A health economics model

The cost benefits of the Physical Activity Strategy for Northern Ireland - a summary of key findings

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Background

The Northern Ireland Physical Activity Strategy 1996-2002

Worldwide research has established that physical inactivity is an independent risk factor for coronary heart disease, and a risk factor for type 2 diabetes, obesity and high blood pressure.[1] The Northern Ireland Health and Activity Survey, published in 1994, found that 7 out of 10 men and 8 out of 10 women do not meet the moderate targets for physical activity beneficial to health.[2]

Against this background, the Ministerial Group on Public Health recognised physical activity as a priority public health issue and supported the development and implementation of the Northern Ireland Physical Activity Strategy for 1996-2002.[3] The Northern Ireland Physical Activity Strategy Implementation Group (NIPAIG) was established to take the Strategy forward.

The goal of the Physical Activity Strategy is to increase levels of health-enhancing physical activity and to reduce the proportion of the population that is sedentary from 20% to 15% by 2002 through an integrated multi-sector action plan.

Strategy Action Plan 1998-2002

With the endorsement and commitment of over 70 organisations, a Strategy Action Plan was published in March 1998, which had been developed through discussion with a wide range of organisations identifying their particular roles and contributions to the development and implementation of key activity programmes.[4] The Action Plan therefore provided a framework for maximising efforts to improve health and wellbeing and reduce health inequalities across all sectors.

One of the recommendations for the health sector in the Action Plan was that 'research should be carried out to evaluate and compare the cost of investing in physical activity programmes against the cost of treating preventable illness'.[4]

To help in the development of this key area, the Department of Health, Social Services and Public Safety's Economics Branch agreed to develop a model that sought to establish the extent of avoidable deaths from physical inactivity and, as a consequence, the avoidable economic and healthcare costs for Northern Ireland.

The final draft was presented to the Research Advisory Group (a sub group of NIPAIG). Following a review by research experts, the final report was endorsed by the Northern Ireland Physical Activity Strategy Implementation Group in June 2000 and a recommendation made to produce a summary report.

Modelling the economic benefits of physical activity

Physical inactivity baseline data

Based on data from the 1994 Northern Ireland Health and Activity Survey, it was estimated that 20% of the adult population in Northern Ireland could be classified as sedentary.[2] This baseline was used in the Strategy Action Plan, which set the following targets:

- **Target 1 - By 2002 the proportion of men and women aged 16+ who are classified as sedentary should be reduced from 20% to 15%.**

- **Target 2 - By 2002 the proportion of men and women aged 16+ who achieve recommended age-related activity levels should be increased from 30% of men and 20% of women to 35% of men and 25% of women in these age groups.[4]**

This summary outlines the potential economic benefits of achieving Target 1 (a full report was previously produced for NIPAIG by the Economics Branch of the DHSSPS).

Limitations of the model

The existing research base regarding the health impact of sedentary lifestyles is limited. Far more work in this area is required to enable evidence-based research and analysis to be carried out. Some epidemiologists refuse to undertake research that treats physical activity in isolation from dietary intake. The simple fact is that existing research has not been able to account for physical activity and the range of confounding variables that impact on an individual's health. The figures arrived at in the following analysis are thus estimates based on the best theories and data available. The research utilised a model developed in the USA[5], which was adapted to the Northern Ireland setting using the latest available health statistics.[6-11] A conservative approach was taken in relation to all figures and calculations. This means that the costs attributable to physical inactivity may be substantially higher than these estimates.

Estimated number of avoidable deaths

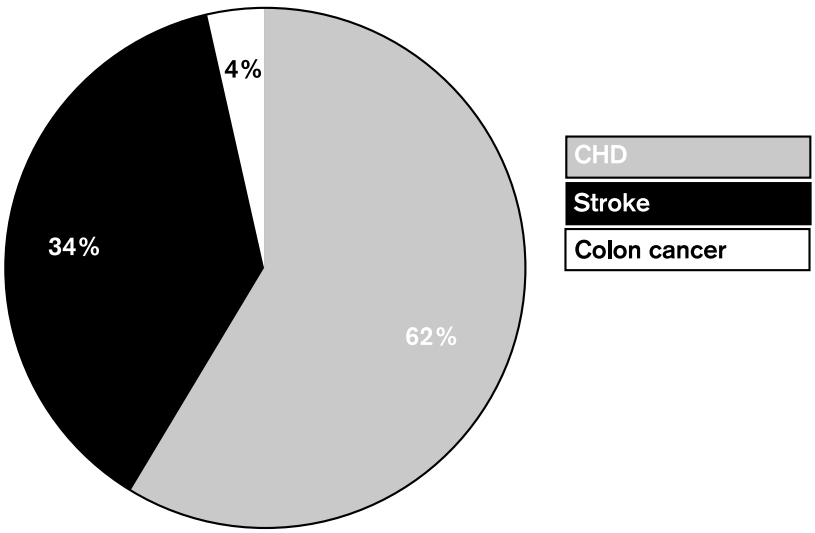
The study selected coronary heart disease (CHD), stroke and colon cancer, as the evidence base highlights these three conditions as the diseases most closely associated with lack of physical activity.[12]

Using the established statistical technique of population attributable risk (PAR) which uses Levin's formula for attributing risk to the total population, we can account for the following numbers of deaths due to physical inactivity.[13] These are based on the proportion of inactive adults (20%) and causes of death data for 1998.

- 1,271 CHD deaths (29.3% of total CHD deaths each year);
- 709 stroke deaths (44.3% of total stroke deaths each year);
- 82 colon cancer deaths (24.8% of total colon cancer deaths each year).

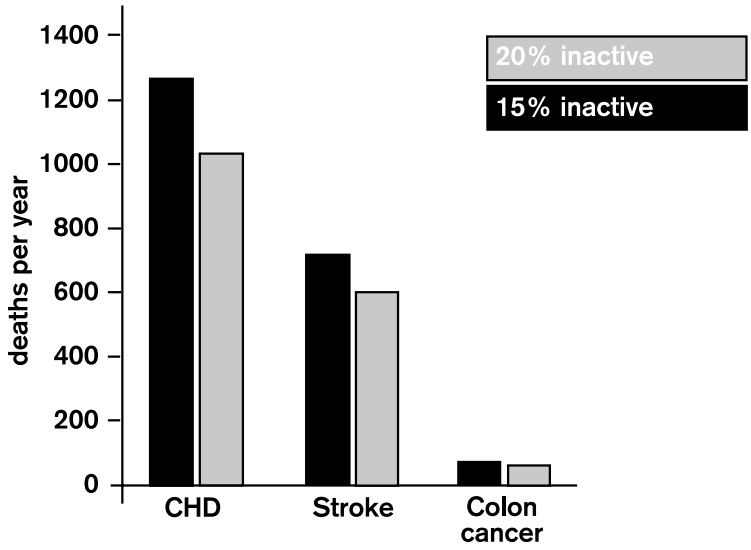
(Appendices 1 and 2 provide more information on how these figures were calculated.)

Figure 1: Distribution of avoidable deaths associated with physical inactivity in Northern Ireland



At least 2,062 people in Northern Ireland die each year due to an inactive lifestyle. If the Physical Activity Strategy is successful in reducing inactivity in the adult population from 20% to 15%, we can expect deaths related to sedentary lifestyles to fall to 1,697; a reduction of 365 deaths each year (see Appendix 3 for calculation of deaths at 15% rate).

Figure 2: Potential reduction in deaths expected if Target 1 is achieved



The benefits of physical activity for people over the age of 75 are considered to be less significant in terms of prolonging life expectancy, compared with similar benefits to younger people. To include those over 75 in the calculation of lives saved may therefore produce inflated estimates of reduced economic costs. If the over 75s are excluded from the calculation, the number of lives saved as a result of decreasing the sedentary proportion of the population from 20% to 15% would be 121 each year.

Based on life expectancies by age and gender[6], the potential years of life lost through the 121 avoidable deaths is estimated at 1,729 years.*

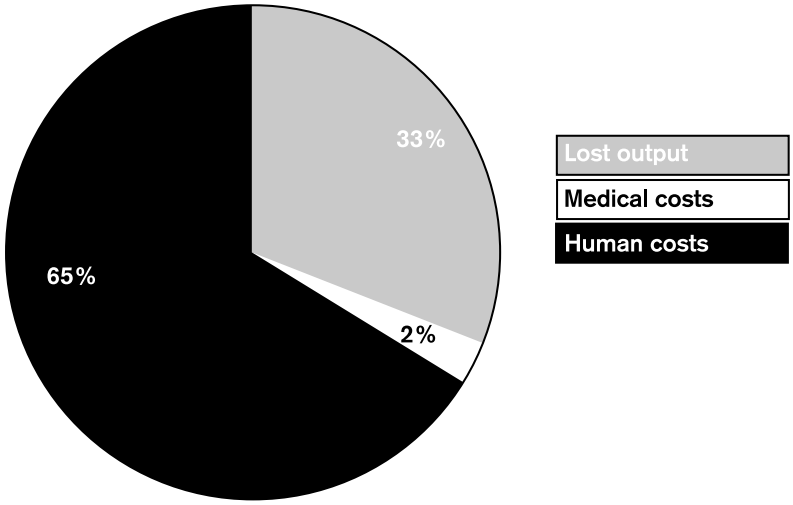
*Figure calculated using potential years of life lost discounted at HM Treasury's 1.5% pure time preference rate. This accounts for life year gains at later life being valued less than the same number of life years gained earlier in life.

Estimated economic benefit from avoidable deaths

The cost to society of an individual death has been estimated to be £1,082,409.* This estimate includes:

- lost output (present value of the expected loss of earnings plus any non-wage payments made by the employer);
- medical and ambulance costs and accident related costs;
- the human costs of death (including the pain and suffering to loved ones).

Figure 3: Distribution of costs associated with premature deaths



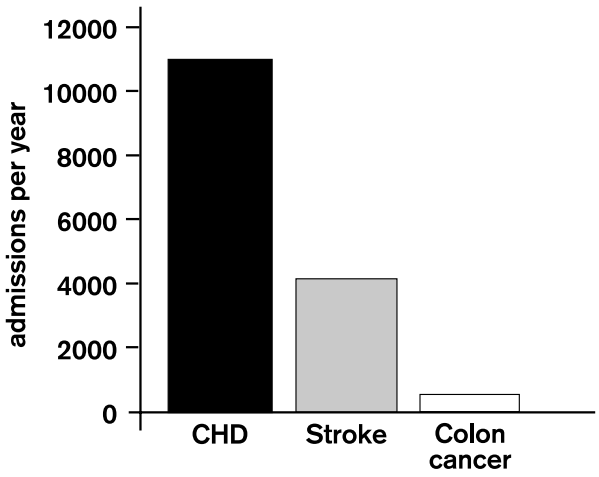
If 121 lives were saved among those under 75 years as a result of a reduction in the sedentary proportion of the population from 20% to 15%, the value of the economic benefit would be approximately £131 million.

Cost saving to the Northern Ireland health service

Estimated annual admissions to hospitals in Northern Ireland include:

- 10,828 people with a CHD diagnosis;
- 4,144 stroke sufferers;
- 624 colon cancer sufferers.

Figure 4: Annual admissions to Northern Ireland hospitals for CHD, stroke and colon cancer



*Department of the Environment, Transport and the Regions (DETR) Highways Economic Note No.1 1997, uprated by using gross domestic product per capita as recommended by DETR.

If the target reduction in inactivity is met we estimate that:

- CHD admissions related to inactivity could fall by two percentage points, resulting in 217 fewer cases;
- stroke admissions could fall by six percentage points, resulting in 249 fewer cases;
- colon cancer admissions could fall by five percentage points, resulting in 31 fewer cases.

The costs to the health service for each case vary by treatment, but the average cost is £1,256. In total, the avoidable cost to the health service of inactivity is estimated at £0.62 million each year (see Appendix 4 for further explanation of how these costs are calculated).

Conclusion

If the Physical Activity Strategy meets its target of reducing the sedentary proportion of the population in Northern Ireland from 20% to 15% then:

- at least 121 lives could be saved each year among those under 75 years;
- the value of the associated economic benefit would be £131 million;
- the direct cost saving to the Northern Ireland health services would be £0.62 million annually.

Recent health interventions (such as the extension of free influenza vaccinations to the over 65s) cost the DHSSPS around £1,000 per life year saved. Based on the figure of 1,729 avoidable lost life years, this suggests an annual budget for reducing physical inactivity of £1.73 million. Taken with reduced admissions to hospitals and consequent treatment costs, it might therefore be worth spending £2.35 million to achieve this five percentage point increase in physical activity levels.

However, the actual cost saving is likely to be significantly higher than this for a number of reasons. Firstly, the calculations were based on conservative estimates both for reductions in disease levels due to increased physical activity, and for the costs of treating particular conditions. In addition, for the purposes of modelling, the calculation was limited to three specific conditions: CHD, stroke and colon cancer. In fact, the development of many other conditions, such as diabetes, hypertension, overweight and obesity, osteoporosis and psychological wellbeing, is also influenced by physical activity levels, and therefore further cost savings would be achieved from increased physical activity due to corresponding reductions in these conditions.

Finally, the over 75s were excluded from the calculation on the basis that the benefits of physical activity are considered to be less significant for people in this age group. Although this is true for those who begin to be more active aged 75 or over, such an approach ignores the benefits that would accrue to the over 75 age group as successive cohorts of people begin to be more physically active while *under* 75 years old. If the increase in physical activity levels were to be sustained for a period of several years, the number of deaths in this age group, and therefore the associated costs, could reduce substantially.

Statistical Appendices

Appendix 1: Calculation of Population Attributable Risk

Levin's formula for attributing risk to the total population, which is otherwise referred to as the population attributable risk (PAR), is used to estimate percentages of CHD, stroke and colon cancer, due to inactivity:

$$\text{PAR (\%)} = \frac{p(RR - 1)}{\{p(RR - 1) + 1\}}$$

where RR = relative risk; and,
p = proportion of population exhibiting the risk.

Appendix 2: Estimation of deaths due to physical inactivity using 20% sedentary prevalence rate

CHD PARs by age cohort - Males

RR No regular exercise	2.0 %	PAR	Actual deaths	Excess deaths
18-24	11	0.10	4	0
25-34	10	0.09	6	1
35-44	14	0.12	32	4
45-54	29	0.22	135	30
55-64	31	0.24	300	71
65-74	54	0.35	644	226
75-84	54	0.35	811	284
85+	54	0.35	333	117

CHD PARs by age cohort - Females

RR No regular exercise	2.0 %	PAR	Actual deaths	Excess deaths
18-24	11	0.10	2	0
25-34	12	0.11	1	0
35-44	11	0.10	10	1
45-54	35	0.26	41	11
55-64	25	0.20	106	21
65-74	36	0.26	349	92
75-84	36	0.26	782	207
85+	36	0.26	775	205
Totals for males and females	20		4,331	1,271

Stroke PARs by age cohort - Males

RR No regular exercise	3.0 %	PAR	Actual deaths	Excess deaths
18-24	11	0.18	2	0
25-34	10	0.17	1	0
35-44	14	0.22	4	1
45-54	29	0.37	23	8
55-64	31	0.38	58	22
65-74	54	0.52	137	71
75-84	54	0.52	236	123
85+	54	0.52	130	68

Stroke PARs by age cohort - Females

RR No regular exercise	3.0 %	PAR	Actual deaths	Excess deaths
18-24	11	0.18	1	0
25-34	12	0.19	1	0
35-44	11	0.18	11	2
45-54	35	0.41	11	5
55-64	25	0.33	36	12
65-74	36	0.42	124	52
75-84	36	0.42	377	158
85+	36	0.42	448	188
Totals for males and females	20		1,600	709

Colon cancer PARs by age cohort - Males

RR No regular exercise	1.8 %	PAR	Actual deaths	Excess deaths
18-24	11	0.08	0	0
25-34	10	0.07	1	0
35-44	14	0.10	3	0
45-54	29	0.19	9	2
55-64	31	0.20	25	5
65-74	54	0.30	56	17
75-84	54	0.30	60	18
85+	54	0.30	23	7

Colon cancer PARs by age cohort - Females

RR No regular exercise	1.8 %	PAR	Actual deaths	Excess deaths
18-24	11	0.08	0	0
25-34	12	0.09	1	0
35-44	11	0.08	1	0
45-54	35	0.22	4	1
55-64	25	0.17	18	3
65-74	36	0.22	42	9
75-84	36	0.22	53	12
85+	36	0.22	33	7
Totals for males and females	20		329	82

Appendix 3: Estimation of deaths due to physical inactivity using 15% sedentary prevalence rate

CHD PARs by age cohort - Males

RR No regular exercise	2.0 %	PAR	Actual deaths	Excess deaths
18-24	11	0.08	4	0
25-34	10	0.07	6	0
35-44	14	0.10	32	3
45-54	29	0.18	135	24
55-64	31	0.19	300	57
65-74	54	0.29	644	186
75-84	54	0.29	811	234
85+	54	0.29	333	96

CHD PARs by age cohort - Females

RR No regular exercise	2.0 %	PAR	Actual deaths	Excess deaths
18-24	11	0.08	2	0
25-34	12	0.08	1	0
35-44	11	0.08	10	1
45-54	35	0.21	41	9
55-64	25	0.16	106	17
65-74	36	0.21	349	74
75-84	36	0.21	782	166
85+	36	0.21	775	165
Totals for males and females	15		4,331	1,031

Stroke PARs by age cohort - Males

RR No regular exercise	3.0 %	PAR	Actual deaths	Excess deaths
18-24	11	0.14	2	0
25-34	10	0.13	1	0
35-44	14	0.17	4	1
45-54	29	0.30	23	7
55-64	31	0.32	58	18
65-74	54	0.45	137	61
75-84	54	0.45	236	106
85+	54	0.45	130	58

Stroke PARs by age cohort - Females

RR No regular exercise	3.0 %	PAR	Actual deaths	Excess deaths
18-24	11	0.14	1	0
25-34	12	0.15	1	0
35-44	11	0.14	11	2
45-54	35	0.34	11	4
55-64	25	0.27	36	10
65-74	36	0.35	124	43
75-84	36	0.35	377	132
85+	36	0.35	448	157
Totals for males and females	15		1,600	600

Colon cancer PARs by age cohort - Males

RR No regular exercise	1.8 %	PAR	Actual deaths	Excess deaths
18-24	11	0.06	0	0
25-34	10	0.06	1	0
35-44	14	0.08	3	0
45-54	29	0.15	9	1
55-64	31	0.16	25	4
65-74	54	0.24	56	14
75-84	54	0.24	60	15
85+	54	0.24	23	6

Colon cancer PARs by age cohort - Females

RR No regular exercise	1.8 %	PAR	Actual deaths	Excess death
18-24	11	0.06	0	0
25-34	12	0.07	1	0
35-44	11	0.06	1	0
45-54	35	0.17	4	1
55-64	25	0.13	18	2
65-74	36	0.18	42	7
75-84	36	0.18	53	9
85+	36	0.18	33	6
Totals for males and females	15		329	65

Appendix 4: Estimation of avoidable admissions cost to hospitals

Avoidable costs to the health service have been estimated using Northern Ireland average costs per case for 1998/99. These are FCE (finished consultant episode) data as supplied by Trusts to the DHSSPS. These are, prior to the introduction of diagnostic group reference costs, based upon the Körner specialty costing model.

There is a lack of published statistical material covering prevalence of disease (morbidity), save for the Northern Ireland Cancer Registry. Therefore, with respect to strokes and CHD a whole of population prevalence rate was used to estimate the total numbers of people suffering from these diseases.

Epidemiological research on risks of a major event (CHD, stroke etc.) rather than death, indicates CHD admissions related to inactivity could fall two percentage points from 6% of total CHD events to 4%. At issue is the precise number of admissions. FCE data as well as data on numbers of discharges and deaths both include multi-admissions (persons admitted more than once with the same condition, or other related problems). As many as 23,343 patients were discharged or died in hospital with CHD ailments during 1998/99. FCE cost data relate all the patients' costs during their various stays in hospital specialities back to individual patients. Therefore, applying average costs with multiple admissions data would inflate our estimate of costs that might be foregone if we reduce physical inactivity.

The case fatality rate of CHD admissions is roughly 40%, so that if we assume the 4,331 deaths by CHD were all admitted, $2^{1}/_{2}$ times that amount might have survived admission. Assuming all those that died were admitted we have a working total number of CHD admissions of 10,828. Applying a 2% reduction in admissions equals 217 less, which at £1,303 average cost of Cardiology FCE equates to an annual saving of £0.28m.

Stroke admissions, by the same analysis, could fall six percentage points from 29% of total stroke events to 23%. Research from Queen's University of Belfast Department of Epidemiology and Public Heath would suggest that as case fatality is only 20%, four times the mortality rate reside at any one time in the community. Given 1,600 deaths from strokes in 1998, we estimate the current numbers of stroke sufferers as 6,400. About half of these would have significant morbidity, so that 3,200 might be expected to draw heavily on hospital services each year. Assuming the 1,600 deaths from stroke were all admitted to hospital, with varying lengths of treatment before death, 4,800 admissions annually are expected.

The September 2000 Health Bulletin from the Chief Medical Officer for Scotland (a region with many parallels to Northern Ireland) stated that Scottish incidence of stroke was 2.98 per 1,000 population. Pro rata to Northern Ireland we estimate 4,470 new and recurrent strokes annually, of whom (using Scottish data) 78% are expected to be admitted, or 3,497 annually.

The mid-point estimate of stroke admissions is 4,144 annually. Using £1,223 as the mid-point in costs between General Surgery and Cardiology FCE and applying a 6% reduction to 4,144 admissions, we estimate the potential for savings as £0.30m annually.

With regard to colon cancer sufferers, the Northern Ireland Cancer Registry indicates a three year average (1993-1995) of 624 cancer sufferers from the disease. Applying a percentage avoided if reaching Target 1 of 4.9% (24.8% at 20% inactivity reducing to 19.9% at 15% inactivity) provides 31 avoidable FCEs (0.049 x 624). We used the £1,218 cost per FCE in Urology (Northern Ireland average for 1998/99) in formulating avoidable costs of £37,758 (31 x £1,218).

It is arguable whether the use of FCEs for a group of patients that are at various stages of treatment from initial diagnosis to most invasive treatments is appropriate. FCEs reflect the full range of inpatient treatments incurred in either successfully treating patients, or not. On this basis, we might halve such costs to reflect the stage of treatment for each patient. However, we chose not to as the types of patients in question would most probably incur additional heath care service costs in the form of daycase and outpatient treatments thereby increasing avoidable costs. These costs were unavailable for analysis.

In total, avoidable costs to the health service are £0.62m per annum.

Notes and References

1. European Heart Network. Physical Activity and Cardiovascular Disease Prevention in the European Union. December 1999
2. MacAuley D, McCrum EE, Stott G, Evans AE, Sweeney K, Trinick T, Boreham CAG. Northern Ireland Health and Activity Survey. Belfast: HMSO, 1994.
3. Northern Ireland Physical Activity Strategy Group. Be Active, Be Healthy - The Northern Ireland Physical Activity Strategy 1996-2002. Belfast: The Health Promotion Agency for Northern Ireland, 1996.
4. Northern Ireland Physical Activity Strategy Group. The Northern Ireland Physical Activity Strategy Action Plan 1998-2002: an implementation plan for Be Active, Be Healthy - The Northern Ireland Physical Activity Strategy 1996-2002. Belfast: The Health Promotion Agency for Northern Ireland, 1996.
5. Hahn R et al. Excess Deaths from Nine Chronic Diseases in the United States, 1986. Journal of the American Medical Association 1990: 264 (20) 2654 - 2659.
6. Department of Finance and Personnel. 78th Annual Report of the Registrar General 1999. Belfast: The Stationery Office, 2000. Table 5.7, Abridged life table by sex and age, 1996-1998.
7. Department of Finance and Personnel. 75th Annual Report of the Registrar General 1996. Belfast: The Stationery Office, 1997. Table 6.2, Deaths by cause.
8. Department of Finance and Personnel. 76th Annual Report of the Registrar General 1997. Belfast: The Stationery Office, 1998. Table 6.2, Deaths by cause.
9. Department of Finance and Personnel. 77th Annual Report of the Registrar General 1998. Belfast: The Stationery Office, 1999. Table 6.2, Deaths by cause.
10. Northern Ireland Cancer Registry, 1999.
11. Specialty Costs for 1998/99. Finance Directorate, DHSSPS. (Unpublished).
12. US Department of Health and Human Services. Physical Activity and Health: A Report of the Surgeon General. Atlanta, Georgia: US Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, 1996.
13. Levin M. The occurrence of lung cancer in man. Acta Intern Cancer 1953: 9, p531.

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