



Overview of Population Simulation Modeling and Results

Presentation to EPA Science Advisory
Board 812 Council Health Effects
Subcommittee

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Background and Motivation

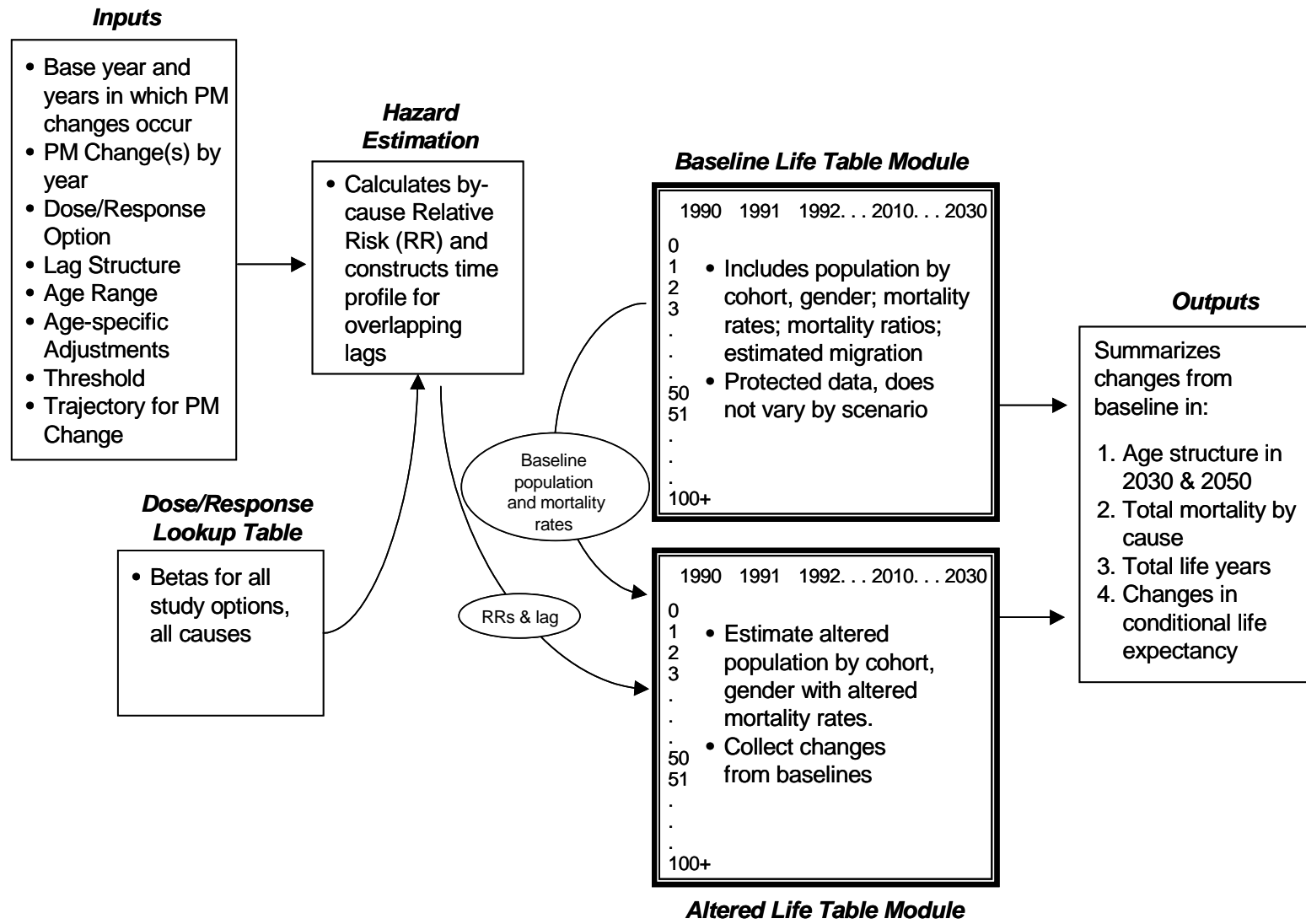
- BenMAP estimates mortality impact over time of a one year change in exposure to air pollution.
- Population basis for BenMAP mortality (and morbidity) estimates incorporates a county-level Census-based forecast, but is static.
- Some observers have asked, “Are we ‘saving’ the same individual multiple times?”
- Dynamic population simulation incorporates cumulative effect of air pollution hazard on population over time.
- Detailed life-table approach, flexibility in hazard level, concentration-response basis, overlapping cessation lags.
- Does not replace BenMAP, but life-years and life expectancy results complement BenMAP results.

Past SAB Advice

- Excerpt from HES advisory in 2004:

“The Subcommittee also notes that mortality and morbidity rates may change over time for at least two different reasons: either because of changes in underlying age-specific disease rates or because of changes in the age structure of the population. Therefore, there is a need for the Agency to carefully consider the potential impacts of changing age structure on mortality and morbidity.”

Conceptual framework of Popsim model



Key Results

- Age structure by scenario
- Total mortality (all cause deaths by cohort)
- Life-years lost
- Effect of air pollution hazard on period conditional and cohort conditional life expectancy

Estimated Life Years Gained As A Result Of CAAA

AGE COHORT	1990	1995	2000	2005	2010	2015	2020	2025	2030	2035	2040	2045
0 to 4	0	5	74	209	537	636	788	992	1,180	1,308	1,436	1,588
5 to 9	0	0	5	73	208	535	635	786	990	1,178	1,306	1,434
10 to 14	0	0	0	5	73	208	535	634	786	990	1,178	1,305
15 to 19	0	0	0	0	5	73	208	534	633	785	989	1,177
20 to 24	0	0	0	0	0	5	73	207	532	631	783	986
25 to 29	0	0	0	0	0	0	5	73	207	531	629	780
30 to 34	0	296	759	1,248	1,494	1,920	2,165	2,382	2,228	2,360	2,660	2,722
35 to 39	0	570	2,646	4,358	5,677	6,694	8,141	8,961	9,070	8,303	8,478	8,672
40 to 44	0	677	3,847	8,496	10,458	12,437	14,209	16,576	17,445	17,302	15,756	15,910
45 to 49	0	790	4,882	12,362	17,724	20,100	22,562	24,817	27,701	28,468	27,921	25,329
50 to 54	0	922	6,044	15,898	25,954	33,290	35,630	38,125	40,110	43,523	44,044	42,891
55 to 59	0	1,158	7,206	19,890	34,485	49,336	58,902	60,004	61,054	62,295	66,361	66,443
60 to 64	0	1,673	9,026	23,272	44,389	65,605	86,788	98,033	94,901	93,431	93,505	98,375
65 to 69	0	2,520	12,594	28,164	51,534	85,163	115,387	144,165	154,480	144,940	140,056	138,629
70 to 74	0	3,415	17,959	37,078	59,415	93,375	143,030	182,851	217,232	225,959	208,803	199,834
75 to 79	0	3,917	23,165	50,202	72,951	101,435	147,254	213,903	259,913	299,829	306,957	281,588
80 to 84	0	4,218	24,680	60,155	90,034	114,201	147,784	203,774	282,960	334,227	380,073	386,629
85 to 89	0	3,739	22,972	55,562	92,439	122,370	145,677	180,759	239,503	325,735	380,787	431,916
90 to 94	0	2,481	15,562	39,545	67,388	101,559	127,916	147,669	178,136	233,069	316,690	371,797
95 to 99	0	1,041	6,642	17,256	34,015	53,805	78,844	97,987	111,475	134,960	178,484	246,571
100+	0	311	1,788	4,950	11,669	22,832	38,384	59,753	80,526	100,320	127,277	171,954
Total Life Years Gained	0	27,734	159,852	378,724	620,451	885,580	1,174,917	1,482,985	1,781,063	2,060,144	2,304,174	2,496,530

Comparison of Life Years Gained Estimates: BenMAP and Popsim results

AGE COHORT		BENMAP RESULTS		POPULATION SIMULATION MODEL	
START AGE	END AGE	2010	2020	2010	2020
30	34	45,234	59,717	5,267	5,435
35	44	143,633	161,788	51,332	57,714
45	54	248,562	262,899	139,270	146,227
55	64	353,304	478,477	326,448	329,696
65	74	328,485	553,108	660,371	711,835
75	84	297,882	376,579	1,012,853	1,192,017
85	99	<u>134,954</u>	<u>185,015</u>	<u>1,284,263</u>	<u>1,539,837</u>
Total		1,552,054	2,077,583	3,479,803	3,982,762

Increase In Period Conditional Life Expectancy Attributable To CAAA

AGE COHORT	1990	1995	2000	2005	2010	2015	2020	2025	2030	2035	2040	2045
0	0.00	0.09	0.23	0.33	0.40	0.47	0.53	0.55	0.55	0.55	0.55	0.55
10	0.00	0.09	0.23	0.33	0.40	0.47	0.53	0.55	0.56	0.56	0.55	0.55
20	0.00	0.09	0.23	0.33	0.40	0.47	0.53	0.55	0.56	0.56	0.56	0.55
30	0.00	0.10	0.23	0.33	0.41	0.48	0.54	0.56	0.56	0.56	0.56	0.55
40	0.00	0.09	0.22	0.32	0.39	0.46	0.51	0.54	0.54	0.54	0.54	0.53
50	0.00	0.08	0.21	0.30	0.37	0.43	0.49	0.51	0.51	0.52	0.51	0.51
60	0.00	0.07	0.18	0.27	0.33	0.39	0.44	0.46	0.47	0.47	0.47	0.47
70	0.00	0.06	0.15	0.22	0.27	0.32	0.36	0.38	0.39	0.39	0.39	0.39
80	0.00	0.04	0.11	0.16	0.20	0.24	0.27	0.28	0.29	0.29	0.29	0.29
90	0.00	0.03	0.07	0.10	0.12	0.14	0.15	0.16	0.16	0.16	0.16	0.16
100+	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Suggestion for using these results

1. Estimates of deaths are not comparable to those from BenMAP; BenMAP mortality approach better reflects local-scale exposures and data AND is a better technical fit for addressing the key policy questions as currently defined by EPA in the conduct of this type of analysis.
2. Dynamic approach makes a large difference in life-years lost estimates, measuring cumulative effect. Is Popsim approach superior to BenMAP approach for this measure?
3. Life expectancy results provide new, relevant measure that as a technical matter provides an effective supplement to the BenMAP results. EPA has indicated an interest in exploring whether such supplemental results may be useful to a policy-making audience. Does the HES have advice in this regard?

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