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To Whom This May Concern:

Attached please find documents summarizing epidemiology studies of Xerox employees. These are being submitted as an FYI to the EPA. This package was originally submitted on October 5, 2000, but was rejected because it did not contain a sanitized version of the information.

Enclosed please find three reports:

- Respiratory morbidity in toner-exposed Xerox workers: Report of cross-sectional findings, 1992-1996 (9/28/00)
- An evaluation of mortality among employees of the Xerox Corporation: 1960 - 1993 (2/15/00) [Contains Confidential Business Information]
- An evaluation of mortality among employees of the Xerox corporation: 1960 - 1993 (2/15/00) [Sanitized Version - Confidential Business Information Removed]

We hope that this has not created an inconvenience. If there are any other issues please call me.

Thank you for your assistance,



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FINAL REPORT

Respiratory Morbidity in Toner-Exposed Xerox Workers:

Report of Cross-Sectional Findings, 1992-1996

Jonathan M Samet

Anne Stocum

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Jonathan M. Samet

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Executive Summary

As part of Xerox's ongoing commitment to their employees and customers, the company has sponsored a set of large, complex health studies. The Xerox "Health Studies" have been underway since 1982 and include both studies of animals exposed to very high concentrations of specially prepared toner as well as studies of toner-exposed employees. These worker studies include an "*Employee Health Study*" (a study which consists of results from lung function tests and a health questionnaire on Xerox manufacturing workers and Service Engineers), and a "*Mortality Study*" (a study that was done to see if there were any trends in the causes of death of Xerox employees indicative of possible risks from toner). The studies complement one another in terms of offering evidence of any hazards associated with exposure to toner. The most recent findings of the "*Mortality Study*" were reviewed in a separate report.

This monograph summarizes the data from the "*Employee Health Study*". The program included voluntary participants in Monroe County, New York (2225 people), Oklahoma City, Oklahoma (329 people), Venray, Holland (905 people) and U.S. customer service engineers (4157 people). The protocol included standardized questions on respiratory symptoms and diseases and spirometry, a test of lung function. The design of the study is cross-sectional, that is on health status of the workers at a particular point in time. The focus is on the potential effect of toner on the lungs.

Detailed analyses were carried out but there were few findings of concern. No detrimental effects were observed when toner-manufacturing workers were compared to non-toner manufacturing workers. A small effect was noted in Webster employees

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(decrease in lung volume and emptying), but this was limited to people who had been exposed to toner for 2.5 – 10 years. No effect was observed in employees who had worked for a longer time at Webster and no effects were observed at the Venray and OKC plants. Similarly, customer service engineers did not demonstrate any changes in lung function when compared to salaried workers. A slight increase was observed in the number of Service Engineers employed over 20 years that had decreased lung volume. This was not seen in the other measures of lung function.

In summary, lung function was evaluated on a variety of employees who were exposed to toner, through manufacturing and service activities. Overall, it was concluded that there was no consistent pattern of work-related effects on lung function and therefore the few statistically significant findings were not likely to be related to exposure to toner.

Data were also collected on respiratory symptoms and diseases. These data were self-reported by the employees in the health questionnaire. While there were some reports of symptoms (for example, cough) and disease (for example, asthma), there were no trends across plants or types of jobs. It was concluded that there was no consistent pattern of work-related effects on respiratory symptoms or diseases.

Data on skin and eye irritation were also self-reported on the questionnaire. Statistically significant increases were observed for eye and skin irritation for toner manufacturing employees, service engineers and non-toner manufacturing employees. These results suggest that the reported problems are likely to be due to something other than exposure to toner and can probably be prevented by the appropriate use of personal protective equipment.

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Xerox has made a very substantial commitment to protecting the health of our employees. These data indicate that the overall patterns are consistent with a healthy population and that there is no reason to suspect that exposure to toner creates any noteworthy health hazards. Nonetheless, given that Xerox employees are exposed to small particles and that small particles are increasingly under investigation for the capacity to produce health problems, it is recommended that the studies be continued.

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INTRODUCTION

Xerox Corporation is one of the largest manufacturers and distributors of toner materials in the world. To increase understanding of any respiratory or other health consequences of long-term exposure to toner materials, Xerox implemented a program of toxicological and epidemiological investigation in the 1980s; this program continues to date. The program has included animal inhalation studies which showed effects only at high exposure levels, into the range at which the phenomenon of "lung overloading" is observed (Mermelstein et al. 1989; Bellmann et al. 1989). Through a cohort study approach, the mortality of Xerox employees is also tracked and periodically compared to expected mortality based on the experience of the entire United States. Mortality of a cohort of 32,436 employees, working between January 1, 1960 and December 31, 1982 has recently been determined up through December 31, 1993 (Samet et al. 2000). The findings, although subject to the inherent limitations of the retrospective cohort method, did not show evidence of an adverse effect of toner exposure on respiratory-related causes of death, including lung cancer and other respiratory diseases.

Another key component of the Xerox program on health risks of toner is the Employee Health Program, comprising the Personal Health Profile (PHP) for Monroe County, New York and Oklahoma City, Oklahoma union employees and their first line engineers and supervisors; the Personal Health Profile (PGP) for Venray, Netherlands employees in manufacturing and their first line engineers and supervisors; and the Employee Health Assessment Program (EHAP) examinations for customer service engineers from throughout the United States while in attendance at past training sessions in Leesburg, Virginia. The protocol for the Employee Health Program includes a standardized set of questions that covers respiratory symptoms and diseases and spirometry, a test of lung function. These examination programs have been in place

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since 1984, with revisions to the questionnaire in 1985 and a major revision to the entire program in 1990-91. The components of the examination include standard respiratory survey methods (a standardized respiratory questionnaire and spirometry, a test of lung function), which offer both symptom and physiologic indicators of lung injury. This type of survey is complementary to the cohort study of mortality and through the sensitivity of the assessment methods, it affords the possibility of finding evidence of injury at the population level before excess disease or mortality occur.

Data collected in the PHP, PGP, and EHAP programs have been previously analyzed and the findings reported. In 1995, Woodard and colleagues (1995) reviewed findings for data collected in 1992-93. Among the toner-manufacturing employees, there was some evidence for increased risk for certain respiratory symptoms, in comparison with non-exposed workers. Customer service engineers did not show a similar increase. For workers in Venray and Monroe County, lung function was slightly reduced for the toner-exposed workers, but similar reductions were not observed in Oklahoma City workers and in the customer service engineers. Results of chest x-rays showed no evidence of work-related lung disease. The 1995 report recommended further data collection to better understand the 1992-93 findings.

The present report provides the results of additional data collected in the Employee Health Program using the same methods as for the data which were the basis of the previous report. The current analyses include data for customer service engineers (1992-1996), Monroe County (1993-1995), Oklahoma City (1993), and Venray (1995-96).^a

^a Because of the small numbers of females at the Venray site, the analysis of the Venray data was restricted to males.

MATERIALS AND METHODS

Study Design

The study design is that of a cross-sectional study or survey. The methodology for the study is described in more detail in the protocol, Investigation of the Health Effects of Toner Exposure 1993-1996 Employee Health Programs (Stocum, 1995).

Exams were offered in Webster on an annual basis between 1993 and 1995; in Venray once between 1995-1996; in Oklahoma City once in 1993; and in Leesburg on an annual basis between 1992-1996. For those participating in the program multiple times, only the first observation was included in the present analysis. The exams for manufacturing workers used in the current analyses were selected to exclude observations already included in the data set assembled for the analysis of 1992-93 data previously reported by Woodward and colleagues (1995). For Customer Service Engineers, an overlap existed in the exams used for the previous (1992) and current analyses. Many Xerox employees were included in both analyses, as the examinations were offered on an annual basis. The data from the two intervals were analyzed separately to assess if associations observed in the earlier time period between exposure and symptom prevalence and lung function level would be replicated in the later time period.

The cross-sectional design has been widely applied for investigating potential respiratory effects of agents inhaled in the workplace. The design has the advantage of feasibility and, as in the example of the Xerox Employee Health Program, a survey can be an element of routine preventive services for workers. The data collection techniques used in the Xerox worker survey are standardized and quality assurance/quality control can be readily implemented and maintained (Ferris 1978). The survey design is inherently limited by collection of data at only one point in time; relationships between

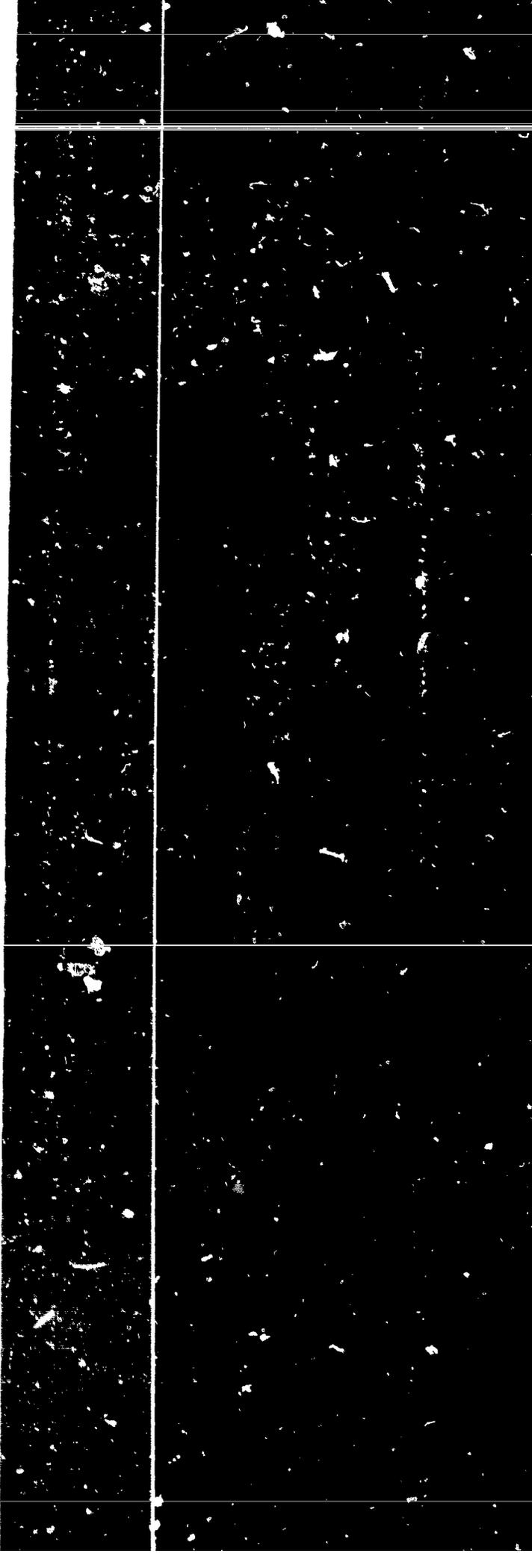
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exposure and outcome measures may be biased and the most affected persons may leave employment and be unavailable to the survey. Nonetheless, associations between measures of outcome, such as symptom prevalence and lung function level, and exposure indexes can be evaluated.

Data Collection

Health Questionnaire: A general health questionnaire (see Appendix A) was self-completed by participants and then reviewed for omissions by medical department personnel. An interviewer's guide was developed to assure standardization of approach. The questionnaire covered basic demographics, work history, health habits including smoking, personal illness history, and, to a limited extent, work or other exposures to potentially toxic agents. With regard to the respiratory tract, questions were included from the standardized questionnaire published by the American Thoracic Society (Fennis 1978) and symptoms related to other organ systems were also included. For Venray, the questions were translated from English to Dutch.

Spirometry: All testing was performed by technicians or nurses who had successfully completed a course in spirometry approved by the National Institute for Occupational Safety and Health. Periodic retraining was given as needed. Testing at all sites was carried out using an Occupational Marketing Incorporated P90ST Spirometry Testing System, including a Sensor Medics 922 dry-rolling seal spirometer. Guidelines for spirometer calibration and for acceptability and reproducibility met American Thoracic Society Criteria. Additional quality assurance was carried out by the Mayo Pulmonary Services, Mayo Clinic, Rochester, MN. Calibration procedures included a daily leak check, volume check with a calibrated syringe every four hours during testing, linearity checks (monthly), chart speed test (weekly), microprocessor verification (monthly) and



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biological calibration (monthly). A sample of pulmonary function tests was sent to the Mayo Clinic from each site for external quality control review. Results were reported back to Xerox for review and then to the appropriate technician, if necessary.

Data Entry and Management

Data were entered into a SAS-based system, the Xerox Occupational Health Information System, via data validation screens. Partial audits were performed to verify the integrity of the data. Work history data were acquired through an automated feed from the Xerox Personnel Data System.

Exposure Classification

Classification by Job and Reported Exposure: The participants were assigned to exposure groups using work histories constructed from company groups. The following groups were created.

- **Toner manufacturing:** Any person who ever held a job as a union employee in Monroe County or Oklahoma City, or in a comparable classification in Venray, who was directly involved in the production of toner. This category was further stratified as "current", based on working in toner manufacturing on the day of data collection, or "past".
- **Salaried:** Supervisors, engineers and other salaried employees in Oklahoma City or Monroe County comprise this category. This category was not used for Venray for which salaried employees were included in the "Other" and "Never Exposed" categories.
- **Customer Service Engineers:** Any person who ever held a position as a Customer Service Representative/Engineer (or Technical Representative).

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- **Other Manufacturing:** All other persons who were ever Monroe County or Oklahoma City union employees, or who ever held a comparable job classification in Venray. This group was further divided into "Other Exposed", including individuals reporting working in jobs with potential respiratory hazards, and/or exposure to toner which could not be documented in company records; and "Never Exposed", including individuals who did not report such exposures.

Exposure Estimates: Indexes of toner exposure were derived from work histories; these included exposure to toner (yes/no), duration of exposure (years), and date of hire or date of first exposure. Further details are given below by site and Figure 1 provides information on dust levels over time at each site:

- **Monroe County:** There were four exposure groups in Monroe County: Toner Exposed, Other Exposed, Never Exposed, and Salaried.
- **Oklahoma City:** There were three exposure groups in Oklahoma City: Toner Exposed, Other Exposed, and Salaried.
- **Customer Service Engineers:** For this group, all participants were considered to be exposed and length of employment was used as a surrogate for duration of exposure.
- **Venray:** For Venray, the groups included Toner Exposed, Other Exposed, and Never Exposed.

Data Analysis

Standard methods for analysis of cross-sectional data were used. For symptoms, prevalence rates were calculated. For the spirometry data, standard prediction equations were used to calculate expected values from an external population. The selected equations for the United States were those reported by

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Knudson and colleagues (1987) from the study of respiratory diseases in Tucson, AZ; for the Venray emphysemas, the 1983 prediction equations of the European Community for Coal and Steel were used (Coulter for 1983). Following the Mayo Clinic protocol, predictions for African Americans and Asians were reduced by 15%.

Even with use of the standard age-adjusted prediction equations, we found that there was an association of the residual values with age, following adjustment with age, in the Customer Service Engineers. Thus, the standard reference equations were not providing complete adjustment for age in the Xerox workers. Consequently, an additional age adjustment was made to the predicted pulmonary function data for all sites. This adjustment was made to avoid potential age-related bias in the percent predicted values. The correction factor was estimated by regressing the percent predicted values on age, using the data for the never smokers in each site.

For analysis, the percent predicted values of the FEV₁, the FVC, and the FEF_{25-75%} were used. In addition to being handled as continuous variables, the first two parameters were also treated as binary outcome measures with stratification at 80% of predicted value, the level typically used for clinical purposes to separate normal from abnormally low values.

Multivariate models were implemented with standard programs of SAS. These included multiple logistic regression for dichotomous outcome measures including presence of symptoms or illnesses and having an abnormally low percent predicted value for the lung function measures. Multiple linear regression was used to model the continuous pulmonary function measures. In controlling for smoking in the analyses, smoking was entered into models with indicator variables for smoking status (current, former, never) and with pack-years of smoking, a cumulative measure of consumption. All analyses were conducted separately by site.

This analysis includes only data from pulmonary function tests, respiratory symptom questions and questions on skin and eye irritation. Questions on other symptoms, hematology and blood chemistry data were not evaluated in this analyses. Data from chest x-rays were also not evaluated as the previous analyses showed the prevalence of parenchymal and/or pleural abnormalities to be lowest among the toner exposed populations.

RESULTS

Participant Characteristics

Table 1 provides the characteristics of participants in the present analysis by site while Table 2 further stratifies the participants of the manufacturing force by their inclusion in the earlier data set. The mean age of employment varied slightly across the four groups, being highest in Webster. Most participants were male and the majority were white. Five percent of the Venray workers, were Asian; and 6% of the Oklahoma City workers were American Indian. At Webster, the toner-exposed group had a higher proportion of blacks compared to the never-exposed group. Mean years of employment were substantially lower in Oklahoma City and comparable in the other three groups. Self-reported duration of exposure to toner was relatively brief, averaging less than 10 years for the various manufacturing groups. The percentages of current smokers were below 50% for all groups and highest in Venray workers.

There was a substantial overlap of employees included in both the current analyses and the previous analyses (1992-1993). In Oklahoma City, 69% of the employees were included in both sets of analyses; in Webster 69%; and in Venray 61%.

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Characteristics were quite close for those in the two analyses as would be anticipated (Table 2).

Respiratory Symptoms and Diseases

Symptom rates for the major respiratory symptoms are provided in Table 3 by site and exposure. The table also provides the prevalence rates for a self-reported doctor confirmed diagnosis of asthma, chronic bronchitis, emphysema, COPD and for the overall category of "significant pulmonary disease".^b The principal respiratory symptoms include chronic cough, chronic phlegm, wheezing, and dyspnea (shortness of breath). For these symptoms, there was little evidence of increased risk from toner exposure, based on comparing toner-exposed and non toner-exposed workers in manufacturing, or across the three strata of years of employment for the customer service engineers.

Respiratory symptoms have multiple determinants including smoking and age. Consequently, we used multiple logistic regression to assess the effect of toner exposure on symptom and disease occurrence, while controlling for smoking, age, and race (Table 4). The table presents the odds ratio, a measure interpretable as the relative increase in risk comparing the exposed to the non-exposed or other reference category. The table also provides an indication as to whether the conventional level of statistical significance ($p < 0.05$) was achieved. For the manufacturing facilities, the odds ratios reflect the comparison of ever-exposed to non-exposed or of currently-exposed to non-exposed, while for the customer service engineers, the comparison is across the three strata of duration of employment.

^b Significant pulmonary disease includes chronic bronchitis, emphysema/COPD, asthma for the U.S. sites and in Venray it additionally included CARA^b (non-specific respiratory disease).

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For chronic phlegm, chronic cough, and persistent wheeze, all generally associated with cigarette smoking, there was no evidence for association with exposure in any of the groups. While some of the odds ratios for toner exposure exceeded one, indicating an increased risk, the elevations were not statistically significant. For wheezing with shortness of breath, the odds ratio was significantly elevated in Oklahoma City, but not in either Venray or Webster. This increase might be due to the increase in the prevalence of asthma at this site. In the customer service engineers, this outcome measure was not associated with duration of employment. The odds ratios varied somewhat widely for dyspnea (shortness of breath) and were significantly reduced for customer service engineers in the category of the longest duration of employment. The anticipated effects of smoking on symptom occurrence were evident.

For self-reported respiratory diseases, there was also little evidence for increases associated with toner exposure. In Venray, there was a significant increase in the prevalence of significant pulmonary disease. This was primarily due to asthma, emphysema, and COPD. However, when each disease was taken separately, the increases were not statistically significant. In addition, the prevalence of asthma developing since hire was the same among exposed and non-exposed workers. For Oklahoma City, there was a statistically significant increase in significant pulmonary disease and asthma when the toner-exposed population was compared to the Webster never-exposed population. However, again many employees who reported having asthma reported that they had it prior to being hired at Xerox. There was no association with these same measures in the Webster employees or in the customer service engineers.

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Spirometry

Table 5 provides the mean and the 5th and 95th percentile values for the spirometric measures by site. For the FEV₁ and the FVC, the means were at about 100% or slightly below the predicted value in exposed and non-exposed workers alike. For FEF₂₅₋₇₅, the mean values were uniformly below 100%, suggesting that the external reference population may not have been fully appropriate for this parameter. In Monroe County, the mean values for exposed workers were slightly below those for never exposed and salaried workers for all three parameters. Among the customer service engineers, the group with the longest duration of employment (>20 years) had the lowest values.

To examine the effect of toner exposure on these parameters, we ran multivariate models which controlled for smoking and obesity. The results of these models are presented in Tables 6 and 7 for FEV₁, in Tables 8 and 9 for FVC and in Table 10 for FEF₂₅₋₇₅%. The first of each pair of tables includes the multiple linear regression model for the percent predicted as a continuous variable; the second includes the multiple logistic model for lung function below 80% of predicted. A number of comparisons were made using the available suite of exposure measures.

There was no consistent pattern of effects noted. There were no detrimental effects seen when toner manufacturing workers were compared to non-toner manufacturing workers at any of the 3 manufacturing sites. At the Webster site, however, there was a significant reduction in FEV₁ and FVC observed in the workers who were exposed for between 2.5 to 10 years. However, this was not seen in workers at Webster exposed for more than 10 years or in workers at the Oklahoma City or Venray sites.

In customer service engineers (CSEs), there were no differences observed when they were compared to Webster Salaried workers. There was, however, a significant increase in the proportion of CSEs employed over 20 years having FVC < 80%. However, no similar changes were seen in FEV₁ or FEF_{25-75%}.

Skin and Eye Symptoms

The questionnaire also covered eye and skin symptoms attributed to workplace exposures but due to the way that the skin and eye irritation questions were asked of respondents, it could not be clearly differentiated whether or not the symptoms that were being reported had been encountered in the past or in current jobs. The prevalence of reported irritated skin tended to be higher in the toner-exposed and other-exposed workers, particularly for the Webster and Venray toner-exposed groups (Table 11). Eye irritation was also more common in the exposed workers. On multivariate analysis, the prevalence of irritated skin due to workplace exposure was significantly elevated in the Webster and Venray toner-exposed groups and other-exposed groups in Webster (Table 12). The prevalence of eye irritation was significantly elevated in Webster other-exposed and Oklahoma City toner-exposed groups. For customer service engineers, an increase was seen in both skin and eye irritation when they were compared to the Webster Salaried population.

DISCUSSION

This report provides the findings of an extensive cross-sectional survey of respiratory symptoms and diseases and lung function in Xerox workers. Overall, the findings provide little evidence for an adverse effect of toner on the respiratory health of

Xerox employees, including those involved in the manufacture of the product or the servicing and repair of copiers. Within the specific groups, some associations were evident. However, there were no consistent patterns of association, present across all four worker groups (Webster, Oklahoma City, Venray, and customer service engineers) indicative of adverse respiratory effects. For lung function, there were no consistent associations of the spirometric parameters with exposure and the mean values were at about 100% of predicted, except for the FEF_{25-75} , for which there appeared to be a general problem of appropriateness of the reference equations. There was a clear pattern of increased reports of skin and eye irritation in toner-exposed and other-exposed workers. The data were not sufficiently detailed to further explore these associations and further data collection is planned.

The findings need to be interpreted within the context of the potential specific limitations of these data as well. First, the sample represents volunteers for an employee health program. Second, a substantial proportion of the participants (60-70% of the manufacturing workers) were represented in both the previous 1992-1993 analysis and in the new analysis described in this report. Third, as in any worker study, some degree of exposure misclassification is inevitable, likely biasing towards the null in this instance. Additionally, exposure estimates were made only for toner and not for other, potentially relevant exposures. Fourth, identifying appropriate comparison populations for specific worker groups is inevitably difficult and groups exposed and not exposed are likely to be different in subtle and not readily measured characteristics. Fifth, there are also general limitations to any cross-sectional survey. Those persons available for study represent the survivors from the cohorts of persons who were employed by Xerox in the years before the survey. If persons left Xerox because of respiratory disease or died from work-related respiratory disease, then the cross-sectional population would provide

a biased description of the occurrence of respiratory diseases among Xerox workers. In this regard, the mortality study shows no evidence for increased risk of death from respiratory disease, weighing against bias from losses to observation because of respiratory illness. Additionally, the sample sizes for the groups included in the survey reflected the numbers available and volunteering for the program. Sample sizes were not specified in advance in order to reach a specific level of statistical power. We did carry out statistical significance testing and confidence intervals, a measure of precision, are provided. The study did have sufficient data to detect clinically meaningful effects.

RECOMMENDATIONS

Given that toner is a strategic material for Xerox, this study provides extremely useful data. It is recommended that Xerox continue the surveillance of the respiratory health of its workers. Additionally, the findings with regard to eye and skin symptoms need follow-up and intervention through worker education. Thus, surveillance should be continued by offering the program to new workers, continuing to study earlier participants, and carrying out longitudinal analyses.

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Table 1. Comparison of Demographics by Site

	Venray 1995-96	OKC 1993	Webster 1993-95	CSEs 1992-96
Mean Age	40	38	45	41
Mean Years of Employment	15	7	17	16
% Male	100	73	78	95
% White	85	72	83	80
% Black	8	12	13	9
Mean Years in Toner Manufacturing (self-reported) – for toner exposed only	7	4	5	-
% Current Smokers	42	35	25	21
Mean Packyears	14	17	21	18
% with at least some college	-	56	44	77
Size of Toner Group	115	217	315	4157
Other unique characteristics	5% Asians	6% Native Americans	More blacks in toner group	

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Table 2. Comparison of Previous and Current Analyses

	Previous Analyses	Current Analyses	
Webster	1992-1993	1993-1995	No. of participants
	Participants	Participants	in both analyses
			(%)
Number of Participants	2158	2225	1526 (69%)
Mean Age	44	45	
Mean Years of Employment	17	17	
% Male	79	78	
% White	84	83	
% Black	13	13	
Mean Years in Toner Manufacturing (self-reported) – for toner exposed only	4	5	
% Current Smokers	26	25	
% Never Smokers	39	40	
% Past Smokers	35	35	
% with at least some college	43	44	
Size of Toner Group	324	315	
Oklahoma City	1992	1993	No. of participants
	Participants	Participants	in both analyses
			(%)
Number of Participants	253	329	228 (69%)
Mean Age	37	38	
Mean Years of Employment	7	7	
% Male	70	73	
% White	74	72	
% Native Americans	6	6	
% Black	10	12	
Mean Years in Toner Manufacturing (self-reported) – for toner exposed only	4	4	
% Current Smokers	40	35	
% Never Smokers	39	43	
% Past Smokers	21	22	
% with at least some college	54	56	
Size of Toner Group	171	217	

Table 2. Comparison of Previous and Current Analyses

Venray, Holland	Previous Analyses 1992-1993 Participants (Males & Females)	Current Analyses 1995-1996 Participants (Males only)	No. of participants (males) in both analyses (%)
Number of Participants	884	905	550 (61%)
Mean Age	39	40	
Mean Years of Employment	15	15	
% Male	94	100	
% White	64	85	
% Black	<1	8	
% Asians	3	5	
Mean Years in Toner Manufacturing (self-reported) – for toner exposed only	8	7	
% Current Smokers	41	42	
% Never Smokers	30	29	
% Past Smokers	29	29	
% with at least some professional education	82	85	
Size of Toner Group	82	115	
Customer Service Engineers	1992 Participants	1992-1996 Participants	No. of participants in both analyses (%)
Number of Participants	1260	4157	1254 (30%)
Mean Age	41	41	
Mean Years of Employment	16	16	
% Male	96	95	
% White	80	80	
% Black	9	9	
% Current Smokers	22	21	
% Never Smokers	45	40	
% Past Smokers	34	33	
% with at least some college	75	77	

Table 3. Summary of Prevalence of Respiratory Symptoms and Diseases

Prevalence of respiratory symptoms or disease (%)	Webster 1993-1995				Venray 1995-1996				OKC 1993			CSE (1992-96) by years of employment		
	Ever Toner	Never Exposed	Other Exposed	Ever Toner	Never Exposed	Other Exposed	Ever Toner	Other Exposed	Ever Toner	Other Exposed	<10	10-<20	> 20	
N=	315	509	886	115	395	395	217	31	964	1850	1343			
Respiratory Symptoms														
Chronic Cough	8	5	7	7	7	8	4	3	7	8	8			
Chronic Phlegm	9	7	8	9	6	10	4	7	9	9	8			
Persistent Wheeze	14	12	15	12	9	11	20	16	18	15	14			
Wheeze with Shortness of Breath	7	8	10	6	7	7	12	13	11	10	9			
Dyspnea	5	3	3	1	3	2	4	0	4	3	3			
Respiratory Diseases														
Significant Pulmonary Disease*	11	9	12	12	7	8	16	13	13	12	11			
Chronic Bronchitis	5	4	3	5	4	5	5	3	4	4	4			
Emphysema/COPD	<1	<1	1	4	<1	0	1	0	<1	<1	1			
Asthma	7	6	9	6	3	4	12	13	11	9	7			
Asthma since Hire Date				2	2	1	1		1	1	2			
CARA	-	-	-	2	2	2	-	-	-	-	-			

Significant Pulmonary Disease includes chronic bronchitis, emphysema/COPD and asthma (all doctor confirmed) for the U.S. sites; and in Venray it additionally includes CARA (non-specific respiratory disease).

Table 4. Summary of Respiratory Symptoms (Odds Ratios); Comparison of Ever Exposed Toner Manufacturing Populations to Never-Exposed Manufacturing Populations and CSEs by Years of Employment.

Symptoms Independent Variables	Venray 1995-1996	OKC 1993	Webster 1993-1995	CSEs 1992-1996
Chronic Cough				
Current Smoker	1.55	3.64*	1.84	2.29*
Ex-Smoker	0.39	0.49	0.30	0.51*
Packyears	1.02	1.03	1.03*	1.02*
Ever Toner Exposed	1.23	0.81	1.70	-
Current Toner Exposed	-	0.66	1.17	-
Male	-	0.56	0.37*	0.68
Age (middle)	4.72	0.89	1.38	-
Age (old)	1.79	0.88	1.00	-
Race Non-White	0.18	0.52	0.50	0.67
Education	1.51	1.11	2.04	-
Employed 10-20 yrs	-	-	-	0.93
Employed >= 20 yrs	-	-	-	0.92
Age	-	-	-	1.01
Chronic Phlegm				
Current Smoker	2.79	3.16*	3.17*	2.04*
Ex-Smoker	1.02	0.95	0.68	0.74
Packyears	1.02	1.01	1.02*	1.02*
Ever Toner Exposed	1.46	0.51	1.02	-
Current Toner Exposed	-	1.19	1.51	-
Male	-	0.57	0.65	1.02
Age (middle)	0.66	1.44	0.86	-
Age (old)	2.56	1.18	1.02	-
Race Non-White	1.21	0.39	0.84	1.02
Education	0.92	2.22*	1.83	-
Employed 10-20 yrs	-	-	-	1.04
Employed >= 20 yrs	-	-	-	1.01
Age	-	-	-	0.98*
Persistent Wheeze				
Current Smoker	1.84	2.32*	3.21*	2.58*
Ex-Smoker	0.99	0.66	1.06	0.90
Packyears	1.01	1.01	1.01	1.02*
Ever Toner Exposed	1.63	1.68	0.99	-
Current Toner Exposed	-	1.28	1.39	-
Male	-	0.75	0.65	0.83
Age (middle)	1.13	0.69	0.96	-
Age (old)	0.93	1.31	1.12	-
Race Non-White	0.20*	1.00	1.46	1.00
Education	1.22	0.86	1.02	-
Employed 10-20 yrs	-	-	-	1.05
Employed >= 20 yrs	-	-	-	1.16
Age	-	-	-	0.96*

* denotes statistical significance at $p < 0.05$

Shading denotes exposure variables

Table 4. Summary of Respiratory Symptoms (Odds Ratios); Comparison of Ever-Exposed Toner Manufacturing Populations to Never-Exposed Manufacturing Populations and CSEs by Years of Employment.

Symptoms Independent Variables	Venray 1995-1996	OKC 1993	Weobter 1993-1995	CSEs 1992-1996
Wheeze with SOB				
Current Smoker	1.82	1.15	1.59	0.78
Ex-Smoker	1.57	0.68	1.14	1.04
Packyears	1.01	1.01	1.02	1.01*
Ever Toner Exposed	0.86	2.50*	1.09	-
Current Toner Exposed		0.40	0.49	-
Male	-	0.59	0.43*	0.84
Age (middle)	0.45	0.36*	0.35*	-
Age (old)	0.98	1.44	1.22	-
Race Non-White	0.65	1.34	1.80	1.10
Education	1.48	0.90	0.93	-
Employed 10-20 yrs	-	-	-	1.09
Employed >= 20 yrs	-	-	-	1.20
Age	-	-	-	0.96*
Dyspnea				
Current Smoker	b	2.25	1.82	0.96
Ex-Smoker	b	4.53*	3.96*	1.11
Packyears	1.02	1.01	1.02	1.02*
Ever Toner Exposed	0.24	1.33	1.84	-
Current Toner Exposed		2.96	0.85	-
Male	-	0.26*	0.36*	0.30*
Age (middle)	1.18	0.37	0.23	-
Age (old)	0.85	6.53*	3.53	-
Race Non-White	2.20	6.74*	4.45*	1.28
Education	1.39	0.61	0.37	-
Employed 10-20 yrs	-	-	-	0.63
Employed >= 20 yrs	-	-	-	0.49*
Age	-	-	-	1.00
Asthma (doctor confirmed)				
Current Smoker	2.32	1.66	1.73	0.98
Ex-Smoker	2.61	1.32	1.51	1.16
Packyears	1.02	0.97	1.00	1.00
Ever Toner Exposed	2.64	2.17*	1.30	-
Current Toner Exposed		0.52	0.46	-
Male	-	0.97	1.19	0.67
Age (middle)	b	0.51	0.55	-
Age (old)	1.61	0.91	0.63	-
Race Non-White	2.23	1.27	1.98*	1.41*
Education	1.34	1.05	0.80	-
Employed 10-20 yrs	-	-	-	1.01
Employed >= 20 yrs	-	-	-	1.07
Age	-	-	-	0.97*

* denotes statistical significance at $p < 0.05$; b - Validity of model questionable due to quasicomplete separation in sample points. The maximum likelihood estimate may not exist. Shading denotes exposure variables

Table 4. Summary of Respiratory Symptoms (Odds Ratios); Comparison of Ever Exposed Toner Manufacturing Populations to Never-Exposed Manufacturing Populations and CSEs by Years of Employment.

Symptoms Independent Variables	Venray 1995-1996	OKC 1993	Webster 1993-1995	CSEs 1992-1996
Significant Pulmonary Disease				
Current Smoker	2.25	1.17	1.67	0.92
Ex-Smoker	2.63	1.11	1.48	1.06
Packyears	1.02	0.99	1.00	1.01
Ever Toner Exposed	2.14*	1.99*	1.54	-
Current Toner Exposed	-	0.65	0.49	-
Male	-	0.61	0.67	0.61*
Age (middle)	0.97	0.73	0.62	-
Age (old)	0.79	0.87	0.74	-
Race Non-White	0.85	1.15	1.45	1.22
Education	2.20*	1.03	0.98	-
Employed 10-20 yrs	-	-	-	1.08
Employed >= 20 yrs	-	-	-	1.22
Age	-	-	-	0.97*

* denotes statistical significance at $p < 0.05$

b - Validity of model questionable due to quasicomplete separation in sample points. The maximum likelihood estimate may not exist.

Shading denotes exposure variables

Table 5. Summary Table— Means and 5th and 95th Percentiles (Pulmonary Function Data) by Site

Percent Predicted FEV1	Webster 1993-95			OKG 1993			Verray 1995-96			CSE 1992-96		
	Mean	5%	95%	Mean	5%	95%	Mean	5%	95%	Mean	5%	95%
Ever Toner Exposed	97.3	72.7	117.7	99.7	80.0	120.2	97.2	73.1	119.4	-	-	-
Never Toner Exposed	99.6	78.8	123.3	-	-	-	97.5	76.3	118.8	-	-	-
Other Exposed	98.3	75.7	120.0	98.7	79.1	116.4	97.5	78.2	116.6	-	-	-
Salaried	100.2	77.4	121.0	99.1	77.0	119.8	-	-	-	-	-	-
< 10 years of employment	-	-	-	-	-	-	-	-	-	100.2	79.8	121.8
10-<20 yrs employment	-	-	-	-	-	-	-	-	-	99.9	79.0	123.0
> 20 years of employment	-	-	-	-	-	-	-	-	-	97.6	75.0	121.2
Percent Predicted FVC												
Ever Toner Exposed	98.7	77.9	117.9	101.6	81.8	122.2	99.8	79.9	120.8	-	-	-
Never Toner Exposed	101.0	81.9	121.7	-	-	-	100.3	81.2	120.0	-	-	-
Other Exposed	100.3	80.4	121.4	100.8	81.1	118.0	100.7	82.2	118.2	-	-	-
Salaried	101.6	83.7	120.8	101.2	81.0	126.5	-	-	-	-	-	-
< 10 years of employment	-	-	-	-	-	-	-	-	-	101.0	81.8	123.1
10-<20 yrs employment	-	-	-	-	-	-	-	-	-	100.8	81.6	123.1
> 20 years of employment	-	-	-	-	-	-	-	-	-	99.6	79.0	120.5
Percent Predicted FEF 25-75%												
Ever Toner Exposed	94.0	41.4	144.0	93.3	51.7	153.1	91.9	44.0	142.0	-	-	-
Never Toner Exposed	96.0	46.3	152.7	-	-	-	91.1	42.2	137.9	-	-	-
Other Exposed	92.9	44.0	145.6	93.8	57.7	164.7	89.2	40.4	138.8	-	-	-
Salaried	96.0	43.8	148.4	92.8	44.4	140.8	-	-	-	-	-	-
< 10 years of employment	-	-	-	-	-	-	-	-	-	98.0	55.0	148.1
10-<20 yrs employment	-	-	-	-	-	-	-	-	-	97.7	51.1	153.7
> 20 years of employment	-	-	-	-	-	-	-	-	-	92.6	44.4	153.5

Table 6. Summary Table of Pulmonary Function Data (FEV1)

Site / Data Set →	Unadjusted % Predicted FEV1				Age Adjusted % Predicted FEV1							
	Webster 93-96	Venray 92-93	Venray 95-96	OKC 1993	Webster 92-93	Webster 1993-95	Venray 1992	Venray 95-96	OKC 1992	OKC 1993	CSE 92-96	
Independent Variables*	Parameter Estimates				Parameter Estimates							
Current Smoker	0.50	-3.96	-3.17	-0.64	-0.95	0.53	-4.32	-2.77	-1.08	-0.72	-0.42	
Ex-Smoker	1.40	2.46	0.30	0.98	2.15	1.40	2.56	-0.08	0.97	0.97	1.52*	
Packyears	-0.19*	-0.05	-0.14*	-0.15*	-0.17*	-0.19*	-0.01	-0.17*	-0.12*	-0.15*	-0.20*	
Body Mass Index	-0.40*	-0.06	0.19	0.38*	-0.45*	-0.40*	-0.02	0.07	-0.43*	-0.37*	-0.32*	
Model (Exposure Variables)												
Ever Toner Exposed vs. Never Exp.												
Ever Toner Exposed	-2.34	-0.18	0.36	1.53	-0.66	-2.27	-0.33	0.40	0.99	0.25	-	
Current Toner Exposed	0.53	-	-	-0.63	-1.06	0.51	-	-	-0.11	-0.61	-	
Other Exposed vs. Never Exposed												
Other Exposed	-1.14	-	0.36	-	-0.12	-1.09	0.67	0.49	-	-	-	
Current Toner vs. Never Exposed												
Current Exposed	-1.78	-	0.67	0.60	-1.73	-1.73	0.83	0.77	0.77	-0.68	-	
Current Toner vs. Past Toner												
Current Toner Exposed	0.41	-	-	-0.49	-1.08	0.39	-	-	-0.22	-0.41	-	
Years Since 1st Exposure												
Current Toner Exposed	0.09	-	-	-0.42	-1.82	0.06	-	-	-0.28	-0.24	-	
Middle	0.77	-	-	-0.51	-0.05	0.73	-	-	3.25	-0.17	-	
Longest	-0.97	-	-	0.41	-2.24	-0.99	-	-	1.97	1.11	-	
Years Since Last Exposure												
1-<6 years	0.88	-	-	-	0.11	0.91	-	-	-	-	-	
>= 6 years	0.39	-	-	-	1.88	0.39	-	-	-	-	-	
Year of First Exposure												
Pre-1975	-1.80	-	-	-	0.30	-1.76	-	-	-	-	-	
1975-1989	-0.51	-	-	-	0.61	-0.50	-	-	-	-	-	
Current Toner Exposed	0.07	-	-	-	-0.99	0.06	-	-	-	-	-	
Duration of Exp / Yrs Employment												
Current Toner Exposed	1.76	-	-	0.59	-1.29	1.74	-	-	-0.63	0.52	-	
Middle Duration	-4.11*	-	0.20	-2.59	2.04*	-4.08*	0.67	0.36	0.87	-2.38	0.08	
Longest Duration	1.58	-	5.01	-2.29	3.24*	1.56	4.49	3.69	0.84	-1.87	-0.86	
Year of Hire												
Pre-1980	-	-	-	-	-	-	-	-	-	-	-	
1980-1989	-	-	4.12	-	-	-	3.42	2.06	-	-	-	
CSEs to Webster Salaried												
CSEs	-	-	-	-	-	-	-	-	-	-	0.05	

* denotes statistical significance at p< 0.05

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Table 7. Summary Table of Pulmonary Function Data (FEV1 < 80%)

Site / Data Set →	% Predicted FEV1 < 80% (Unadjusted)				% Predicted FEV1 < 80% (Age-Adjusted)						
	Webster 93-95	Venray 1992	Venray 95-96	OKC 1992	CSE 92-96	Webster 1993-95	Venray 1992	Venray 95-96	OKC 1992	OKC 1993	CSE 92-96
Independent Variables*	Odds Ratios										
Current Smoker	1.67	1.55	5.06	1.00	1.13	1.41	2.83	2.10	1.00	0.81	1.37
Ex-Smoker	1.13	0.58	4.11	0.75	0.83	0.97	1.01	1.47	0.81	0.63	0.93
Packyears	1.02*	1.01	1.02	1.02	1.03*	1.02*	1.00	1.02*	1.02*	1.02*	1.03*
Body Mass Index	1.07*	1.09	0.88	1.06	1.06*	1.05	1.09	1.02	1.06	1.04	1.07*
Model (Exposure Variables)											
Ever Toner Exposed vs. Never Exp.											
Ever Toner Exposed	1.35	1.67	1.18	0.74	-	1.00	1.15	1.19	0.84	1.14	-
Current Toner Exposed	1.18	-	-	0.51	-	1.88	1.19	-	0.73	0.29	-
Other Exposed vs. Never Exposed:											
Other Exposed	1.23	-	0.83	-	-	0.93	1.16	0.79	-	-	-
Current Toner vs. Never Exposed:											
Current Exposed	1.59	-	1.61	0.38	-	2.00*	1.37	1.23	0.65	0.33	-
Current Toner vs. Past Toner:											
Current Toner Exposed	1.32	-	-	0.61	-	1.88	1.32	-	0.68	0.33	-
Years Since 1st Exposure:											
Current Toner Exposed	1.17	-	-	0.60	-	1.70	1.17	-	0.69	0.32	-
Middle	0.91	-	-	2.42	-	0.81	0.91	-	0.80	1.47	-
Longest	0.69	-	-	0.60	-	0.73	0.69	-	1.57	0.58	-
Years Since Last Exposure:											
1-<6 years	0.37	-	-	-	-	0.85	0.37	-	-	-	-
>= 6 years	0.56	-	-	-	-	0.49	0.56	-	-	-	-
Year of First Exposure:											
Pre-1975	0.50	-	-	-	-	0.37	0.50	-	-	-	-
1975-1989	0.94	-	-	-	-	0.80	0.94	-	-	-	-
Current Toner Exposed											
Current Toner Exposed	1.14	-	-	0.48	-	2.06	1.14	-	1.38	0.29	-
Middle Duration	2.37	-	QCS ^b	3.07	0.92	0.59	2.37	2.31	0.17	2.41	1.11
Longest Duration	0.29	-	QCS ^b	1.47	0.87	2.27	0.29	1.52	0.30	1.07	1.45
Year of Hire:											
Pre-1980	-	-	1.10	-	-	-	-	1.42	0.50	-	-
CSEs to Webster Salaried:											
CSEs	-	-	-	-	0.83	-	-	-	-	-	0.75

* denotes statistical significance at p< 0.05; QCS = validity of model questionnaire due to questionnaire separation in sample points. The maximum likelihood estimate may not exist

Table 8. Summary Table of Pulmonary Function Data (FVC)

Site / Data Set →	Unadjusted % Predicted FVC				Age Adjusted % Predicted FVC							
	Webster 93-95	Venray 92-93	Venray 95-96	OKC 1993	CSE 92-96	Webster 92-93	Webster 1993-95	Venray 95-96	OKC 1992	OKC 1993	CSE 92-96	
Independent Variables*	Parameter Estimates											
Current Smoker	3.08*	-2.54	0.23	1.80	0.16	0.44	3.33*	-2.12	0.52	1.63	1.96	0.92
Ex-Smoker	1.27	3.31	2.85	0.76	2.65*	3.16*	1.28	2.77	1.95	2.54	0.58	1.58*
Packyears	-0.05	0.11	0.07	-0.01	0.01	-0.06	-0.07*	0.06	-0.01	-0.05	-0.03	-0.07*
Body Mass Index	-0.44*	-0.05	0.24	-0.33*	-0.51*	-0.50*	-0.43*	-0.14	0.04	-0.40*	-0.13*	-0.48*
Model (Exposure Variables)	Parameter Estimates											
Ever Toner Exposed vs. Never Exp.	Parameter Estimates											
Ever Toner Exposed	-2.10	-3.01	-0.38	1.81	-	0.16	-1.56	-2.55	-0.02	2.74	0.48	-
Current Toner Exposed	-0.75	-	-	-1.29	-	-2.03	-0.80	-	-	-1.87	-0.60	-
Other Exposed vs. Never Exposed	Parameter Estimates											
Other Exposed	-0.96	-	0.23	-	-	0.12	-0.60	0.3	0.53	-	-	-
Current Toner vs. Never Exposed	Parameter Estimates											
Current Toner Exposed	-2.90*	-	0.33	0.20	-	-2.00	-2.40	-1.14	0.78	0.97	-0.40	-
Current Toner vs. Past Toner	Parameter Estimates											
Current Toner Exposed	-0.68	-	-	-1.02	-	-1.96	-0.71	-	-	-2.06	-0.33	-
Years Since 1st Exposure	Parameter Estimates											
Current Toner Exposed	-0.40	-	-	-0.69	-	-2.57	-0.58	-	-	-2.10	-0.03	-
Middle	0.58	-	-	0.30	-	-1.07	0.19	-	-	2.47	0.87	-
Longest	0.96	-	-	2.24	-	-1.80	0.41	-	-	3.32	2.05	-
Years Since Last Exposure	Parameter Estimates											
1-<6 years	-0.55	-	-	-	-	0.56	-0.28	-	-	-	-	-
>= 6 years	2.82	-	-	-	-	3.66*	2.54	-	-	-	-	-
Year of First Exposure	Parameter Estimates											
Pre-1975	0.73	-	-	-	-	-0.17	0.64	-	-	-	-	-
1975-1989	-0.95	-	-	-	-	-1.60	-0.91	-	-	-	-	-
Duration of Exp / Yrs Employment	Parameter Estimates											
Current Toner Exposed	-0.68	-	-	-	-	-2.08	-0.71	-	-	-	-	-
Current Toner Exposed	0.79	-	-	-0.38	-	-1.43	0.74	-	-	-3.13	0.45	-
Mid	-4.45*	-	5.90	-3.16	2.98*	-1.13	-4.28*	0.26	5.71	0.04	-3.09	-0.32
High	1.64	-	7.57*	-0.43	5.69*	-3.54	1.28	2.14	5.30	2.55	-0.96	-1.00
Year of Hire	Parameter Estimates											
Pre-1980	-	-	4.21	-	-	-	-	-1.05	0.81	-	-	-
CSEs to Webster Salaried	Parameter Estimates											
CSEs	-	-	-	-	0.63	-	-	-	-	-	-	-0.20

* denotes statistical significance at p < 0.05; QCS = - validity of model questionable due to quasicomplete separation in sample points. The maximum likelihood estimate may not exist

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Table 9. Summary Table of Pulmonary Function Data (FVC < 80%)

Site / Data Set →	Unadjusted % Predicted FVC < 80%			Age Adjusted % Predicted FVC < 80%			CSE 92-96					
	Webster 93-96	Venray 92-93	Venray 95-96	Webster 92-93	Webster 1993-95	Venray 1992		Venray 95-96	OKC 1993	OKC 1992	OKC 1993	CSE 92-96
Independent Variables	Odds Ratios			Odds Ratios								
Current Smoker	9.13	0.63	QCS ^b	1.72	2.53	1.86	1.72	2.53	1.86	1.08	2.39	0.71
Ex-Smoker	7.93	0.45	QCS	0.62	2.30	0.40	0.62	2.30	0.40	0.58	2.12	0.70
Packyears	1.01	0.98	1.01	0.99	1.00	0.98	0.99	1.00	0.98	1.00	0.99	1.02
Body Mass Index	1.08	1.01	0.64	1.09*	1.09*	0.96	1.09*	1.09*	0.96	1.08*	1.10*	1.13*
Model: Exposure Variables												
Ever Toner Exposed vs. Never Exp.												
Ever Toner Exposed	2.02	4.51	QCS ^b	1.19	1.48	2.09	1.19	1.48	2.09	0.76	1.13	-
Current Toner Exposed	0.68	-	QCS	0.55	0.93	-	0.55	0.93	-	0.92	0.24	-
Other Exposed vs. Never Exposed												
Other Exposed	1.53	-	0.54	1.03	1.28	0.70	1.03	1.28	0.70	-	-	-
Current Toner vs. Never Exposed												
Current Exposed	1.47	-	QCS	0.67	1.44	1.22	0.67	1.44	1.22	0.89	0.27	-
Current Toner vs. Past Toner												
Current Toner Exposed	0.59	-	QCS	0.56	0.95	-	0.56	0.95	-	0.95	0.22	-
Years Since 1 st Exposure												
Current Toner Exposed	0.64	-	QCS ^b	0.52	0.85	-	0.52	0.85	-	0.98	0.25	-
Middle	2.38	-	QCS	0.95	1.43	-	0.95	1.43	-	0.25	QCS ^b	-
Longest	1.43	-	QCS	0.78	0.71	-	0.78	0.71	-	0.39	3.04	-
Years Since Last Exposure												
1-<6 years	2.40	-	-	2.07	2.12	-	2.07	2.12	-	-	-	-
>= 6 years	0.43	-	-	1.38	0.38	-	1.38	0.38	-	-	-	-
Year of First Exposure												
Pre-1975	0.87	-	-	0.20	0.52	-	0.20	0.52	-	-	-	-
1975-1989	2.48	-	-	1.13	1.38	-	1.13	1.38	-	-	-	-
Current Toner Exposed	0.68	-	-	0.47	0.90	-	0.47	0.90	-	-	-	-
Duration of Exp / Yrs Employment												
Current Toner Exposed	0.40	-	QCS ^b	0.52	0.78	-	0.52	0.78	-	3.49	0.07*	-
Middle Duration	9.92*	-	QCS	1.73	2.05	0.43	1.73	2.05	0.43	0.74	0.16	QCS ^b
Longest Duration	QCS ^b	-	QCS	QCS	0.60	0.49	QCS	0.63	0.49	0.45	0.08	QCS
Year of Hire												
Pre-1980	-	-	QCS ^b	-	-	2.51	-	-	2.51	0.27	-	-
CSEs to Webster Salaried												
CSEs	-	-	-	-	3.95	-	-	-	-	-	-	1.78

* denotes statistical significance at p<0.05; QCS = validity of model questionable due to quasicomplete separation in sample points. The maximum likelihood estimate may not exist

Table 10. Summary Table of Pulmonary Function Data (FEF 25-75%)

Site / Data Set →	Unadjusted % Predicted FEF 25-75%				Age Adjusted % Predicted FEF 25-75%				CSE 92-96	CSE 92-96
	Webster 93-95	Venray 92-93	Venray 95-96	OKC 1993	Webster 1993-95	Venray 1992	Venray 95-96	OKC 1992		
Independent Variables*	Parameter Estimates				Parameter Estimates					
Current Smoker	-5.64	-5.18	-10.13*	-6.13	-7.73*	-8.13	-11.03*	-4.71	-7.76*	-2.59
Ex-Smoker	-0.38	-0.01	-5.84	-1.21	0.13	1.56	-5.42	-1.94	-0.00	1.61
Packyears	-0.51*	-0.40*	-0.51*	-0.49*	-0.48*	-0.20	-0.48*	-0.37*	-0.45*	-0.54*
Body Mass Index	-0.23	0.15	0.04	-0.34	-0.19	0.62	0.19	-0.16	-0.29	0.22
Model (Exposure Variables)										
Ever Toner Exposed vs. Never Exp.										
Ever Toner Exposed	-2.38	5.92	2.19	2.54	-3.42	6.03	1.94	-4.40	-1.66	-
Current Toner Exposed	2.86	-	-	-0.03	3.25	-	-	6.62	-1.14	-
Other Exposed vs. Never Exposed										
Other Exposed	-1.88	-	-0.13	-	-0.01	-0.47	-0.39	-	-	-
Current Toner vs. Never Exposed										
Current Exposed	0.68	-	1.65	2.30	0.08	6.74	1.17	1.72	-3.17	-
Current Toner vs. Past Toner										
Current Toner Exposed	2.59	-	-	-0.36	2.82	-	-	6.72	-1.27	-
Years Since 1 st Exposure										
Current Toner Exposed	0.85	-	-	-1.27	1.70	-	-	6.69	-1.65	-
Current Toner Exposed	3.90	-	-	-3.84	6.35	-	-	2.78	-3.59	-
Middle	-5.27	-	-	-6.41	-3.11	-	-	-7.51	-2.76	-
Longest										
Years Since Last Exposure										
1-6 years	2.37	-	-	-	-3.67	1.89	-	-	-	-
>= 6 years	-6.14	-	-	-	-7.03	-5.63	-	-	-	-
Year of First Exposure										
Pre-1975	-6.92	-	-	-	-0.78	-6.08	-	-	-	-
1975-1989	3.01	-	-	-	5.14	4.62	-	-	-	-
Current Toner Exposed	1.85	-	-	-	4.41	2.39	-	-	-	-
Duration of Exp / Yrs Employment										
Current Toner Exposed	2.20	-	-	2.92	2.17	2.08	-	7.27	0.90	-
Middle Duration	0.88	-	-11.96	-3.07	9.14*	1.52	-0.62	-11.95	7.23	-1.20
Longest Duration	0.75	-	0.27	-9.62	-9.07	1.84	7.72	-2.79	-6.49	-0.79
Year of Hire										
Pre-1980	-	-	1.18	-	-	14.23	3.82	-	-	-
CSEs to Webster Salaried										
CSEs	-	-	-	-	-	-	-	-	-	0.70

* denotes statistical significance at p < 0.05; QCS = - validity of model questionable due to quasicomplete separation in sample points. The maximum likelihood estimate may not exist.

Table 11 - Summary of Skin and Eye Symptoms

SKIN & EYE SYMPTOMS	Webster 1813-95				OKC 1993				Venray 1995-96				CSEs
	Toner (315)	Other (886)	Never (1109)	Salaried (515)	Toner (217)	Other (31)	Salaried (81)	Toner (115)	Never (395)	Other (395)	92-96 (4157)		
N=													
Prolonged/persistent irritated skin (red and/or itching) due to workplace exposure? (176)	11% ^a (34) 16	9% (78) 28	6% (29) 13	3% (19) 7	8% (17) 6	7% (2) 0	5% (4) 1	14% (16) 13	6% (25) 22	9% (34) 20	7% (308) 162		
Prolonged/persistent irritated skin (red and/or itching) now due to your current job? (176c) **	5% (2) 0	2% (2) 2	2% (2) 2	1% (1) 1	Question Not Asked	Question Not Asked	Question Not Asked	2% (2) 2	3% (11) 9	3% (10) 9	4% (42) 32		
Prolonged/persistent irritated skin (red and/or itching) NOT due to workplace exposure?	8% (26) 13	9% (82) 44	9% (46) 30	15% (78) 45	13% (28) 22	13% (4) 3	9% (7) 4	11% (13) 10	13% (50) 38	16% (63) 53	12% (480) 350		
Serious eye injury? (Includes splinters) (182)	5% (15) 4	8% (72) 4	5% (23) 5	5% (24) 3	10% (22) 2	3% (1) 0	3% (2) 1	8% (9) 1	7% (28) 5	13% (51) 7	8% (323) 29		
Serious eye injury (includes splinters) in your current job? (182a) **	0% (0) 0	2% (2) 0	0% (0) 0	1% (1) 0	Question Not Asked	Question Not Asked	Question Not Asked	1% (1) 0	1% (4) 2	2% (9) 2	2% (16) 0		
Any eye irritation related to any job activity? (183)	7% (22) 2	8% (74) 16	4% (18) 8	4% (20) 4	12% (28) 5	7% (2) 0	4% (3) 0	6% (7) 3	4% (17) 10	7% (28) 6	8% (348) 122		
Eye irritation now related to your current job? (183a) **	0% (0) 0	3% (4) 3	1% (1) 1	4% (4) 2	Question Not Asked	Question Not Asked	Question Not Asked	3% (3) 3	3% (10) 8	2% (7) 5	3% (33) 19		

** Questions 176c, 182a and 183a were not added until April '95 so total number of responders will be lower than for other questions
^a percent of employees reporting the condition; followed by the number of employees reporting the condition in parentheses and the number of employees who report that the condition is still present at the time of the exam in italics

Table 12 Odds Ratios for Skin and Eye Symptoms

ODDS RATIOS FOR SKIN & EYE SYMPTOMS	Webster 1993-95 (compared to Webster Never Exposed)		OKC 1993 (compared to Webster Never Exp)	Venray 1995-96 (compared to Venray Never Exposed)		CSEs 92-96 (compared to Webster Salaried)
	Toner	Other	Toner	Toner	Other	CSEs
Prolonged/persistent irritated skin (red and/or itching) due to <i>workplace exposure</i> ?	3.06*	1.75*	1.63	2.26*	1.38	3.14*
Serious eye injury? (Includes splinters)	1.38	1.85*	2.40*	1.40	2.05*	1.47
Any eye irritation related to any job activity?	1.29	2.54*	3.89*	1.54	1.57	2.88*

* denotes statistical significance at $p < 0.05$

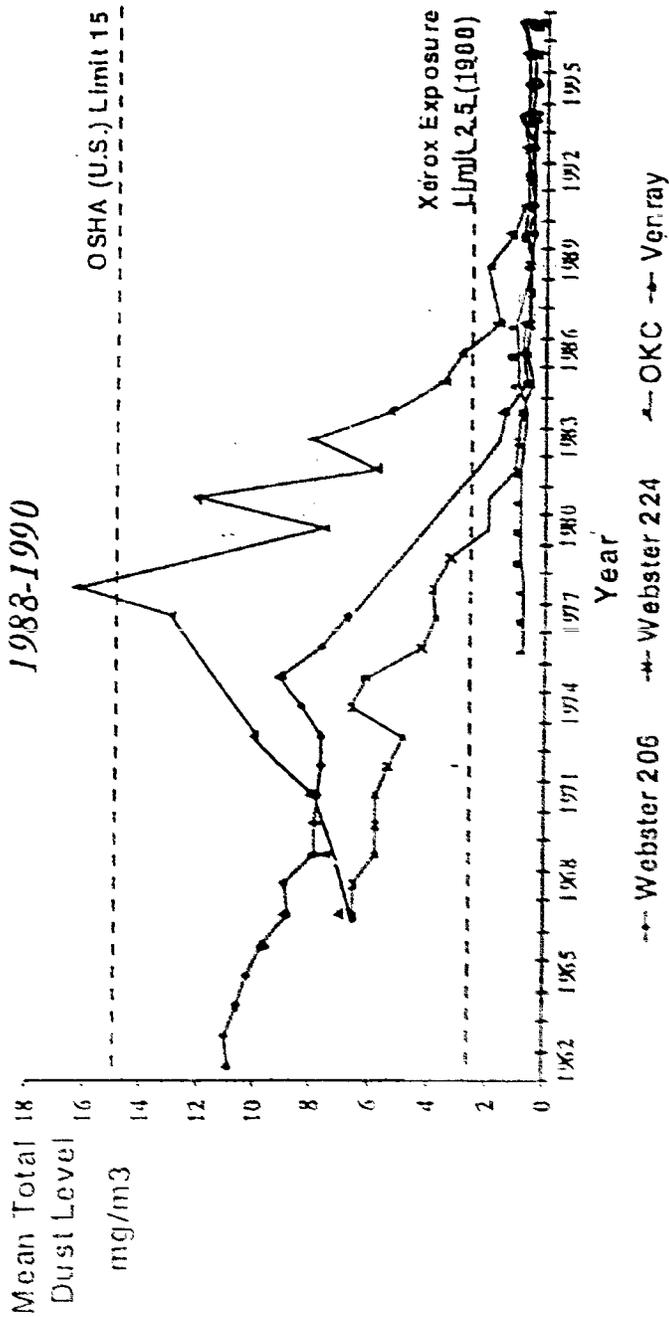
THE DOCUMENT COMPANY
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Environment, Health & Safety



Toner Exposure Levels

*Dust Levels Lowered in Toner Manufacturing Plants
1988-1990*



Xerox Confidential Data
September 28, 2000

Appendix A
Xerox Health Questionnaire