependence are 4.6-fold higher for women and 1.9-fold higher for men (John et al., 2013). To estimate mortality in formerly alcohol-dependent people, we use a meta-analysis showing an odds ratio for mortality of 0.35 for abstainers compared with continued heavy drinking in alcohol use disorders (Figure 2 of Roerecke et al., 2013) and an odds ratio for mortality of 0.61 for those still drinking but with reduced alcohol consumption and abstainers excluded (Figure 3 of Roerecke et al., 2013).

Method to calculate next-year PINASTFAD prevalence using modifiable model parameters

Integrating the parameters described above, we model the dynamics of future prevalence with a simple arithmetic process. The prevalence of dependence in the next period is basically the prevalence now, minus those who achieve stable abstinence/moderated nonproblematic drinking following treatment, minus also the proportion of people who achieve natural remission, plus the number of people who relapse from their state of former dependence, minus the number in the cohort who died. This is done for eight age/gender subgroups, with an adjustment in the youngest age band to account for new 18- to 19-year-olds each year.

Three main modifiable parameters are used to develop "what-if" scenarios. The first is the Starting Specialist Treatment Access Rate, which could be increased or decreased by the user. Calculations are done on a weekly basis (52 weeks equals 1 year). The number of people entering treatment each week is calculated from the user input annual Starting Specialist Treatment Access Rate divided by 52 (the default being the 2013/14 baseline Starting Specialist Treatment Access Rate for the Local Authority modeled). The second set of modifiable parameters are the proportions of people assigned to the 22 different pathways (default being calculated based on 2013/14 assignments for the Local Authority modeled). The third modifiable parameter concerns the propor-

TABLE 2. Model parameters affecting the dynamics of prevalence over time

Part A: Natural remission parameters derived from NESARC study

Gender	Age band	Prob. entering subgroup given remission		Annual natural remission rates (without treatment)			
		Former AD abstainer	Former AD drinker	Mild AD	Moderate AD	Severe AD	Complex needs
Male	18–24	26%	74%	12%	12%	12%	12%
	25–34	26%	74%	10%	10%	10%	10%
	35–54	26%	74%	8%	8%	8%	8%
	≥55	26%	74%	6%	6%	6%	6%
Female	18–24	26%	74%	12%	12%	12%	12%
	25–34	26%	74%	10%	10%	10%	10%
	35–54	26%	74%	8%	8%	8%	8%
	≥55	26%	74%	6%	6%	6%	6%

Part B: Relapse parameters

Gender	Age band	Annual relapse rate to alcohol dependence from former dependence		Probability of entering each subgroup given relapse (assumed the same %s as baseline prevalence for the example Local Authority)			
		Former AD abstainer	Former AD drinker	Mild AD	Moderate AD	Severe AD	Complex needs
Male	18–24	3.4%	12.2%	45.0%	43.6%	10.5%	0.8%
	25–34	2.8%	10.2%	47.8%	42.0%	9.5%	0.7%
	35–54	1.9%	7.4%	54.5%	37.7%	6.8%	1.0%
	≥55	1.0%	4.5%	65.9%	28.0%	3.5%	2.6%
Female	18–24	3.4%	12.2%	51.8%	39.0%	7.3%	1.9%
	25–34	2.8%	10.2%	64.2%	26.4%	2.7%	6.7%
	35–54	1.9%	7.4%	63.5%	28.6%	3.7%	4.2%
	≥55	1.0%	4.5%	72.2%	12.7%	0.0%	15.1%

Part C: Mortality rates per 1,000 population per annum parameters

Gender	Age band	Never alcohol dependent	Former AD abstainer	Former AD drinker	Currently alcohol dependent
Male	18–24	0.00048	0.00047	0.00083	0.00135
	25–34	0.00066	0.00066	0.00116	0.00190
	35–54	0.00220	0.00228	0.00397	0.00650
	≥55	0.02897	0.03262	0.05551	0.08789
Female	18–24	0.00019	0.00047	0.00082	0.00134
	25–34	0.00034	0.00083	0.00144	0.00235
	35–54	0.00144	0.00361	0.00627	0.01024
	≥55	0.02838	0.08109	0.13330	0.20137

Notes: NESARC = National Epidemiologic Survey on Alcohol and Related Conditions; AD = alcohol dependent.

tions achieving different outcomes (successful completion of the treatment journey with abstinence, dropout, etc.), with the default being the national average outcome percentages for each pathway.

Modeling impact on future system capacity required using duration of treatment journey data

Our study also examined the capacity requirements within the system in terms of the number of people in contact with community-based services at any one time and the number of residential and inpatient places required at any one time. To convert estimates of the number of people starting treatment each week into the number of people in contact at any one time, the model uses information on the national average duration of treatment by three severity subgroups (using

"number of units consumed in typical drinking day in previous 28 days"), by the 22 pathways and by the 6 different treatment outcomes. As an example, people with 0–15 units per typical drinking day at baseline, who access Pathway Number 1 ("community psychosocial only treatment") and achieve an outcome of "successful completion of treatment journey with moderated nonproblematic drinking" have an average treatment journey duration calculated from the NDTMS of 19 weeks. Therefore, within the model, if people experiencing this path enter community psychosocial-only treatment in week 20 of the financial year, then we model them as leaving the treatment system in week 39. At that point these people enter the "former dependent with current moderate nonproblematic drinking" state within the model. A second more complicated example is people with more than 30 units per typical drinking day at baseline, who

access Pathway Number 11 in the model (i.e., "inpatient assisted withdrawal followed by community psychosocial and pharmacological relapse prevention" and achieve an outcome of "successful completion of treatment journey with abstinence"). Analysis of the NDTMS shows their average treatment journey duration to be 26 weeks of community-based treatment plus 2 weeks of inpatient treatment. Therefore, if such people enter treatment in week 20 of the model, they will leave the system and enter the "former dependent and abstaining drinking" state within the model in week 48.

The model undertakes calculations like the examples above each week of the financial year for all three severity subgroups (0–15, 16–30, and ≥31 units), all 22 pathways, and all 6 outcome combinations for each week. Summing these calculations, the model then provides three key output measures of required capacity: number of community-based clients required to be treated weekly, number of residential places required, and number of inpatient places required.

Unit costs data for components of specialist treatment and general NHS care

Finally, our study examined costs. There is no national data set for commissioning costs of specialist treatment for alcohol dependence. Instead, we updated recent estimates of costs from the NICE CG115 guidelines (National Collaborating Centre for Mental Health, 2011) to quantify costs per week for each component (see Table 3 and Appendix 8.3 on p. 249 of Brennan et al., 2016, for full methods). Within the model calculations, these weekly costs are multiplied by national average durations observed in the NDTMS for each severity–pathway–outcome combination. A user can overwrite default cost inputs and durations if more accurate local costings are available.

We also examine a broad estimate of the cost impact of changes in the prevalence of alcohol dependence over time on general NHS care. We use an annual estimate of additional general NHS care for a person dependent on alcohol of £1,800 per person based on NICE guidelines (National Collaborating Centre for Mental Health, 2011) and assume that this will reduce to zero when people move from alcohol dependence to a state of former alcohol dependence. Discounting of future costs is undertaken at 3.5% per annum and the model time horizon in these analyses is 5 years.

Approach to what-if analysis

The model was constructed in Excel (Microsoft, Redmond, WA) with VBa macros. To examine the impact of scenarios, the STreAM model allows the user to make two main changes to model inputs. The user can alter Specialist Treatment Access Rates from their current levels. This can be done at the whole population level or for specific age/gender subgroups. The user can also alter the percentages

of people assigned to each of the 22 different pathways. The research team is able to adapt and develop the model and undertake more "under the hood" changes to any of the input variables.

When running a scenario analysis, the model is usually run so that it compares the proposed new Specialist Treatment Access Rates With "Same As Last Year's Specialist Treatment Access Rates and percentage assignment to pathways."

The model outputs analyze the difference between the two scenarios modeled. These include the differences in the following outputs: the number of people who are PINASTFAD, number of people successfully treated, number of deaths, specialist treatment costs, general NHS costs, and three required capacity outputs—number of people in contact with community services at any one time, number of residential places, and number of inpatient places.

Illustrative exemplar case study

The exemplar analyses in this article are for the city of Leeds Local Authority. It is important to emphasize that the scenarios examined are entirely illustrative and have not been discussed with Local Authority commissioners or service providers in that area. We examine four illustrative scenarios for changing Specialist Treatment Access Rates, each compared against a base scenario of "no change" keeping rates at the same level as 2013/14:

A. No change

B. Set Specialist Treatment Access Rate for each age/gender subgroup to be at the 70th percentile level nationally (i.e., only 30% of Local Authorities have a higher Specialist Treatment Access Rate for that age/gender subgroup)

C. Increase Specialist Treatment Access Rate by a factor of 25%

D. Increase access rates to approximately the levels currently achieved in Scotland

E. Reduce Specialist Treatment Access Rate by a factor of 25%.

Results

Detailed analysis for Scenario B (achieve 70th percentile access rates) versus Scenario A (no change in access rates)

Table 4-1 shows the input specialist treatment access rates for scenario B, the 70th percentile nationally for each age/gender group compared with the most recent year alongside those for Scenario A. Scenario B implies a slightly higher number of new journeys overall—1,713 versus 1,580, an extra 133 people per annum starting treatment (+8.4%), which would move this Local Authority from being ranked 64th (of 151) up to being ranked 50th for its Specialist Treatment Access Rates. The input Specialist Treatment Access Rates

TABLE 3. Costs inputs for the specialist treatment intervention components

Intervention component	Research team's estimated 2013/2014 update to NICE CG115 costings (£)	Duration of component as costed in NICE CG115 (weeks)	Implied weekly cost (£)	Implied daily cost (£)
Community psychosocial	99.00	1.00	99.00	14.14
Pharmacological interventions for relapse prevention	505.00	52.00	9.71	1.38
Community assisted withdrawal	363.00	1.43	254.10	36.40
Intensive community program	2,442.00	3.00	814.00	116.29
Residential assisted withdrawal	5,975.00	2.50	2,390.00	341.43
Residential rehabilitation	633.00	1.00	633.00	90.43
Comprehensive assessment	454.00	1.00	454.00	454.00

Notes: NICE = National Institute for Health and Care Excellence.

vary by age/gender for this scenario and the increases in access are highest for men 18–24 years, women 18–24 years, and men ≥55 years, with small decreases in access implied for 35- to 44-year-old men and women.

Table 4-2 shows the impact of this on the number of people who are PINASTFAD. By the end of 5 years this is estimated to be 191 lower for Scenario B than it would be under Scenario A. This is a small difference, an approximately 1.3% reduction of the baseline 14,851 people who are PINASTFAD. The implied prevalence of PINASTFAD per total adult population in 5 years' time would be marginally lower at 2.23% under Scenario B versus 2.26% under Scenario A. Most of the estimated lower numbers occurred in the mild dependence (-102) and moderate dependence (-72) subgroups.

Table 4-3 shows a summary of the outcomes for people receiving specialist treatment. In total over 5 years, an additional 449 people are estimated to exit treatment under Scenario B compared with Scenario A. This includes 282 additional successful treatments, of which 171 are successful completion of the treatment journey with abstinence and 111 successful completion of the treatment journey with moderated nonproblematic drinking. There is also a small estimated impact on mortality, with 8 fewer deaths over 5 years, all of which are in the male ≥55 subgroup (not shown in the table).

Figure 1A shows that the overall prevalence of people who are PINASTFAD is estimated to be falling under Scenario A and falling marginally more under Scenario B. Figure 1B shows that the difference in prevalence between Scenario B and Scenario A is larger for men ≥55 than for women ≥55. This reflects the inputs for Scenario B in that Specialist Treatment Access Rates were increased more for men ≥55 than for women ≥55, and it also explains why the modeled reductions in mortality are estimated to be occurring mostly in men ≥55.

Table 4-4 shows the implied difference in impact on capacity required. At Year 5, we estimate the additional number of people receiving community-based services care at any one time is 31 more for Scenario B than for Scenario A. Tables in the Supplemental Online Appendix show that, in Year 5, the number of people receiving community-based services care at any one time under scenario B is 488. The additional capacity for residential-based care is around 1 extra place on a typical day under Scenario B compared with Scenario A (13.3 vs. 12.4 residential places). Very little additional capacity would be required in the inpatient service (0.5 inpatient places under both Scenario B and A).

Table 5 shows the differences between Scenario B and Scenario A for the estimated number of former dependent drinkers in the population. By the end of Year 5, an additional 199 people are in the former dependent group, with 145 of these abstaining. Most of the differences are in the men ages 18–24 (46 of them), 25–24 (68 of them), and ≥55 (63 of them).

Finally, our broad analysis of financial cost impact estimates that the extra (discounted) cost of providing the additional specialist treatment services in Scenario B compared with Scenario A is around £2.25 million cumulatively over 5 years. This would be somewhat offset by general NHS cost savings of approximately £1 million due to a lesser number of people with alcohol dependence.

Comparison of results across Scenarios A–E

Figure 2 compares Scenarios B, C, D, and E all against the no change scenario A. A detailed results table for each scenario is given in the Supplemental Online Appendix.

Figure 2-1 shows the estimated impact on the number of people who are PINASTFAD in 5 years' time, with Scenario B achieving a reduction of 191, C (a 25% increase in Specialist Treatment Access Rates) a reduction of 477, and D (increasing to approximately Scottish rates) a reduction of almost 2,800. Scenario E (a reduction, that is, -25% change in Specialist Treatment Access Rates) would cause an estimated increase in the number of people potentially in need of treatment for alcohol dependence of 533. This relative scale of impact is reflected in the other model outputs. Mortality averted over 5 years is almost 10 times higher for Scenario D (73 fewer deaths) than Scenario B (8 fewer),

TABLE 4.   Impact of Scenario B: Achieving 70th percentile of access rates nationally

Part 4-1: Change in no. of journeys under Scenario B:
Achieve 70th percentile of access rates nationally

	Original starting specialist treatment access rate	70th %ile starting specialist treatment access rate	No. of people PINASTFAD by age / gender at baseline	Original new journey numbers per annum	Implied new journeys if 70th %ile numbers per annum
Male					
18–24	1.4%	2.3%	3,533	48	80
25–34	5.4%	6.3%	3,982	214	251
35–54	20.1%	19.1%	3,052	612	582
≥55	12.4%	16.3%	1,121	139	183
Female					
18–24	2.3%	3.5%	1,555	36	54
18–24	28.5%	28.2%	443	126	125
25–34	43.2%	47.8%	700	302	334
35–54	52.4%	52.3%	197	103	103
Total			14,581	1,580	1713
Overall implied specialist treatment access rate				10.8%	11.7%
Overall rank out of 151 Local Authorities in England (1 = highest)				64	50
Overall implied percentile				58th	67th

Part 4-2: Impact of Scenario B on estimated prevalence of dependence by severity subgroup
Year on year comparison of Scenario B (achieve 70th percentile specialist treatment
access rates) with Scenario A (no change in specialist treatment access rates)
No. of people who are PINASTFAD Scenario B − no. of people who are PINASTFAD Scenario A

| | Alcohol dependence subgroups | | | | |
Time point	Mild	Moderate	Severe	Complex needs	Total
Now	0	0	0	0	0
After 1 year	-23	-15	-3	-1	-42
After 2 years	-51	-34	-7	-2	-95
After 3 years	-73	-49	-10	-2	-135
After 4 years	-89	-62	-12	-3	-166
After 5 years	-102	-72	-14	-3	-191

Part 4-3: Impact of Scenario B on number of treatment exits by outcome
Year on year comparison of Scenario B with Scenario A
(treatment exits Scenario B − treatment exits Scenario A)

| | Additional number of treatment exits by outcome | | | | |
	Successfully completed treatment (non-drinking)	Successfully completed (abstinence)	Transferred	Dropped out	Total
Now	0	0	0	0	0
After 1 year	17	27	4	23	70
After 2 years	42	66	9	55	173
After 3 years	66	103	15	86	269
After 4 years	89	138	20	115	361
After 5 years	111	172	24	143	450

Part 4-4: Change in service capacity requirements on a typical day after 5 years due to Scenario B

Community increase	Residential increase	Inpatient increase
30.9	0.9	0.0

Notes: No. = number; PINASTFAD = potentially in need of assessment for and treatment in specialist services for alcohol dependence.
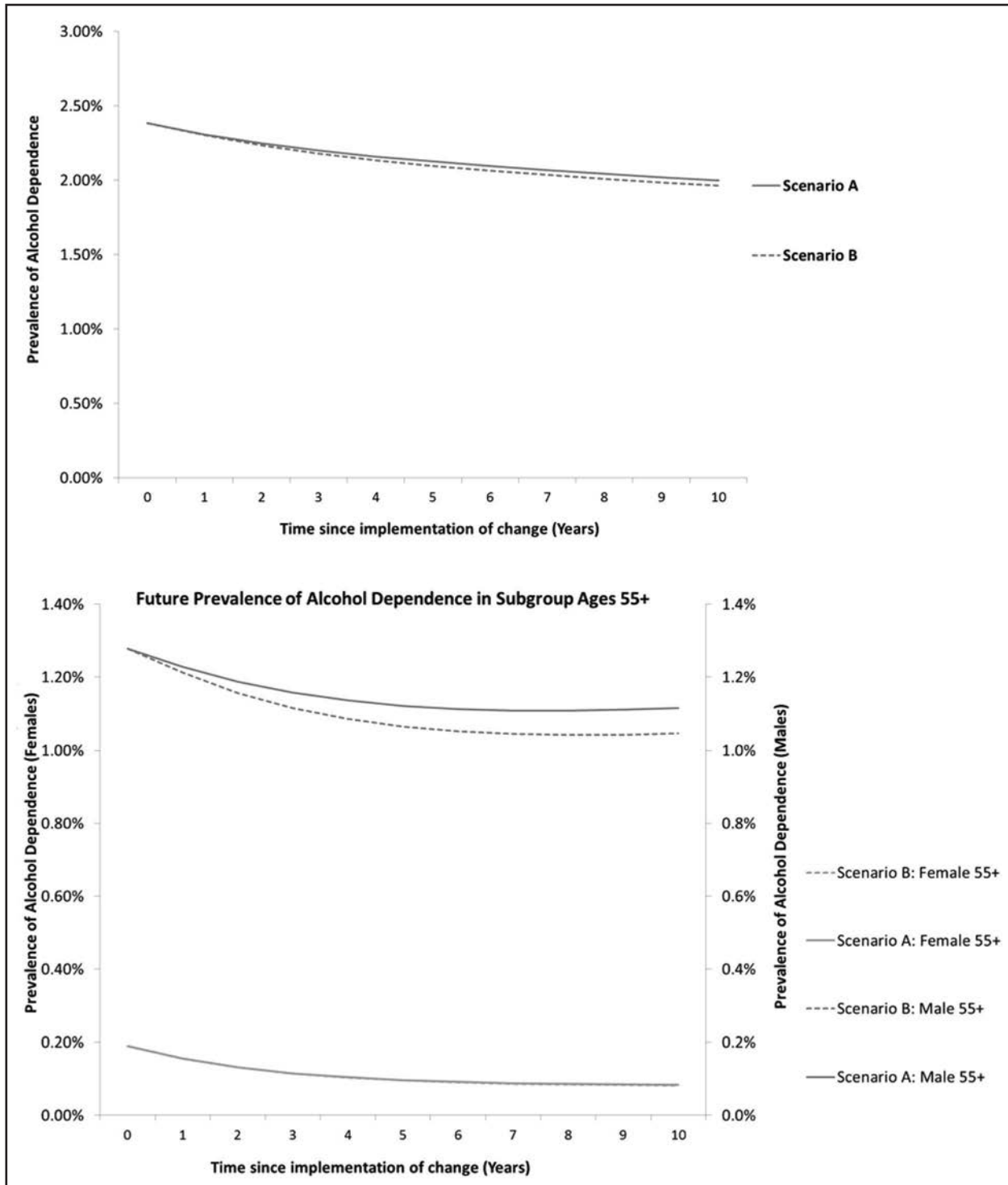
FIGURE 1.   Example Trends in Modeled Prevalence for Scenario 1—70th percentile in each age group versus no change in access rates

whereas Scenario E is estimated to result in an increase in mortality (+15 deaths).

In terms of capacity, comparing Scenario D versus A, the additional number of people receiving community-based services care at any one time is estimated to be around 370

(a substantially larger difference than that of 31 people for Scenario B versus A). Similarly, the additional capacity for residential and inpatient-based care (combined) is around 11 extra places on a typical day under Scenario D (which would be almost double the current baseline level of 12.9 people

TABLE 5.   Detailed age–sex breakdown of the difference between B (achieving 70th percentile of access rates nationally), and A (no change in access rates)

Leeds	Base-line	Year 1	Year 2	Year 3	Year 4	Year 5
No. of people in formerly dependent on alcohol states	0	43	96	138	171	199
Abstainers/alcohol free	0	27	63	93	121	145
Nonproblematic drinker	0	16	33	44	51	54
Male						
18–24	0	11	25	34	41	46
25–34	0	13	31	45	58	68
35–54	0	-8	-16	-21	-24	-26
≥55	0	14	31	44	54	63
Female						
18–24	0	6	14	19	23	25
25–34	0	0	1	2	3	4
35–54	0	6	11	14	16	18
≥55	0	0	0	1	1	1
Total (males & females all ages)	0	**-42**	**-95**	**-135**	**-166**	**-191**
% prevalence per adult population	0.00%	-0.01%	-0.02%	-0.02%	-0.03%	-0.03%
No. estimated in treatment at April 1	2	34	28	23	19	16
Not in treatment	-2	-77	-122	-157	-185	-207
Male						
18–24	0	-11	-25	-34	-41	-45
25–34	0	-13	-31	-45	-58	-68
35–54	0	8	16	21	24	26
≥55	0	-13	-29	-41	-50	-56
Female						
18–24	0	-6	-14	-19	-23	-25
25–34	0	-0	-1	-2	-3	-4
35–54	0	-6	-11	-14	-16	-18
≥55	0	-0	-0	-1	-1	-1
No. of people who are PINASTFAD by severity group						
Mild	0	-23	-52	-73	-89	-102
Moderate	0	-15	-35	-50	-62	-72
Severe	0	-3	-7	-10	-12	-14
Complex	0	-1	-2	-2	-3	-3
No. of complete treatment journeys	0	73	102	96	92	89
Specialist treatment access rate	0	0.53%	0.77%	0.75%	0.74%	0.74%
Successful completed	0	45	65	60	58	56
Not successfully completed	0	28	38	36	34	33
Male						
18–24	0	21	31	31	30	30
25–34	0	22	33	32	32	31
35–54	0	-14	-20	-19	-19	-19
≥55	0	23	32	30	28	27
Female						
18–24	0	12	17	17	17	17
25–34	0	0	-1	-2	-2	-3
35–54	0	10	11	8	7	6
≥55	0	0	0	0	0	-1
No. of people in contact with service on a typical day						
Community	2.1	37.1	34.5	32.8	31.6	30.9
Residential	0.1	1.0	1.0	0.9	0.9	0.9
Inpatient	0.0	0.0	0.0	0.0	0.0	0.0

Notes: No. = number; PINASTFAD = potentially in need of assessment for and treatment in specialist services for alcohol dependence.
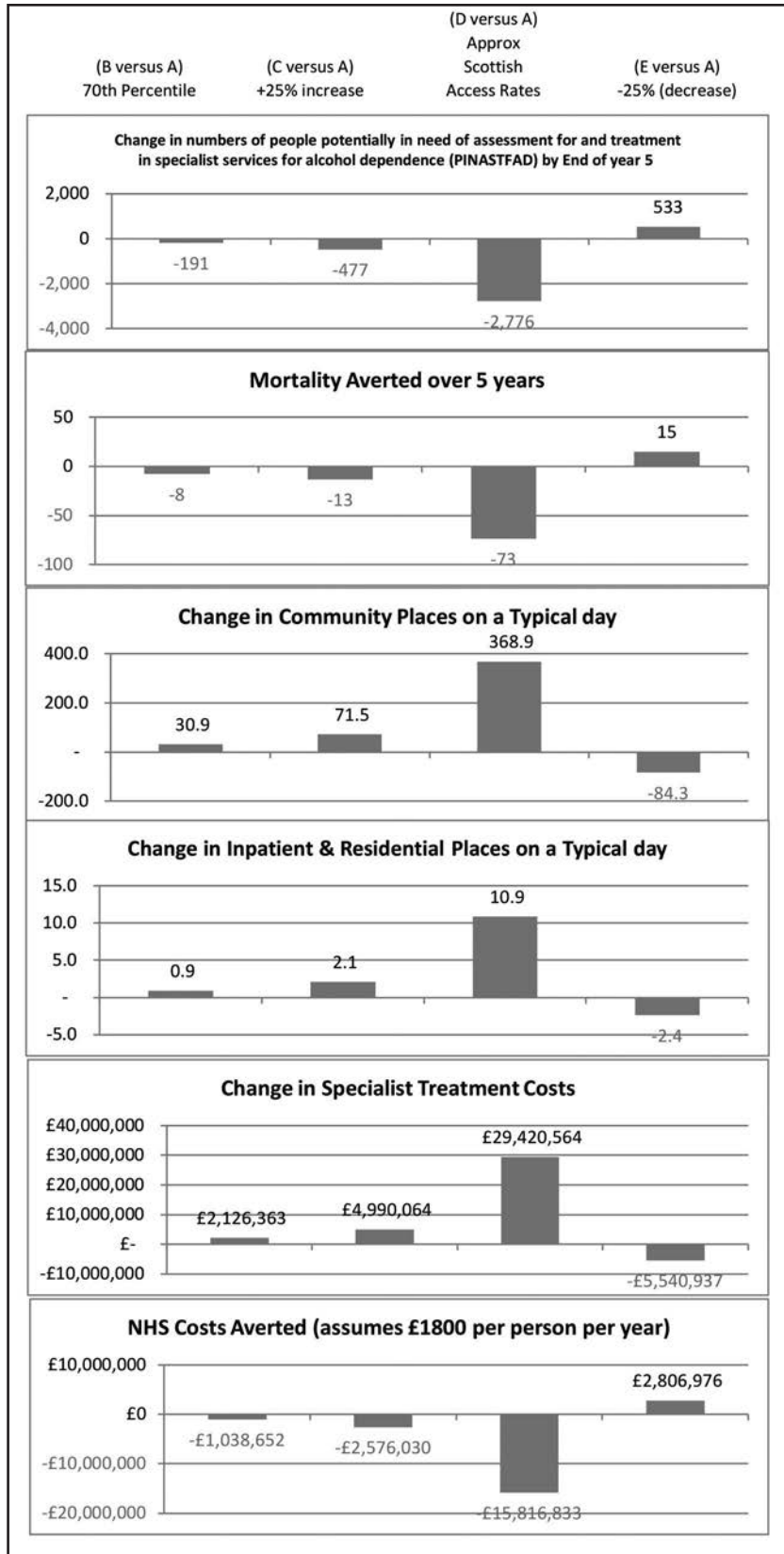
FIGURE 2.   Comparison of the Impact of Four Different Scenarios for Changing Specialist Treatment Access Rates (vs. Scenario A—no change)

in residential or inpatient care). Scenario E would imply a change (reduction) in capacity requirements of around -84 community places and -2 inpatient/residential places.

Finally, the broad cost analyses show a similar pattern. The cumulative additional cost of specialist treatment over 5 years is almost +£29 million for Scenario D versus A as compared with £2.1 million for Scenario B versus A, and Scenario E would show a savings in specialist treatment costs of around -£5.5 million. The indicative estimated NHS costs averted due to reduced prevalence of alcohol dependence would also be substantially larger under Scenario D (around -£16 million for D versus A, compared with -£1 million for B versus A), and there would be an increase in general NHS costs under Scenario E of an estimated +£2.8 million.

Discussion

This study develops a new STreAM framework to examine the impact of changing Specialist Treatment Access Rates and treatment pathway assignment for people who are potentially in need of assessment and specialist treatment for alcohol dependence. The study incorporates evidence from English national surveys and sources of routine data wherever possible, particularly using the Adult Psychiatric Morbidity Survey and the National Drug Treatment Monitoring System, and combines this with published evidence on natural remission and relapse after treatment. The new model extends the Rush et al. (1990) framework and allows Local Authorities to consider commissioning decisions and their potential impact on outcomes. The outcomes examined are as follows: future prevalence of alcohol dependence, service capacity required, mortality, commissioning costs for structured treatment, and NHS costs averted if future alcohol dependence prevalence can be reduced.

There is an important issue to consider when interpreting results. It is acknowledged that the model default rates for relapse and natural remission are based on literature estimates from long-term U.S. studies because neither national nor Local Authority level U.K. data are available on these parameters. One implication of this is that the model outputs for the no-change scenario do not produce a steady-state "flat line" for Local Authority prevalence. In a sense, the model is not really a prediction of what will happen in our Local Authority under no change, because we cannot be sure whether the natural remission and posttreatment relapse rates used from U.S. studies are reflective of this particular Local Authority in England at this time. It is instructive to think of model outputs in terms of what-if scenarios, that is, "what if under Scenario A there is no change in Specialist Treatment Access Rates and the U.S. remission and relapse rates were to apply to this Local Authority?" as compared with "what if under Scenario B the Specialist Treatment Access Rates were at the 70th percentile nationally and the U.S. remission

and relapse rates were to apply to this Local Authority?" A second implication is that, as researchers, we feel more confident about the results in terms of differences between the scenarios (e.g., Scenario B minus Scenario A giving 191 fewer people who are PINASTFAD in 5 years' time) than we do about the absolute levels of Scenario A or Scenario B results in the model.

There are some limitations to evidence and our analysis. The modeling of health benefits is relatively simple in that it uses population average death rates by age and gender combined with a relative risk of mortality for two subgroups, people in the alcohol-dependent state and people who are in the formerly alcohol-dependent state. It would be possible in principle, although a substantial research task, to link together this work with that of the Sheffield Alcohol Policy model (Brennan et al., 2015), which takes a wider public health perspective of the whole population and models 43 different health conditions. Second, our modeling does not include some important impacts, such as reductions in crime, reductions in harm to others (including children or partners of people who are alcohol dependent), and reductions in social care costs for children or adults. Finally, our present analysis does not undertake a cost per quality-adjusted life years–gained analysis because we have not modeled the disease profile or health-related quality of life losses for people with alcohol dependence.

Several research priorities have emerged as important through consideration of the evidence gaps. First, since the APMS is only undertaken every 7 years, the estimation of the prevalence of people who are PINASTFAD can become somewhat out of date. At present the model simply starts with the latest year's estimated prevalence, rather than using trend evidence. More frequent collection of estimates of alcohol dependence prevalence would be useful. Second, the NDTMS does not collect any information routinely on the severity of alcohol dependence, other than the number of units drunk on a typical drinking day in the last month. We would strongly advise incorporation of the AUDIT and SADQ into the NDTMS so that benchmarking across Local Authorities in relation to the Specialist Treatment Access Rates for severity subgroups can be undertaken. Third, despite there being considerable evidence for the effectiveness of specialist treatments for alcohol dependence, it is less clear what the wider natural history of alcohol dependence looks like in England. For the modeling of relapse rates after specialist treatment and the natural remission of people who are untreated, we have had to rely on published literature estimates from long-term U.S. studies. It would be useful if research were undertaken in England to attempt to quantify both natural remission and relapse rates.

Finally, we have considered the generalizability of this modeling framework to other countries. This would be possible if the data sets on prevalence of alcohol dependence and access to specialist treatment in a particular country are

very similar to those in England. We would advise that the international research community consider making recommendations globally on a standardized framework for estimating the prevalence of people in need of assessment and specialist treatment for alcohol dependence. We would further advise making recommendations to produce a standardized definition of Specialist Treatment Access Rates, which could also prove powerful for international benchmarking.

In conclusion, this new STreAM model provides a framework and quantitative methodology for analyzing the potential impact of increasing access to specialist treatment for alcohol dependence in England, and we hope it will be useful to policymakers in England and adaptable globally.

Acknowledgments

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