Title: Cost-Effectiveness of Alternative Strategies to Prevent Drowning. Preliminary Findings (abstract 23731).
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Abstract

In the U.S., drowning is the 3rd leading cause of unintentional injury death. Every year, some 5,000 individuals drown and an estimated 88,000 suffer near-drowning episodes. A substantial number of these events occur while enjoying recreational activities in swimming pools or boats.

Our objective was to characterize the cost-effectiveness of: fencing of residential in-ground swimming pools, covering of residential above-ground swimming pools; and use of personal flotation devices (PFDs) in recreational boating. Our analyses incorporate the fact that one could implement these interventions in specific subpopulations (e.g., residential swimming pools of families with children less than 5 years old) and expand incrementally the spread of these interventions to additional subpopulations (e.g., residential pools in homes with children less than 18 years old or to all residential pools).

Data on the incidence, mortality, morbidity, long-term impacts associated with drowning and near drowning, and their associated medical costs are presented in Table 1. Most of the epidemiological data were obtained from the literature. Information on the costs of installing and maintaining the fences or buying PFDs were obtained from the providers. Information on the effectiveness of the interventions was obtained form the literature and from an interview with experts. Cost-effectiveness ratios were computed following the recommendations of the U.S. Panel on Cost-Effectiveness in Medicine. The numerators summarize the net costs of the intervention (1999 US $) and the denominators indicate the net health benefits --combining mortality and morbidity benefits in Quality-Adjusted Life Years (QALYs). We modeled hypothetical cohorts that captured either 10 million residential pools or 10 million boats over the years in which the populations of interest were accessing them (which ranged from 3 to 20 years, depending on intervention and subpopulation). Health-related costs and benefits were spread over the remaining life expectancy of the individual protected with the intervention.

Fencing of residential pools in homes with children less than 18 years old resulted in a cost effectiveness ratios ranging from $25,000 to $31,000 per QALY gained, depending on whether the fenced pools belonged to homes with children of different age subgroups and whether an incremental evaluation was being considered (Table 2). PFDs when compared to no intervention, resulted in ratios of $4,000 per QALY gained. In contrast, fencing of all residential pools and covering of above-ground pools in homes with younger children resulted in cost-effectiveness ratios of $255,000 and $5 Million per QALY gained, respectively. Even though there is uncertainty around some effectiveness estimates, sensitivity analysis suggested the robustness of these findings.

Fencing of in-ground pools in homes with children less than 18 years old and purchasing of PFDs for boats results in cost effectiveness ratios well below that of numerously implemented interventions in the clinical and public health realm. In contrast, fencing of all residential pools or covering lead to much higher ratios.

Table 1. Selected Base Case Values and Ranges Used in Cost-Effectiveness Analysis

Variables	Base Case	Range:		Reference(s)
Incidence				
Residential in-ground swimming pool:				
Drowning cases (in US)				
<5 years old	320	224	416	CDC Fact Sheets 1991
5-17 year old	128	90	166	"
18 and older	555	389	722	"
Near-drowning cases (in US)				
Hospitalized: <5 year old	1,152	806	1,498	Est. based on Wintermute, 1990
5-17 year old	453	317	589	"
18 and older	2,000	1,400	2,600	"
Non-Hospitalized: <5 year old	4,480	3,136	5,824	"
5-17 year old	1,762	1,233	2,291	"
18 and older	7,776	5,443	10,109	"

Number of pools				
Families with child <5	494,000	345,800	642,200	Est. based on MSPI, 2000 and Census, 2000
Families with child 5-17	798,000	558,600	1,037,400	"
Families without children	2,508,000	1,755,600	3,260,400	
Residential above-ground swimming pool < 5 years old:				
Drowning cases	14	10	18	Est. based on CDC data, 1991 & Wintemute,
Hospitalized cases	50	35	65	1990
Non-Hospitalized cases	196	137	255	"
Number of pools	429,000	300,300	557,700	"
Recreational Boating:				NTSB, 1993
Drowning cases	924	647	1,201	Est. based on Wintemute, 1990
Hospitalized near-drowning cases	3,326	2,328	4,324	"
Non-Hospitalized near-drowning cases	12,936	9,055	16,817	
	20,869,565	14,608,696	27,130,435	NTSB, 1993
Number of boats (in 1991)	48,000,000	33,600,000	62,400,000	NTSB, 1993
Population in boats (in 1991)				
Cost of Program (per unit)				
Fence of residential in-ground pools	$2,000	$1,000	$3,000	Wintemute, 1990
Covers of residential above-ground pools	$1,500	$1,000	$2,000	Market Rate, 2000
PFDs in one average boat	$81	$20	$159	Market Rate, 2000
Direct Medical Cost				
Drowning case	$2,454	$1,718	$3,190	Rice, 1989 (lifetime)
Hospitalized case	$18,176	$12,273	$23,629	Wintemute, 1990 (lifetime)
Severely impaired hospitalized cases	$131,989	$92,392	$171,586	Wintemute, 1990 (annual)
Non-Hospitalized case	$126	$88	$164	Miller, 1995 (lifetime)
Effectiveness of Intervention				
Fencing when child <5	70%	50%	90%	Wintemute, 1990
Fencing when child 5-17	10%	1%	50%	Expert Opinion
Fencing for 18 and older	10%	1%	50%	"
Covering above-ground pools for < 5	5%	1%	25%	"
Quality of Life Losses				
Drowning <45 years	1.00	0.70	1.00	Fryback et al. 1993
	0.92	0.64	1.00	Fryback et al. 1993
45-54 years	0.87	0.61	1.00	Fryback et al. 1993
55-64 years	0.84	0.59	1.00	Fryback et al. 1993
65-74 years	0.82	0.57	1.00	Fryback et al. 1993
> 75 years	0.85	0.81	0.90	Est. based on Fryback, 1993 & Expert Opinion
Hospitalized near-drowning* <45 years	0.78	0.74	0.82	"
	0.74	0.70	0.78	"
45-54 years	0.71	0.68	0.75	
55-64 years	0.70	0.66	0.73	
65-74 years				
> 75 years				
Non-hospitalized near-drowning cases	0.00	0.00	0.00	"

* age category-specific weights were used for some calculations

Table 2. Cost Effectiveness Base Case Results

	Net ***		Incremental ****		CE Ratio
	Cost	Effects	Costs	Effects	Average: Incremental
Residential pools:	(Million 1999 $)	(Thousand QALYs)	(Million 1999 $)	(Thousand QALYs)	(1999 $ per QALY gained)
Fencing* in homes with children <5	19,800	800	N/A	N/A	25,000:N/A
Fencing in homes with children <18	22,800	795	15,500	500	29,000:31,000
Fencing in all homes	47,800	200	40,000	Negative	255,000:N/A
Covering** in homes with children <5	15,000	3	N/A	N/A	5 Million:N/A
Boating: (PFDs)	0.9	202	N/A	N/A	4,000:N/A

* Fencing relates to above-ground pools; ** Covering relates to in-ground pools
*** Refers to the comparison of the proposed intervention with the do-nothing alternative;
****Refers to the incremental cost-effectiveness ratio of the proposed intervention with respect to the intervention listed above.