Appendix A. Supplementary Data

Initiatives to Reduce Lead from Electronic Devices: Evidence of Success from the Toxicity Characteristic Leaching Procedure

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Supplementary Data

The supplementary information section contains:

Average component weight percent composition for all devices

Mercury analysis for select samples of each device

Analysis of variance for various products manufactured during different time periods

Results of the TCLP or modified large-scale TCLP for lead, cadmium, chromium, copper, iron, antimony, and zinc from 9 electronic devices manufactured during different time periods,

Table A.1 Comparing previous study in 2004 electronic device composition by component weight percentage (average) for devices manufactured 2000-2005, 2006-2007, and after 2008

Devices	Cell Phones	Remote Controls	Computer Mice	Smoke Detectors	Keyboards	Personal Computers (PCs)	Laptops	Computer Monitor Flat Screens	Printers
Original Study in 2004 (Manufactured 1987-2003)									
Plastic	45	82	52	65	55	8	38	24	44
Ferrous Metal	8	1	5	15	27	68	7	25	43
Non-ferrous Metals	3	0	0	2	0	5	11	9	5
Printed Wire Boards (PWBs)	40	17	11	17	11	16	16	10	7
Wires	0	0	32	1	7	3	1	4	1
Other	4	0	0	0	0	0	27	28	0
Average Manufactured (2000-2005)									
Plastic	50	81	50	76	87	15	47	16	41
Ferrous Metal	6	0	15	7	1	61	9	34	47
Non-ferrous Metals	10	0	0	0	0	7	14	11	0
Printed Wire Boards (PWBs)	23	19	7	16	1	13	17	7	8
Wires	1	0	28	1	11	4	2	20	2
Other	10	0	0	0	0	0	11	12	2

Table A.1 Comparing previous study in 2004 electronic device composition by component weight percentage (average) for devices manufactured 2000-2005, 2006-2007, and after 2008 (Cont'd)

Devices	Cell Phones	Remote Controls	Computer Mice	Smoke Detectors	Keyboards	Personal Computers (PCs)	Laptops	Computer Monitor Flat Screens	Printers
Average Manufactured (2006-2007)									
Plastic	50	80	49	64	69	11	33	58	60
Ferrous Metal	10	1	6	17	25	65	9	26	34
Non-ferrous Metals	5	0	0	2	0	8	24	8	0
Printed Wire Boards (PWBs)	19	19	11	13	1	13	16	7	4
Wires	1	0	33	4	5	3	3	1	1
Other	15	0	0	0	0	0	16	0	1
Average Manufactured (after 2008)									
Plastic	44	81	64	72	88	12	44	50	51
Ferrous Metal	14	1	0	12	1	62	10	36	39
Non-ferrous Metals	8	0	0	1	0	8	12	2	1
Printed Wire Boards (PWBs)	21	18	14	15	1	14	15	7	4
Wires	1	0	22	0	10	3	1	0	1
Other	12	0	0	0	0	0	18	5	4

Table A.2 Test results for mercury in every electronic device

Electronic devices	Average mercury concentration (mg/L)
Cell phones (n=3)	< 0.002
Keyboards (n=3)	< 0.002
Laptop computers (n=3)	< 0.002
Computer monitors without fluorescent lamp (n=3)	< 0.002
Computer mice (n=3)	< 0.002
Personal Computers (PCs) (n=3)	< 0.002
Printers (n=3)	< 0.002
Remote controls (n=3)	< 0.002
Smoke detectors (n=3)	< 0.002

Table A.3 Summarized ANOVA (analysis of variances) and t-test (pair test) results. Average TCLP lead concentrations from 9 electronic devices were compared among each manufactured period and to the original study

Devices/Comparing periods	Results
Cell phones	
Original study vs 2000-2005	Significant difference
2000-2005 vs 2006-2007	Significant difference
2006-2007 vs 2008+	Insignificant difference
Keyboards	
Original study vs 2000-2005	Insignificant difference
2000-2005 vs 2006-2007	Insignificant difference
2006-2007 vs 2008+	Insignificant difference
Laptop computers	
Original study vs 2000-2005	Significant difference
2000-2005 vs 2006-2007	Significant difference
2006-2007 vs 2008+	Insignificant difference
Monitors	
Original study vs 2000-2005	Significant difference
2000-2005 vs 2006-2007	Insignificant difference
2006-2007 vs 2008+	Significant difference
Computer mice	
Original study vs 2000-2005	Insignificant difference
2000-2005 vs 2006-2007	Insignificant difference
2006-2007 vs 2008+	Significant difference
PCs	
Original study vs 2000-2005	Significant difference
2000-2005 vs 2006-2007	Insignificant difference
2006-2007 vs 2008+	Insignificant difference
Printers	
Original study vs 2000-2005	Significant difference
2000-2005 vs 2006-2007	Insignificant difference
2006-2007 vs 2008+	Insignificant difference
Remote controls	
Original study vs 2000-2005	Insignificant difference
2000-2005 vs 2006-2007	Significant difference
2006-2007 vs 2008+	Insignificant difference
Smoke detectors	
Original study vs 2000-2005	Insignificant difference
2000-2005 vs 2006-2007	Insignificant difference
2006-2007 vs 2008+	Insignificant difference

Remark: A normal distribution was assumed and the hypothesis was rejected when the p-value < alpha (0.05)

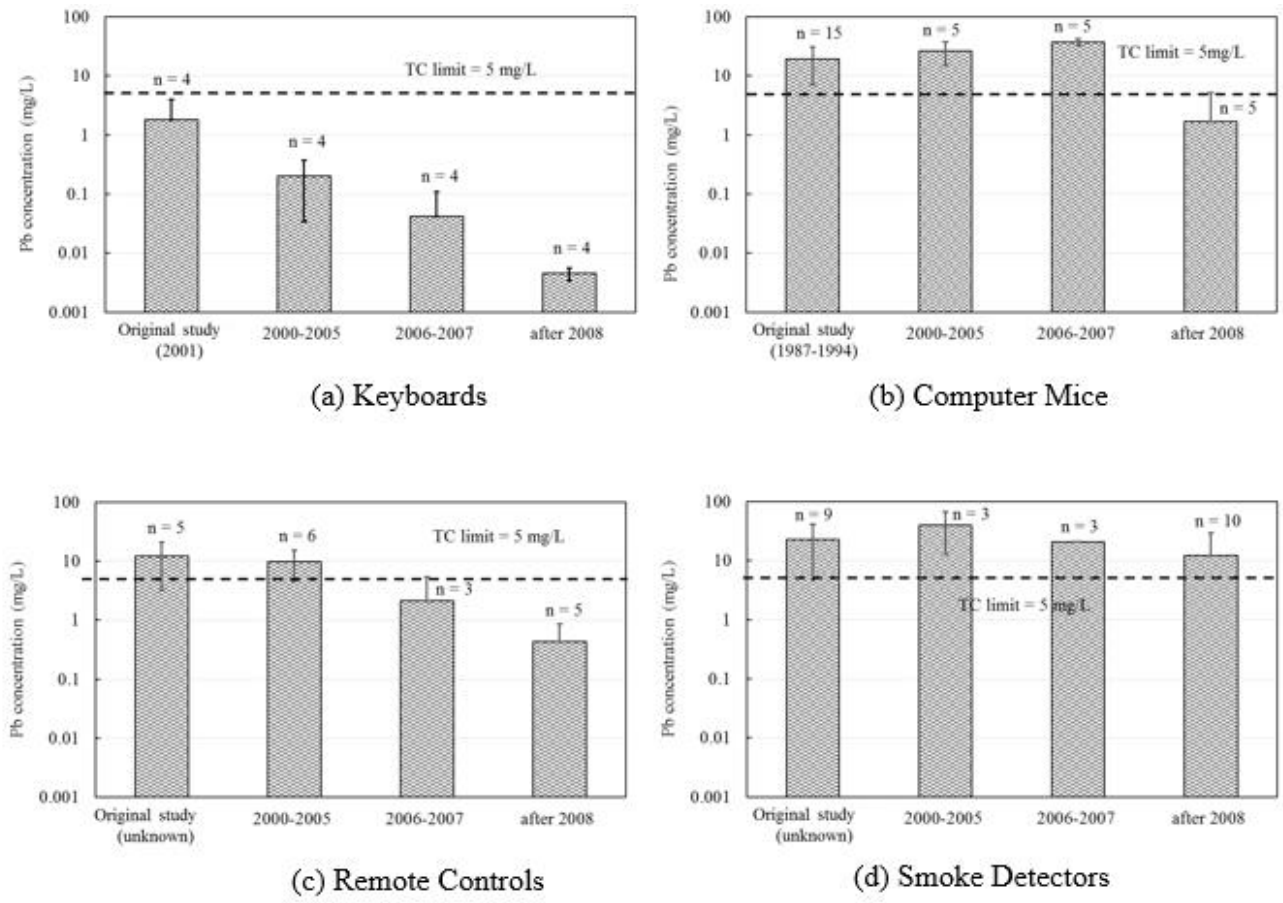

Fig. A.1 TCLP lead concentrations for a smaller electronic devices manufactured during different time periods: (a) keyboards, (b) computer mice, (c) remote controls, and (d) smoke detectors. Error bars represent standard deviations.

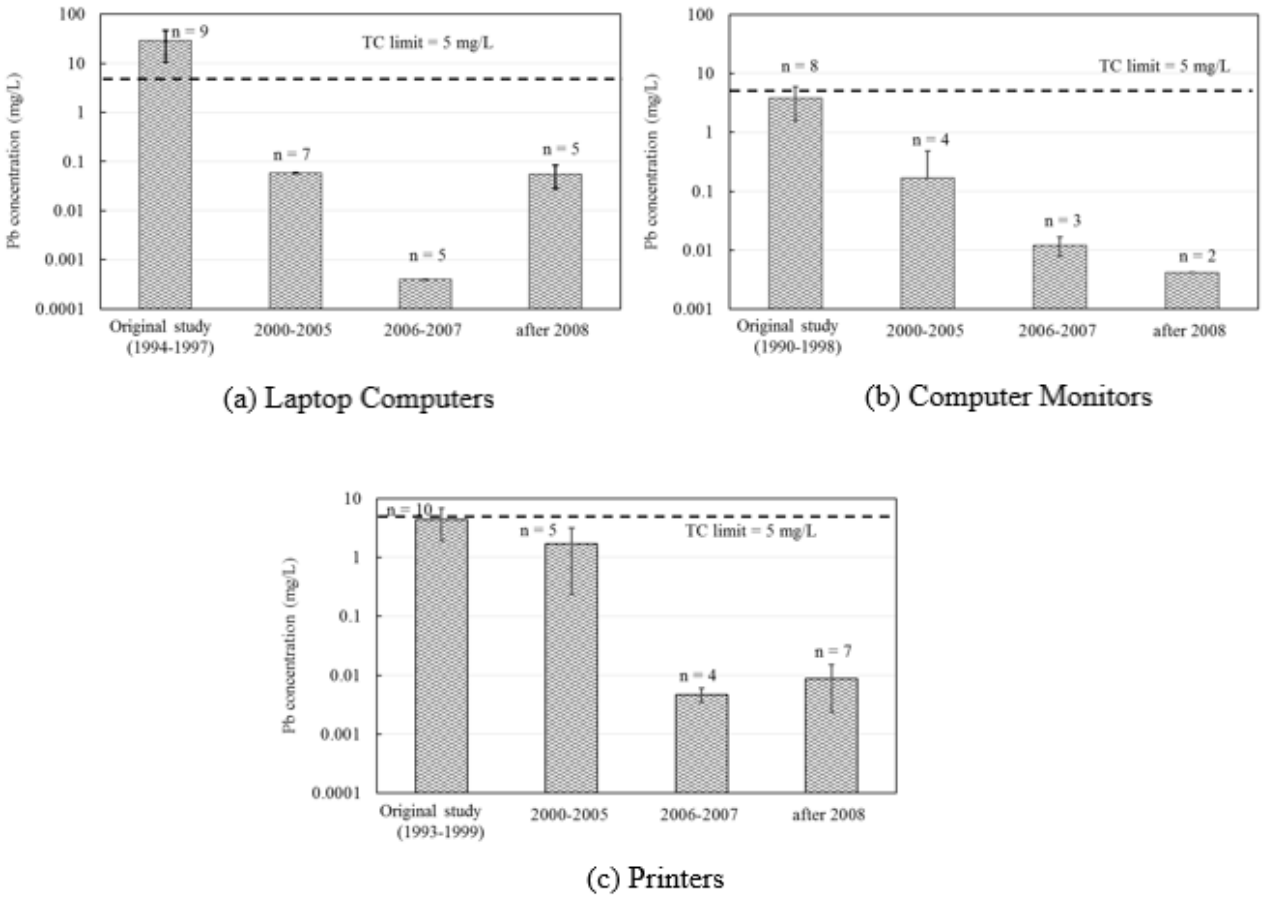

Fig. A.2 TCLP lead concentrations for larger electronic devices manufactured during different time periods: (a) laptop computers, (b) computer monitors, and (c) printers. Error bars represent standard deviations.

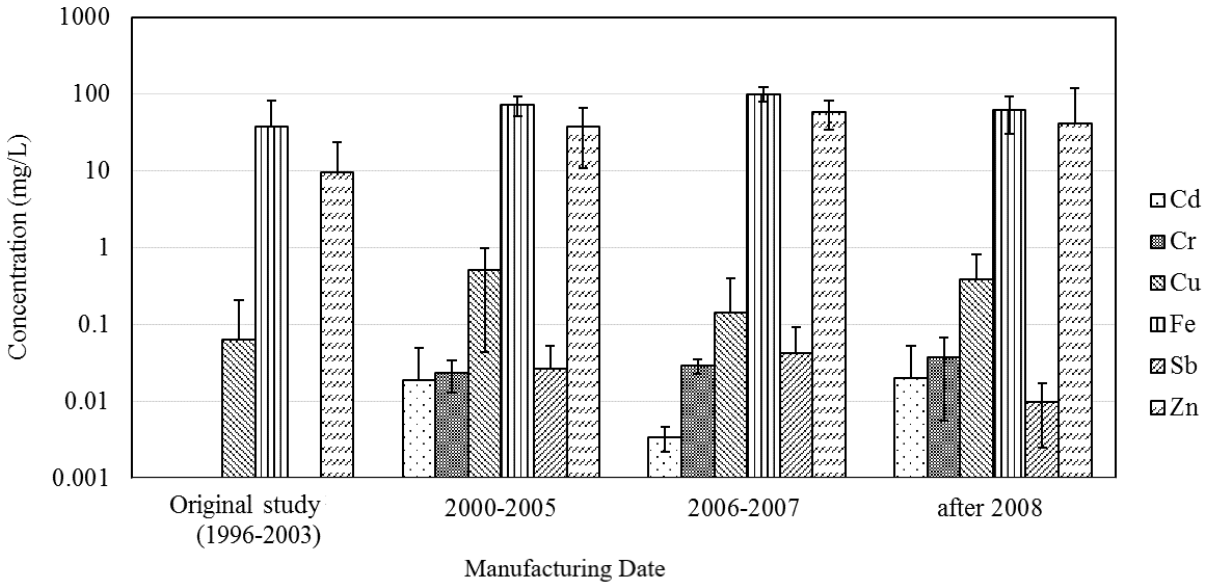

Fig. A.3 TCLP concentrations for other metals (Cd, Cr, Cu, Fe, Sb, and Zn) for cell phones manufactured during different time periods. Error bars represent standard deviations.

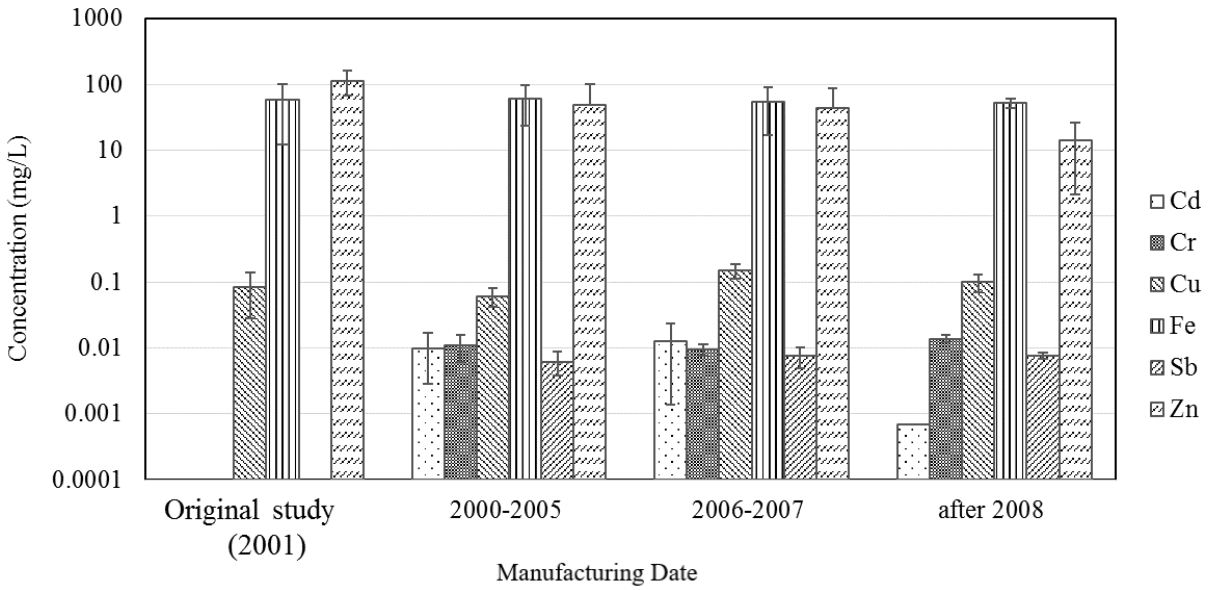

Fig. A.4 TCLP concentrations for other metals (Cd, Cr, Cu, Fe, Sb, and Zn) for keyboards manufactured during different time periods. Error bars represent standard deviations.

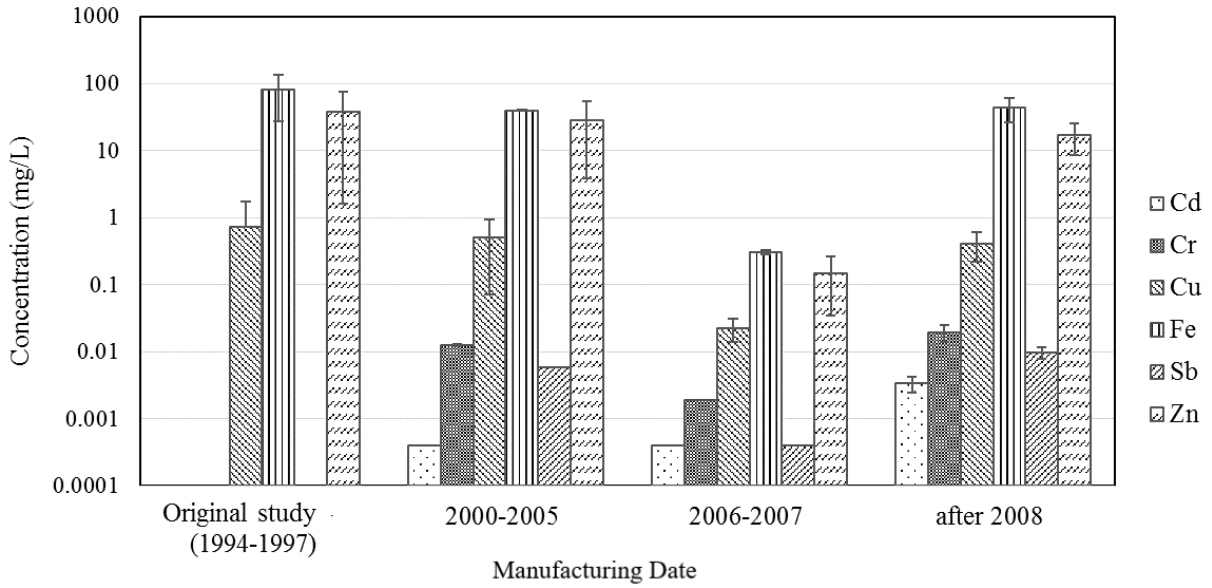

Fig. A.5 TCLP concentrations for other metals (Cd, Cr, Cu, Fe, Sb, and Zn) for laptop computers manufactured during different time periods. Error bars represent standard deviations.

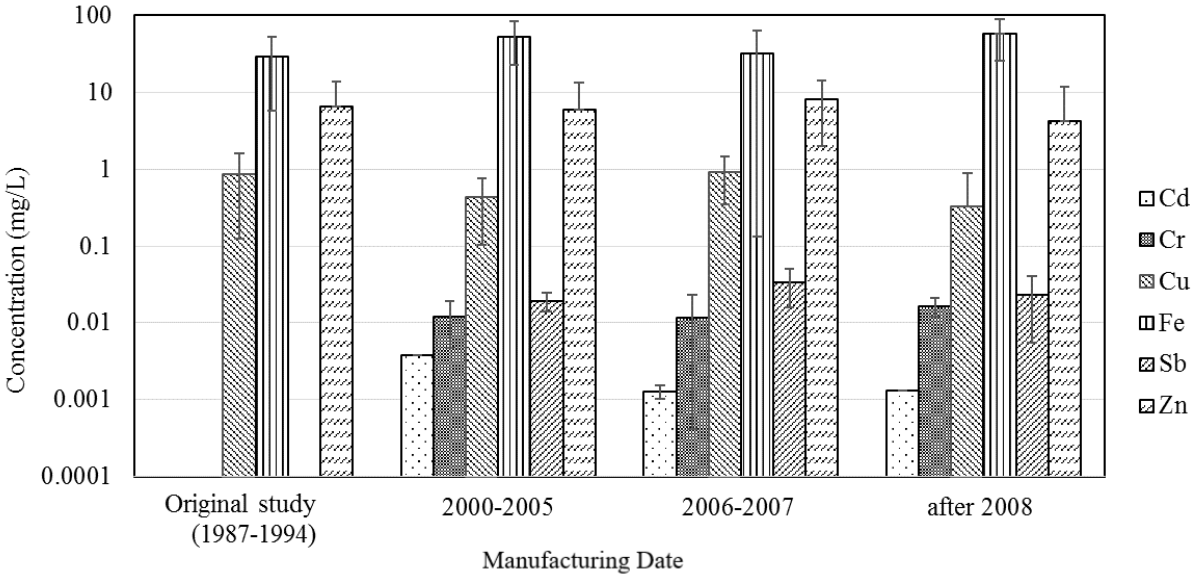

Fig. A.6 TCLP concentrations for other metals (Cd, Cr, Cu, Fe, Sb, and Zn) for computer mice manufactured during different time periods. Error bars represent standard deviations.

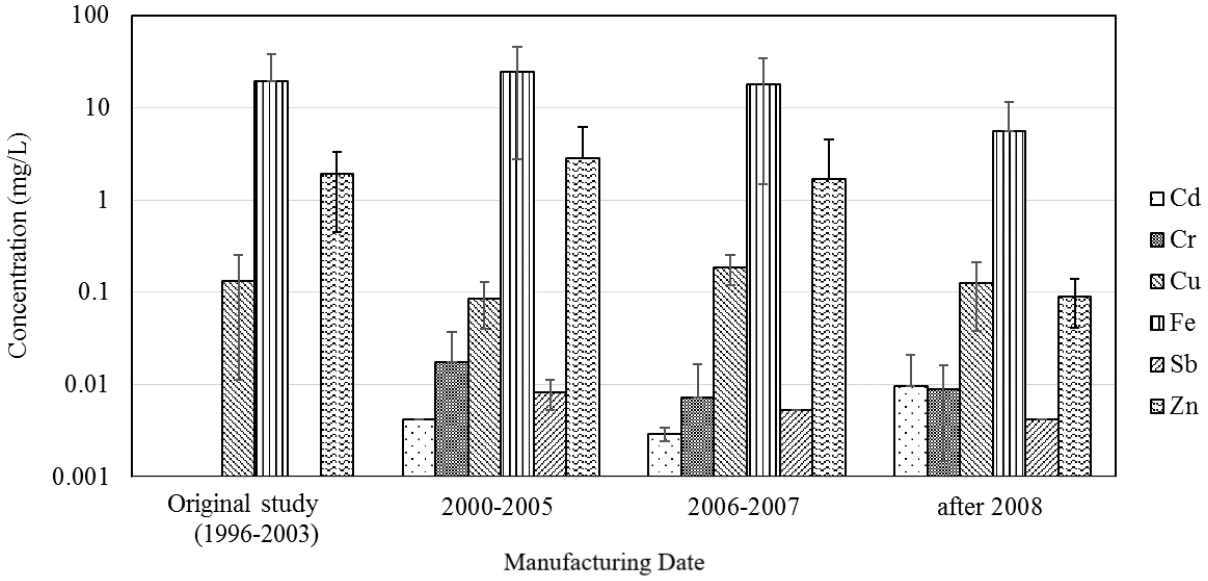

Fig. A.7 TCLP concentrations for other metals (Cd, Cr, Cu, Fe, Sb, and Zn) for remote controls manufactured during different time periods. Error bars represent standard deviations.

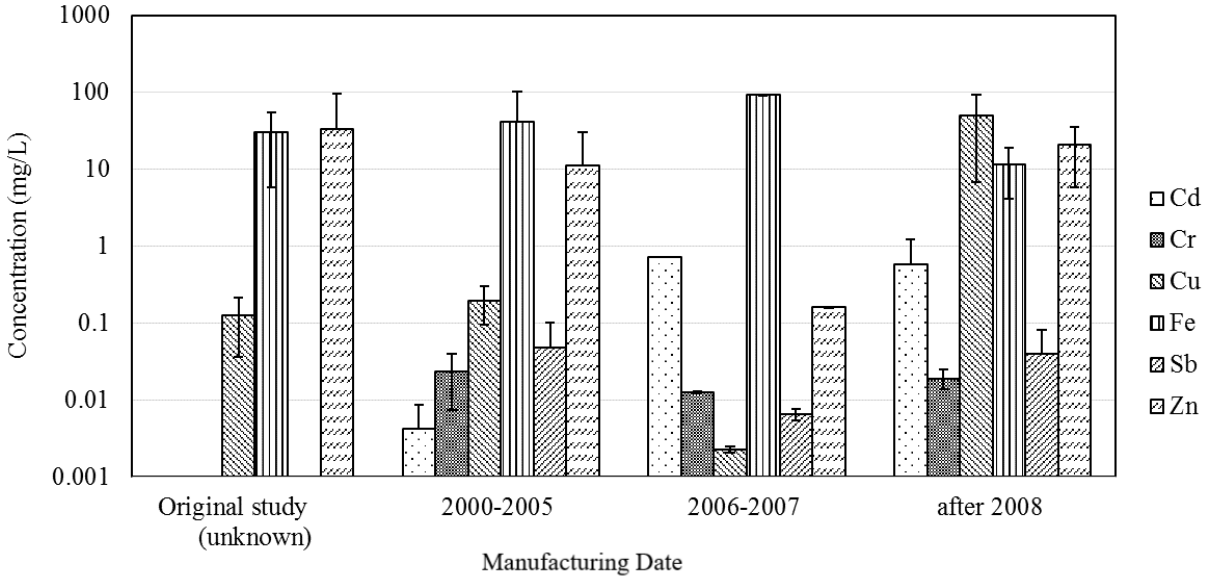

Fig. A.8 TCLP concentrations for other metals (Cd, Cr, Cu, Fe, Sb, and Zn) for smoke detectors manufactured during different time periods. Error bars represent standard deviations.

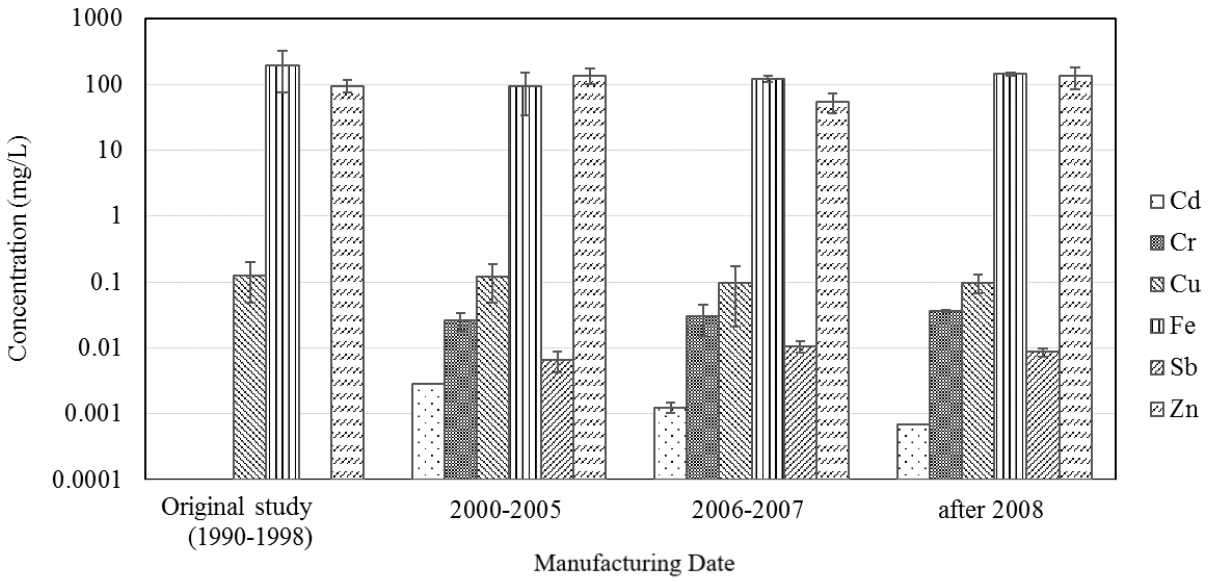

Fig. A.9 TCLP concentrations for other metals (Cd, Cr, Cu, Fe, Sb, and Zn) for computer monitors manufactured during different time periods. Error bars represent standard deviations.

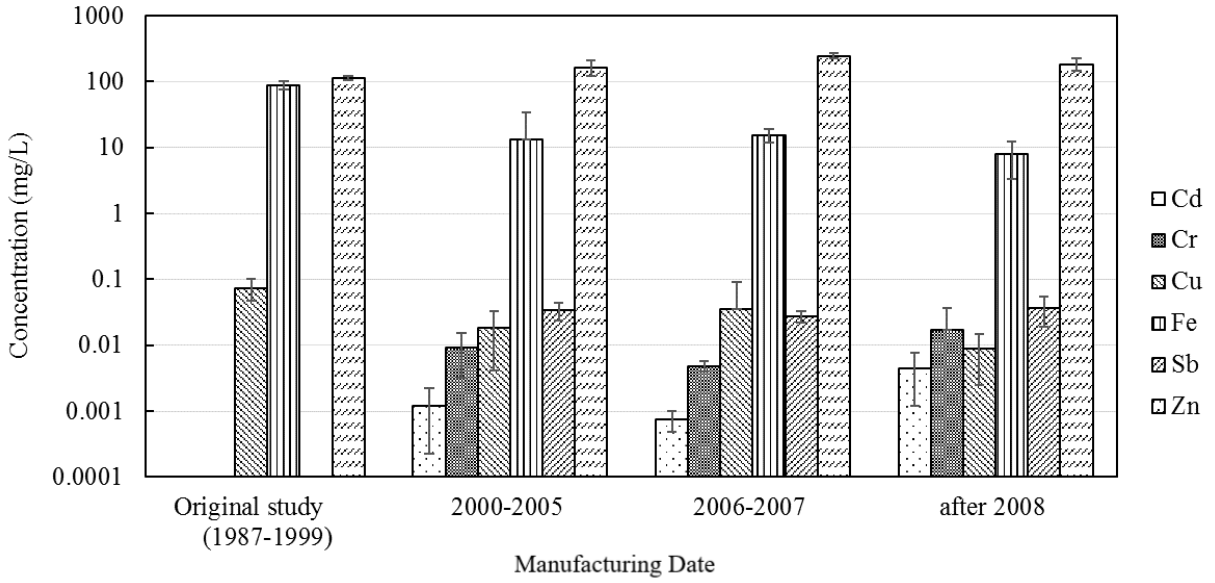

Fig. A.10 TCLP concentrations for other metals (Cd, Cr, Cu, Fe, Sb, and Zn) for PCs manufactured during different time periods. Error bars represent standard deviations.

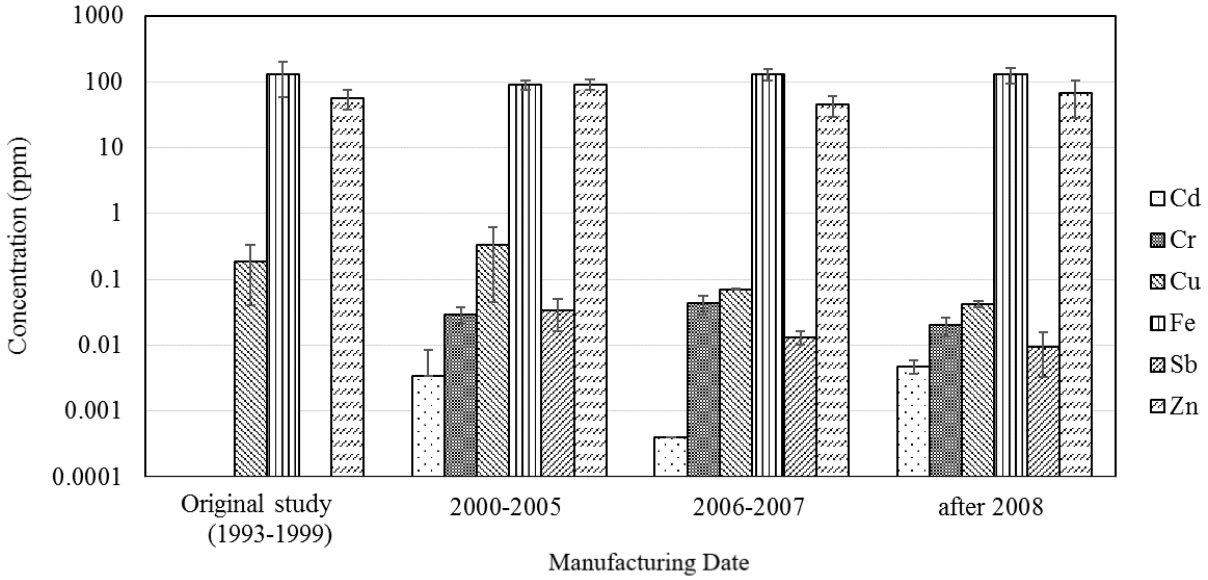

Fig. A.11 TCLP concentrations for other metals (Cd, Cr, Cu, Fe, Sb, and Zn) for printers manufactured during different time periods. Error bars represent standard deviations.