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Memorandum

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TO: Allyson Tenney
Project Manager for Bedclothes
Directorate for Engineering Sciences

THROUGH : Russell Roegner, Ph.D.
Associate Executive Director
Directorate for Epidemiology

Kathleen Stralka
Division Director
Division of Hazard Analysis
Directorate for Epidemiology

FROM: David Miller
Division of Hazard Analysis
Directorate for Epidemiology

SUBJECT: Mattress and Bedding Fire Casualty Prevention Estimates – Updates using 2003 –
2004 NFIRS Data

Purpose:

This memorandum was prepared in support of the project on bedclothes flammability. It reports updates of mattress and bedding fire casualty estimates using the most current data from 2003 and 2004. Estimates previously reported in a 2006 briefing package¹ used estimated proportions of home fire casualties that were associated with mattresses and bedding from previous years and then applied them to 2003 and 2004 estimates of total home fire casualties. The methods and estimates reported in 2006 are described in the Background section. This section is followed by updated estimates and comparisons of the 2006 reported estimates with the updates.

¹ “Final Rule for the Flammability (Open Flame) of Mattress Sets”, January 2006.

Background:

For the January 2006 Briefing Package on Mattress Flammability, estimates of addressable deaths and injuries from fires where a mattress or bedding was the *item first ignited* were produced. Also, the annual number of deaths and injuries that would be prevented by the open flame standard for mattresses (“the standard”) was estimated². At that time, the most recent year for which National Fire Incident Reporting System (NFIRS) data were available was 2002. For this reason the NFIRS/NFPA³ estimates for 1999 - 2002 were used. To obtain estimates of addressable mattress and bedding fire deaths and injuries for 2003 and 2004 that were reported in the 2006 briefing package, the proportion of estimated NFIRS residential structure fire deaths and injuries respectively from 1999 - 2002 that were associated with mattress and bedding were calculated. Then these proportions were applied to the National Fire Protection Association (NFPA) annual survey estimates of residential structure fire deaths and injuries for 2003 and 2004 to obtain addressable mattress and bedding fire death and injury estimates for those years. See Appendix for more details of how CPSC staff obtained the estimates of both casualties and casualties to be prevented.

An analysis of mattress and bedding in-depth investigations (IDIs) from 1999 - 2004 led to estimates of the proportion of deaths and injuries that would be prevented by the standard broken down by *heat source* and *age of victim*. These estimates were given in terms of a range (e.g., 75% - 85% of a certain group of casualties will be prevented). These ranges are not confidence intervals. Estimates, also in a range, of the proportion of addressable mattress and bedding fire deaths that would become injuries (instead of deaths) as a result of the standard also resulted from the IDI analysis. These estimates were also broken down by *heat source* and *age of victim*. These proportions (by *heat source* and *age of victim*) were applied to the NFIRS/NFPA annual average estimates of addressable mattress and bedding fire deaths and injuries from 1999 - 2002⁴. From this, a range of total deaths and injuries that would be prevented was estimated. These estimates of the total number of casualties to be prevented were then divided by the NFIRS/NFPA 1999 - 2002 average totals for deaths and injuries to arrive at a range of percentage of deaths and injuries to be prevented by the standard. These estimates were 69% - 78% of deaths and 73% - 84% of injuries. Last, these percentages were multiplied by the total annual average estimates from 2000 - 2004 (with the 2003 and 2004 estimates derived without the NFIRS data) to obtain estimates of the number of deaths and injuries to be prevented by the standard. These estimates were 240 – 270 deaths and 1,150 – 1,330 injuries to be prevented by the standard at full compliance⁵.

Update:

NFIRS data is now available through 2004. This data can be used to estimate mattress and bedding fire deaths and injuries for 2003 and 2004 using the national estimates approach. To estimate the number of deaths and injuries to be prevented by the standard, the same proportions of deaths prevented, injuries prevented, and deaths that would become non-fatal injuries were applied (by *heat source* and *age of victim*). Instead of using the estimates of annual average mattress and bedding deaths and injuries by heat

² “Updated Estimates of Residential Fire Losses Involving Mattresses and Bedding”, p. 10, L. Smith, D. Miller, Directorate for Epidemiology, CPSC, December 2005.

³ The methods CPSC staff uses to produce these estimates are detailed in “Updated Estimates of Residential Fire Losses Involving Mattresses and Bedding”, L. Smith, D. Miller, Directorate for Epidemiology, CPSC, December 2005.

⁴ Although the IDI analysis included IDIs through 2004, the proportions were applied to the estimates only through 2002 because 2002 was the most recent year of estimates available at the time.

⁵ The estimates of casualties prevented are estimates for when all mattresses are compliant but that will happen gradually.

source and age from the 1999 - 2002 estimates, CPSC staff is now using 2002 - 2004 estimates. In doing this, the overall proportion of deaths estimated to be prevented by the standard remains unchanged. However, because the estimated number of deaths that will become injuries (by *heat source* and *age of victim*) changes, the estimated overall proportion of injuries that will be prevented by the standard changes. The proportion of deaths prevented by the standard remains 69% - 78% but the proportion of injuries prevented by the standard drops to 71% - 83%. The estimated number of deaths and injuries to be prevented by the standard at full compliance is now **240 - 270 deaths and 940 - 1,090 injuries**.

Estimates:

The following table gives the previous estimates and the updated estimates for both addressable⁶ mattress and bedding fire losses and casualties to be prevented by the standard. The previous estimate uses NFIRS/NFPA estimates for 1999 - 2002 along with the proportional estimates for 2003 and 2004. The updated estimate is based on NFIRS/NFPA estimates for 2002 - 2004.

Old and New Estimates of Mattress and Bedding Fire Casualties and How Many will be Prevented

	Previous Estimate	Updated Estimate
Annual Average Mattress and Bedding Fire Deaths	346 ^{7,8}	341
Annual Average Mattress and Bedding Fire Injuries	1,575	1,309
Proportion of Mattress and Bedding Fire Deaths to be Prevented by the Standard	69% - 78%	69% - 78%
Proportion of Mattress and Bedding Fire Injuries to be Prevented by the Standard	73% - 84%	71% - 83%
Estimated Number of Mattress and Bedding Fire Deaths to be Prevented Annually at Full Compliance	239 - 270	237 - 267
Estimated Number of Mattress and Bedding Fire Injuries to be Prevented Annually at Full Compliance	1,153 - 1,330	935 - 1,090

⁶ The standard only targets certain types of mattress and bedding fires that CPSC staff believe it can address. This portion of the mattress and bedding fires and their associated losses are called 'addressable'.

⁷ 2000 - 2004 average with 2003 and 2004 estimates obtained by applying 1999 - 2002 NFIRS proportions of residential structure fire casualties (deaths and injuries respectively) that have mattress and bedding as the item first ignited to the NFPA estimates of residential structure fire deaths and injuries for 2003 and 2004.

⁸ All death and injury estimates are rounded to the unit's place.

Appendix

Methodology for Obtaining Fire Loss Estimates:

For the estimates for the January 2006 Briefing Package, the NFIRS data was only available through 2002. The death and injury estimates from 1999 - 2002 (broken down by *heat source* and *victim age*) along with staff's analysis of IDIs, were used to develop estimates of overall proportions of deaths and injuries to be prevented by the standard. These proportions were applied to annual average addressable death and injury estimates for mattresses and bedding for the period of 2000 - 2004. The estimates for 2003 and 2004 were obtained as follows:

Step 1:

Estimate the proportion for 1999 through 2002 of residential structure fire deaths and injuries that are associated with mattresses and bedding.

Estimated 1999 mattress and bedding fire deaths = 313

Estimated 1999 residential structure fire deaths = 2,920

Estimated proportion of 1999 residential structure fires that were associated with mattress and bedding = $313/2,920 = 0.1072$

Estimate of 2000 proportion = $359/3,445 = 0.1043$

Estimate of 2001 proportion = $275/3,140 = 0.0876$

Estimate of 2002 proportion = $383/2,625 = 0.1421$

Estimated average proportion of residential structure fire deaths for 1999 - 2002 = 0.1103

Therefore estimated proportion of residential structure fire deaths that are mattress and bedding fire deaths = 11.03%

Following the same procedure for injuries, gives:

Estimated average proportion of residential structure fire injuries that are associated with mattresses and bedding = 0.1046

Therefore estimated proportion of residential structure fire injuries that are mattress and bedding fire injuries = 10.46%

Step 2:

Apply the estimated proportion of fire deaths and injuries to 2003 and 2004 NFPA Survey estimates of residential structure fire deaths and injuries.

2003 NFPA estimate of total residential structure fire deaths = 3,165; 2003 injuries estimate = 14,075

2004 NFPA estimate of total residential structure fire deaths = 3,225; 2004 injuries estimate = 14,175

Multiplying the proportions by these estimates gives:

Estimate of **2003** mattress and bedding fire deaths = $3,165 \times 0.1103 = \mathbf{349.06}$; 2003 injuries = $14,075 \times 0.1046 = \mathbf{1,472.26}$

Estimate of **2004** mattress and bedding fire deaths = $3,225 \times 0.1103 = \mathbf{355.68}$; 2004 injuries = $14,175 \times 0.1046 = \mathbf{1,482.72}$

Updated Fire Loss Estimates:

The 2003 and 2004 estimates that were produced using the estimated average proportions from 1999 to 2002 are replaced with estimates that use the NFIRS data for 2003 and 2004 which are now available. Those estimates are:

Estimate of **2003** mattress and bedding fire deaths = **379.68⁹**; 2003 injuries = **1,345.77**
Estimate of **2004** mattress and bedding fire deaths = **241.98**; 2004 injuries = **1,372.31**

In the updated estimates, CPSC staff applies annual averages from 2002 - 2004 instead of 2000 - 2004. The 2002 - 2004 estimated annual averages of addressable mattress and bedding fire deaths and injuries are:

341.27 deaths and **1,309.48** injuries

Victim age was included in the raking for producing these estimates so the estimates can be broken down by age categories. This is useful in estimating the casualties to be prevented by the standard.

Estimated Casualties to be Prevented by the Standard:

Deaths:

The death estimates in the table below are the 2002 - 2004 annual average addressable fire loss death estimates where a mattress or bedding was the item first ignited. They are broken down by victim age and heat source. These estimates are derived using NFIRS data and the NFPA survey just as the 1999 - 2002 estimates were derived.

Estimated Annual Deaths

Victim Age	Smoking	Small Open Flame	Other
Ages <5	10.29	21.45	23.90
Ages 5 – 14	2.36	18.57	6.63
Ages 15 – 64	111.94	45.26	17.32
Ages 65+	54.31	20.88	8.36

The IDI analysis done for the January 2006 Briefing Package resulted in a range of estimated probabilities for deaths prevented by heat source and victim age. These estimated probabilities are for deaths that would be deaths with pre-standard mattresses but would be either non-fatal injuries or no injury at all with post-standard mattresses. These ranges are not confidence intervals. Below are the estimated proportions:

Proportion of Deaths to be Prevented by the Standard

Victim Age	Smoking	Small Open Flame	Other
Ages <5	80.0% - 90.0%	76.8% - 86.7%	76.3% - 86.3%
Ages 5 – 14	80.0% - 90.0%	83.3% - 91.2%	84.4% - 92.2%
Ages 15 – 64	67.7% - 76.4%	72.4% - 81.2%	63.3% - 72.2%
Ages 65+	63.2% - 72.3%	56.4% - 63.6%	66.3% - 74.6%

⁹ These estimates were obtained, as were the 1999 - 2002 estimates, using NFIRS data.

Applying (multiplying) these ranges of probabilities to the 2002 - 2004 annual average estimates of mattress and bedding fire deaths results in a range of estimated annual deaths to be prevented for these categories:

Estimated Deaths to be Prevented by the Standard

Victim Age	Smoking	Small Open Flame	Other
Ages <5	8.23 - 9.26	16.47 - 18.59	18.24 - 20.63
Ages 5 – 14	1.89 - 2.12	15.47 - 17.02	5.60 - 6.11
Ages 15 – 64	75.74 - 85.53	32.75 - 36.74	10.97 - 12.51
Ages 65+	34.31 - 39.25	11.78 - 13.27	5.54 - 6.23

Adding the cells to get the totals for both the estimated number of deaths and the estimated range of deaths to be prevented results in:

Estimated Annual Deaths

Victim Age	Total	Smoking	Small Open Flame	Other
Total	341	179	106	56
Ages <5	56	10	21	24
Ages 5 – 14	28	2	19	7
Ages 15 – 64	175	112	45	17
Ages 65+	84	54	21	8

Note: Detail may not add to total due to rounding.

Estimated Deaths to be Prevented by the Standard

Victim Age	Total	Smoking	Small Open Flame	Other
Total	237 - 267	121 - 136	76 - 86	40 - 45
Ages <5	43 - 48	8 - 9	16 - 19	18 - 21
Ages 5 – 14	23 - 25	2	15 - 17	6
Ages 15 – 64	119 - 135	76 - 86	33 - 37	11 - 13
Ages 65+	52 - 59	34 - 39	12 - 13	6

Note: Detail may not add to total due to rounding.

Finally, dividing the range numbers in the prevented table by the numbers in the corresponding cell of the ‘Estimated Annual Deaths’ table results in a table of the ranges of proportions prevented (including for the totals):

Estimated Proportion of Deaths to be Prevented by the Standard

Victim Age	Total	Smoking	Small Open Flame	Other
Total	69.4% - 78.3%	67.2% - 76.1%	72.0% - 80.7%	71.8% - 80.9%
Ages <5	77.2% - 87.1%	80.0% - 90.0%	76.8% - 86.7%	76.3% - 86.3%
Ages 5 – 14	83.3% - 91.7%	80.0% - 90.0%	83.3% - 91.2%	84.4% - 92.2%
Ages 15 – 64	68.4% - 77.2%	67.7% - 76.4%	72.4% - 81.2%	63.3% - 72.2%
Ages 65+	61.8% - 70.3%	63.2% - 72.3%	56.4% - 63.6%	66.3% - 74.6%

Note: Proportions based on computations involving unrounded numbers.

Injuries:

There are two components to the estimates of injuries to be prevented by the standard. The first is the estimates of injuries to be prevented by the standard that are made just as in the deaths above. These are estimated proportions of injuries to be prevented by the standard that were produced from the IDI

analysis. These estimated proportions are applied to the estimated number of injuries to obtain an estimated range of injuries prevented. The second component is that some of the deaths prevented by the standard will become non-fatal injuries instead of deaths. These injuries are non-fatal injuries that will occur post-standard that would not have counted as injuries pre-standard because they would be deaths. Therefore, these injuries are subtracted from the injuries prevented numbers.

Step 1: Estimated number of injuries to be prevented by the standard without accounting for deaths that will become injuries:

Estimated Annual Injuries

Victim Age	Total	Smoking	Small Open Flame	Other
Total	1,309	390	717	202
Ages <5	141	19	95	26
Ages 5 – 14	143	10	114	19
Ages 15 – 64	899	304	470	126
Ages 65+	126	57	38	31

Note: Detail may not add to total due to rounding.

The IDI analysis resulted in estimated proportions of injuries occurring before the standard that would not occur with post-standard mattresses. Below are these estimated proportions:

Estimated Proportion of Injuries to be Prevented by the Standard

Victim Age	Smoking	Small Open Flame	Other
Ages <5	80.0% - 90.0%	75% - 84.4%	69.5% - 79.5%
Ages 5 – 14	80.0% - 90.0%	81.5% - 90.2%	82.2% - 91.3%
Ages 15 – 64	77.2% - 86.7%	79.8% - 89.7%	83.0% - 91.5%
Ages 65+	80.0% - 90.0%	68.3% - 78.3%	84.0% - 92.0%

Applying these ranges of probabilities to the annual average estimates of mattress and bedding fire injuries results in a range of estimated annual injuries to be prevented for these categories:

Estimated Injuries to be Prevented¹⁰ by the Standard (with Totals)

Victim Age	Total	Smoking	Small Open Flame	Other
Total	1,033 - 1,157	304 - 341	565 - 634	164 - 182
Ages <5	105 - 119	15 - 17	72 - 81	18 - 21
Ages 5 – 14	116 - 129	8 - 9	93 - 103	16 - 17
Ages 15 – 64	714 - 800	235 - 263	375 - 421	104 - 115
Ages 65+	98 - 110	46 - 52	26 - 30	26 - 29

Note: Detail may not add to total due to rounding.

Step 2: Estimated number of injuries that will occur as a result of deaths prevented by the standard:

As mentioned before, some of the deaths that will be prevented by the standard will become non-fatal injuries instead of deaths. When estimating the number of injuries that will be reduced by the standard it is important to take this into account as an offset to the injuries prevented estimates given above. The estimated range of probabilities that a pre-standard death would be a post-standard injury come from the IDI analysis and are given in the following table:

¹⁰ These estimates do not take into account yet the injuries that result from the deaths prevented by the standard.

Estimated Proportion of Deaths that will Become Injuries because of the Standard

Victim Age	Smoking	Small Open Flame	Other
Ages <5	10.0% - 20.0%	32.6% - 42.4%	21.1% - 31.1%
Ages 5 – 14	10.0% - 20.0%	8.9% - 17.8%	10.0% - 20.0%
Ages 15 – 64	18.2% - 27.1%	17.1% - 25.9%	16.7% - 25.6%
Ages 65+	24.8% - 33.9%	23.6% - 32.1%	23.8% - 32.9%

The ranges are applied to the mattress and bedding annual fire **death** estimates from 2002 - 2004.

Estimated Annual Deaths

Victim Age	Smoking	Small Open Flame	Other
Ages <5	10	21	24
Ages 5 – 14	2	19	7
Ages 15 – 64	112	45	17
Ages 65+	54	21	8

Note: Detail may not add to total due to rounding.

Multiply estimated proportion ranges to death estimates to get estimates of injuries:

Estimated Injuries Resulting from Deaths Prevented by the Standard (including totals)

Victim Age	Total	Smoking	Small Open Flame	Other
Total	67 - 98	35 - 51	21 - 31	11 - 16
Ages <5	13 - 19	1 - 2	7 - 9	5 - 7
Ages 5 – 14	3 - 5	0	2 - 3	1
Ages 15 – 64	31 - 46	20 - 30	8 - 12	3 - 4
Ages 65+	20 - 28	13 - 18	5 - 7	2 - 3

Note: Detail may not add to total due to rounding.

Step 3: Subtract the estimated injuries resulting from deaths prevented from the estimated injuries prevented in Step 1:

When subtracting, it makes sense to subtract the high end of the range of injuries resulting from deaths prevented from the low end of the range of injuries prevented from Step 1. The results are the net injuries reduced by the standard estimates given below:

Net Estimated Number of Injuries Reduced by the Standard

Victim Age	Total	Smoking	Small Open Flame	Other
Total	935 - 1,090	252 - 306	535 - 613	149 - 171
Ages <5	87 - 106	13 - 16	62 - 74	11 - 16
Ages 5 – 14	111 - 127	7 - 8	90 - 101	14 - 17
Ages 15 – 64	667 - 769	204 - 243	363 - 413	100 - 112
Ages 65+	70 - 90	27 - 38	19 - 25	23 - 27

Note: Detail may not add to total due to rounding.

Dividing these ranges by the annual injury estimates gives the estimated range of proportions of injuries prevented:

Net Estimated Proportions of Injuries Reduced by the Standard

Victim Age	Total	Smoking	Small Open Flame	Other
Total	71.4% - 83.3%	64.7% - 78.4%	74.5% - 85.5%	73.4% - 84.8%
Ages <5	61.5% - 75.0%	69.2% - 84.6%	65.5% - 77.1%	41.3% - 60.4%
Ages 5 – 14	77.9% - 88.5%	75.1% - 87.5%	78.6% - 88.7%	75.2% - 87.8%
Ages 15 – 64	74.2% - 85.5%	67.2% - 80.0%	77.3% - 88.0%	79.4% - 89.2%
Ages 65+	55.5% - 70.9%	47.9% - 66.5%	50.6% - 65.3%	75.2% - 85.6%

Note: Proportions based on computations involving unrounded numbers.

In summary, an estimated **69% - 78%** of mattress and bedding addressable fire deaths will be prevented by the standard at full compliance. This is an estimated **237 - 267** fire deaths. There is to be an estimated reduction of addressable mattress and bedding fire injuries of **71% - 83%**. This is an estimated **935 - 1,090** injuries.