A Five-Year Review of Blood Lead Levels in Portsmouth City, Virginia

ABEX CORPORATION
PORTSMOUTH CITY, VIRGINIA

Letter Health Consultation

September 7, 2018

Virginia Department of Health
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September 7, 2018

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Dear Dr. James,

To evaluate blood lead levels (BLLs) among residents of Portsmouth City, Virginia, a five-year analysis of blood lead testing surveillance data collected between 2013 and 2017 was performed by the Virginia Department of Health (VDH) Division of Environmental Epidemiology (DEE) Public Health Toxicology Program. Blood lead data was extracted from the Virginia Electronic Disease Surveillance System (VEDSS), which performs public health surveillance of elevated BLLs and other reportable diseases. The goal of this analysis was to look at trends in elevated BLLs among Portsmouth City residents as a response to recent public concerns regarding potential lead exposure and its health effects in the areas surrounding the former Abex Corporation site.

After a review of the public health data, VDH concludes:

1. Average BLLs for both children and adults are lower than reference levels used by CDC and VDH to confirm lead exposure. Among Portsmouth City blood lead results collected by VEDSS, 93.3% (n = 2,960) of the results are below the reference range for an elevated BLL and did not require any public health action.

2. The average BLL for both children and adults in Portsmouth City are slightly higher when compared to the average BLLs for children and adults across the state.

3. Incidence rates for lead cases in Portsmouth City are lower than statewide incidence rates for children, but higher among adults.

4. An increase in the number of BLL results that are above the CDC reference value has been observed between the years of 2013 to 2017. The increase in the number of cases may be attributed, but is not limited to, recent changes in the case definition for lead exposure, enhanced screening efforts by healthcare providers, additional laboratories reporting to VDH, or improved accessibility of diagnostic or laboratory testing.

As a result of the analysis performed, VDH recommends:

1. Despite that most of the blood lead tests received by VEDSS are below the CDC reference level for a confirmed lead exposure, the CDC and VDH acknowledges that there are no safe levels of lead. Primary prevention measures should continue by the Virginia Department of Health, Portsmouth City Health Department, and pediatricians to inform, educate, and empower residents about methods and resources for lead exposure prevention.

2. Average BLLs for blood children and adults in Portsmouth City are slightly higher when compared to the average BLL for their respective age group across the state. Secondary prevention strategies such as targeted blood lead screening for at risk populations should continue. Children and pregnant women, particularly those in housing built prior to 1978, should continue to be screened for lead exposure. Occupational screening for lead exposure among industrial workers should continue to be performed as well.

3. Once children or adults have been identified with an elevated blood lead level, healthcare providers and local health departments should continue to follow guidelines and regulations for the reporting and management of confirmed blood lead levels as outlined by Virginia Department of Health in a timely manner. See attachments for a copy of Virginia regulations and guidelines for lead reporting and case management.

4. VDH recommends that all women of childbearing age, pregnant women, and children less than six years of age in Virginia have their blood tested for lead. By doing so, they can then make more informed decisions with their health care providers on whether to increase the frequency of blood lead testing and determine the need for other testing such as for nutritional deficiencies. If blood lead testing is not done by a personal health care provider, the test results need to be shared with their health care providers for follow-up recommendations.

BACKGROUND AND STATEMENT OF ISSUES

Between 1928 and 1978, the Abex Corporation operated a two-acre brass and bronze foundry located in the eastern section of the Portsmouth City for recycling used railroad car journal bearings. The foundry site contained five buildings and occupied a city block bordered by Green, Washington, Brighton, and Randolph streets (ATSDR, 2000a). On August 30th, 1990, the Environmental Protection Agency (EPA) designated the Abex site as a Superfund site (EPA) and the foundry was demolished in 1997 (ATSDR, 2000b). Various cleanup activities were performed between 1986 and 2002 (ATSDR, 2000b) and a site review of the former Abex Corporation site is performed by the EPA every 5 years.

In 2012, the CDC adopted a reference level of 5 micrograms per deciliter (µg/dL) as part of its case definition for elevated blood lead exposure for both children and adults. The reference level was based on data from the 2007 to 2009 National Health and Nutrition Examination Survey (NHANES) of children in the United States ages 1–5 years who are in the highest 2.5% of children when tested for lead in their blood (CDC, 2012). Prior to 2012, children with a blood lead laboratory result of 10 µg/dL or greater, and adults with a laboratory result of 25 µg/dL greater, had a blood lead "levels of concern" and required public health follow up. In the past however, BLL tests below "levels of concern" may or may not have been reported to public health for follow up. Starting in 2016, VDH adopted the CDC's new blood lead reference levels for surveillance purposes only (VDH, 2016). A lower reference value means more children will likely be identified as having lead exposure allowing parents, doctors, public health officials, and communities to take action earlier to reduce the child's future exposure to lead and its potential health effects. The public health intervention levels of 10 µg/dL and 25 µg/dL for children and adults, respectively, did not change. Additionally, recommendations for when to use medical treatment for children did not change with the new reference levels (CDC, 2012). Experts recommend chelation therapy when a child is found with a BLL of greater than or equal to 45 µg/dL (CDC, 2012).

Historical BLL Evaluations

Community members of Portsmouth City have raised several environmental health concerns regarding the Abex site. Blood lead screening initiatives were performed by the Portsmouth City Health Department in 1992, 1994, and 1999 (ATSDR, 2000a) to evaluate the possibility of lead toxicity in children living in close proximity to the Apex Site. Citizens of Portsmouth City have raised concerns regarding the accuracy of public health screening efforts in the past (ATSDR, 2000b). More recently, concerns have been expressed regarding the lowering of reference values for lead as it may have led to children not being properly diagnosed and or aware of having an elevated BLL (EPA, E-mail communication, February 2, 2018).

Several screenings and data reviews of community BLLs have occurred near the Abex site. From 1977 to 1990, the Portsmouth City Health Department conducted voluntarily BLL

screening for over 1100 children living near the site. The BLL data was obtained from children who visited the outpatient clinic, children admitted to the Children's Hospital of Kings Daughter, or during a 1986 door-to-door survey near the site. While promoximity to the site was a potential risk factor observed in the study, the study concluded there was only a weak association between soil lead concentrations and toxicity (Portsmouth City Health Department, 1991). In 1992, the Portsmouth City Health Department, conducted BLL screening of over 500 residents. In this BLL sampling event, 10 children under the age of six had BLL between 10 and 19 µg/dL (ATSDR, 2000b).

In 1993, based on community concerns, the City of Portsmouth requested ATSDR review BLL data and any follow-up recommendations. In the 1993 ATSDR health consulation, ATSDR concluded the BLLs of some children (especially young children) near the site indicated exposure to lead and recommended health education and repeat BLL testing for children and pregnant women who had a BLL above 10 µg/dL (ATSDR, 1993). In July 1999, EPA worked with Portsmouth City Health Deparment to perform BLL sampling from adults and children near the site. The average BLL in adults and children was 2.7 µg/dL (ATSDR, 2000a). In December 1999, ATSDR performed BLL screening for the Washingon Park Housing Project adjacent to the site, which included both BLL sampling and a short exposure questionnaire. From November to December 1999, BLL screening was provided to 415 current and former residents, including 38 children. The BLL results ranged from non-detect to 16.4 µg/dL with a mean of 2.4 µg/dL (ATSDR, 2000a). The maximum value for children under age six was 15 µg/dL (ATSDR, 2000a). Based on the data collected, ATSDR concluded that the BLLs among Washington Park community members sampled were not significantly elevated among those tested (ATSDR, 2000a).

Methodology

Blood lead laboratory results and confirmed cases of lead exposure were extracted from VEDSS, which maintains several databases for the management of public health information; the Core Datamart and Lab Report Datamart were used for this analysis. The Core Datamart provides generic case information, patient demographics, and some laboratory or morbidity information for the surveillance of patients who have been assigned a case status for lead exposure. The Lab Report Datamart is a database of electronic laboratory reports submitted to VEDSS. The inclusion criteria used for the extraction of public health information for this analysis include laboratory results collected between the dates of January 1, 2013 through December 31, 2017, results for the jurisdiction of Portsmouth City, and laboratory results for lead testing. Data analysis was performed using Microsoft Excel and the R Foundation's R statistical computing software.

Laboratory Report Adjustments

A total of 2,190 lead laboratory results for Portsmouth City were adjusted for analysis. Because detection limits for blood lead testing may differ by laboratory and the instrumentation used, blood lead results indicating a value below its reference range were provided a conservative approximate blood lead value. The instrumentation used for the results received was not provided by VEDSS. Similar adjustments were applied to statewide laboratory results that were analyzed. Specific adjustments made are as follows:

- Lead result = "Not Detected," 597 records
    - *Detection or reporting limits for lead testing instruments can range between approximately 0.1 µg/dL to 3 µg/dL depending on the instrumentation. Half of the upper detection limit of 3 µg/dL, or 1.5 µg/dL, was used as the result number for individuals with a lab result of "Not Detected" in the analysis.*
- Lead result = "<1.0 µg/dL," 20 records
    - *Half of the result's maximum number of 1.0 µg/dL was used, or 0.5 µg/dL was used as the lab result number for individuals with a lab result of "<1.0 µg/dL" in the analysis.*
- Lead result = "< 2.0 µg/dL," 6 records.
    - *Half the result's maximum number of 2.0 µg/dL was used, or 1.0 µg/dL was used as the lab result number for individuals with a lab result of "<2.0 µg/dL" in the analysis.*
- Lead result = "< 3.0 µg/dL," 1,331 records.
    - *Half of the result's maximum number of 3.0 µg/dL was used, or 1.5 µg/dL was used as the lab result number for individuals with a lab result of "< 3.0 µg/dL" in the analysis.*
- Lead result = "< 3.3" µg/dL," 236 records.
    - *Half of the result's maximum number of 3.3 µg/dL was used, or 1.65 µg/dL was used as the lab result number for individuals with a lab result of "< 3.3 µg/dL" in the analysis.*

Results

In this report, surveillance of blood lead testing results received by VEDSS is presented for all Portsmouth City residents who were tested for lead at least once between the years of 2013 and 2017. Two case definitions for lead exposure classification were in effect during the years analyzed. Between the years of 2013 and 2015, a child (age < 16 years) with a confirmed BLL ≥ 10 µg/dL and an adult (age ≥ 16 years) with a BLL ≥ 25 µg/dL were defined as a case of lead exposure. Starting in 2016, VDH adopted the CDC's case definition for lead exposure for both children and adults. Individuals with a venous BLL ≥ 5 µg/dL regardless of age, or two capillary blood lead tests ≥ 5 µg/dL for children, were classified as having an elevated BLL (CDC, 2016).

Analysis of the VEDSS Lab Report Datamart found that between 2013 and 2017, the total number of lead laboratory results received by VEDSS for the City of Portsmouth was 3,168**.** Between the years of 2013 and 2017, the average BLLs for all age groups have been found to be below the CDC's reference value of 5 µg/dL for blood lead testing (**Figure 1**). In fact, 93.3% (n = 2,960) of all BLLs received by VEDSS were below the reference range of 5 µg/dL for an elevated blood lead level and did not require any public health action from local health departments (Error! Reference source not found.). This number includes repeat, routine, or confirmatory tests. It appears, however, laboratory results with higher blood lead levels were being reported more frequently between 2015 and 2017 when compared to earlier years. This observation is supported by a slight increase in the small proportion of elevated blood lead results for adults and children (**Table 1**).

The average BLL in the City of Portsmouth for all tests received between 2013 and 2017 for all ages is 2.25 µg/dL (**Table 2**). For children, the average BLL was 2.10 µg/dL and for adults, the average BLL was 2.96 (**Table 2**). When compared to BLLs for the rest of the state, the average BLL for Portsmouth City is slightly higher for both age groups. Between the years of 2013 and 2014, the average BLL for children in Portsmouth City were similar to the average BLL for children in Virginia as a whole, while the average BLL for adults in Portsmouth City was slightly higher (**Table 2**). The slight increase in average BLL for children in subsequent years may be reflective of an increase in awareness of the importance of blood lead testing, as well as an increase in screening of at risk populations for lead exposure.

The incidence rate of lead cases was calculated to measure the proportion of confirmed cases of lead with the population in Portsmouth City and Virginia between the years of 2013 and 2017. Because population data for 2017 was unavailable at the time of this report, population data for 2016 was used to calculate the incidence rate for 2017. Individual year population data was used for each of the single preceding years. From the calculations performed, the incidence rate for confirmed cases of lead exposure among children was lower than the state incidence rate for 4 of the 5 years analyzed; 2015 being the exception (**Table 3**). Between 2014 and 2015, however, the incidence of lead cases among Portsmouth City children increased from 9.8 to 29.2 (per 100,00) and continued to increase in the subsequent years after the change in reference levels (**Table 3**). For adults, the incidence rate for lead in Portsmouth City was higher for 3 of the 5 years analyzed; 2013 and 2015 did not have any adult cases of elevated BLLs (**Table 3**). From 2013 to 2017, the incidence rate increased for both age groups in Portsmouth City and across Virginia. In 2016, the reference level was lowered to 5 µg/dL and an approximate four-fold increase in the incidence rate of lead cases was measured in Portsmouth City for all ages. Across the state, the increase in the incidence rate for 2016 as calculated to be approximately six-fold when compared to the incidence rate in 2015.

With a lowered CDC reference value to meet the case definition of a confirmed lead exposure, more adults and children are expected to be identified as confirmed during public health surveillance as having lead exposure. Over the past five years, the number of blood lead

cases has increased for children under the age of 16 years, and adults over the age of 16 years (**Figure 2**). Since implementing the CDC's case definition for lead exposure, 84% (n = 48) of the cases for elevated blood lead levels in adults and children over the past 5 years, occurred in 2016 and 2017 (**Table 4**). The remaining 16% (n = 9) cases were counted between the years of 2013 and 2015 when the previous case definition for elevated lead levels was in effect (**Table 4**). There were no confirmed cases of elevated blood lead levels above the CDC reference level among Portsmouth City children in 2013 (**Table 4)**. Although an increase in the number of child lead cases has occurred, over half (55%) of the cases were for blood lead levels between 5 µg/dL and 9 µg/dL (**Table 4**). This is also illustrated in **Figure 3**, as a clustering of cases is observed in within BLLs of 5 µg/dL to 9 µg/dL between the years of 2016 and 2017 for both adults and children. Adults also have seen an increase in blood lead cases over the past 5 years. However, 96% (n = 23) of adult lead cases have occurred between 2016 and 2017 when the reference level for lead exposure was lowered from 25 µg/dL to 5 µg/dL (**Table 4**). The rise of blood lead cases could be attributed to a several plausible factors, including but not limited to, the lowered reference values for lead exposure for both children and adults, increased awareness of blood lead testing, and increased targeted screening of at risk populations for lead.

DISCUSSION

Rates of Exposure/Pathways

There are several routes of exposure for lead including ingestion, inhalation, dermal absorption, and mobilization of lead already in the body. Among children, the two primary routes of exposure are through ingestion or inhalation of lead, but ingestion is the most common route of exposure attributed to elevated BLLs (ATSDR, 2017). Common sources of lead ingested by children include lead contaminated paint, dust, soil, or water, which are typically found in homes built prior to 1978 or former mine and smelter communities (ATSDR, 2017). Inhalation of second hand smoke has also been identified as a source of lead exposure among children. For adults, the primary route of lead exposure is through inhalation of lead particulates among workers in industrial occupations, home renovators, or hobbyists handling lead materials (ATSDR, 2017). Dermal exposure to lead-based occupational materials is another plausible pathway of exposure. For both adults and children, endogenous exposures are possible. Pregnant women are at risk from the remobilization of lead absorbed in bones, which can put the developing fetus at risk for trans-placental exposure (ATSDR, 2017). Elevated blood lead levels have also been found in adults with a retained bullet or shrapnel fragments (ATSDR, 2017).

Health Effects

Currently, the CDC recognizes that there are no proven safe level of lead exposure and recommends reducing lead exposure wherever possible (CDC, 2012; Council on Environmental Health, 2016). Children are the most vulnerable population for lead exposure due to the behavioral and developmental factors associated with their young age. Because children can

easily absorb lead, even low levels of lead have been associated with adverse health effects such as diminished intellectual and academic abilities, increased rates of neurobehavioral disorders. Elevated blood lead levels in pregnant women has been associated with adverse health outcomes such as miscarriage, low birth weight, or learning and behavioral problems (ATSDR, 2017).

Lead exposure in adults can affect a variety of organs. Most notably, lead exposure is associated with cognitive and neurological effects such as decreased reaction time and memory, or weakness in the extremities. With high levels of lead exposure, lead can damage the brain, kidneys, and reproductive system and result in cardiovascular disease (ATSDR, 2000a).

Comparison with Older Results

A review of previous Health Consultations, Health Assessments, Memorandums, and reports by Portsmouth City Health Department, VDH, and ATSDR pertaining to the Abex Corporation site and blood lead screenings was performed to identify the findings of previous blood lead screening initiatives. The documents reviewed were limited to the records available onsite at the Virginia Department of Health's Division of Environmental Epidemiology.

1991: A screening and review of childhood blood lead results from July 1977 to February 1990 was conducted by the Portsmouth City Health Department. The study examined blood lead results of children from a review of medical records from the King's Daughters Children Hospital, blood lead screening at the Portsmouth City Health Department, and a community door-to-door survey conducted in 1986. In total, information on blood lead levels were collected from 1,111 children who were tested for lead toxicity. Of the data collected, **141 (12.7%) children had lead toxicity of 25 µg/dL or greater. The blood lead levels for 228 children ranged from 5 to 160 µg/dL, with an average of 32 ± 22 µg/dL** (Portsmouth City Health Department, 1991).

1992 (July – October): Portsmouth City Health Department performed blood lead screening of 555 blood lead test results from current and former residents in the community surrounding the Abex site. Among the samples received for testing, 22 children (4% of all tested) had blood lead levels above the 10 µg/dL "level of concern" at the time of sampling. **The average BLL among children with elevated samples was 12.32 µg/dL**, and the average age of the children tested with elevated results was 6 years and 5 months. Ten children under the age of six had blood lead levels between 10 and 19 µg/dL. Blood lead values that were below the "level of concern" for lead poisoning (10 µg/dL), and adult BLLs, were not included in the average blood level reported (ATSDR, 1993; ATSDR, 2000a).

1994: Portsmouth City Health Department continued a targeted blood lead screening for current and former residents of the Washington Park Housing Development. The screening effort took

place prior to major Abex Corporation Site cleanup activities. Three children screened had BLLs above 10 µg/dL, but may not have resided in the Washington Park community (ATSDR, 2000b).

1999 (July): Portsmouth City Health Department with EPA performed blood lead screening for the residents of the Washington Park Housing Development. However, residents outside of the Washington Park community also participated in the screening. The **average BLL for adults and children screened for blood lead levels was 2.7 µg/dL** (ATSDR, 2000a; ATSDR, 2000b).

1999 (November – December): Portsmouth City Health Department conducted blood lead screening with VDH and CDC/ATSDR for 415 current and former residents of the Washington Park Housing Development. Of 415 residents tested, 38 were children under the age of 6. **The average blood level was 2.4 µg/dL for adults and children**, with a maximum value of 16.4 µg/dL and 15 µg/dL for adults and children under the age of six, respectively. The report concluded that blood lead levels were not significantly elevated (ATSDR, 2000a).

2013 to 2017: 3,168 Blood lead lab results were submitted to VEDSS during this period. **The average BLL for all tests received for adults and children is 2.25 µg/dL**. Children under the age of 16 years old had an average BLL of 2.10 µg/dL (n = 2,628) and adults had an average BLL of 2.96 µg/dL (n = 541). Children under the age of 6 years old had an average BLL of 2.14 µg/dL (n = 2,447).

Limitations

Limitations of this data analysis include reliance on either city-level or county-level surveillance data reported to VDH. This data is not necessarily representative of BLLs of individuals living in close proximity to any particular hazardous site, dwelling, or other potential exposure source in a more localized area, such as Portsmouth City, Virginia. Additionally, BLL reporting by VEDSS is a passive surveillance system that is limited by incomplete data and the underreporting of laboratory results. In addition, it is important to note, VDH does not receive BLL testing data for the Portsmouth Naval Hospital because their laboratory reports do not feed into VEDSS. For the purposes of report, however, the laboratory reports received in VEDSS should be representative of BLL in Portsmouth City between the years analyzed.

CONCLUSIONS

1. Average BLLs for both children and adults are lower than reference levels used by CDC and VDH to confirm lead exposure. Among Portsmouth City blood lead results collected by VEDSS, 93.3% (n = 2,960) of the results are below the reference range for an elevated BLL and did not require any public health action.

2. The average BLL for both children and adults in Portsmouth City are slightly higher when compared to the average BLLs for children and adults across the state.

3. Incidence rates for lead cases in Portsmouth City are lower than state wide incidence rates for children, but higher among adults.

4. An increase in the number of BLL results that are above the CDC reference value has been observed between the years of 2013 to 2017. The increase in the number of cases may be attributed, but is not limited to, recent changes in the case definition for lead exposure, enhanced screening efforts by healthcare providers, additional laboratories reporting to VDH, or improved accessibility of diagnostic or laboratory testing.

RECOMMENDATIONS

1. Despite that most of the blood lead tests received by VEDSS are below the CDC reference level for a confirmed lead exposure, the CDC and VDH acknowledges that there are no safe levels of lead. Primary prevention measures should continue by the Virginia Department of Health, Portsmouth City Health Department, and pediatricians to inform, educate, and empower residents about methods and resources for lead exposure prevention.

2. Average BLLs for blood children and adults in Portsmouth City are slightly higher when compared to the average BLL for their respective age group across the state. Secondary prevention strategies such as targeted blood lead screening for at risk populations should continue. Children and pregnant women, particularly those in housing built prior to 1978, should continue to be screened for lead exposure. Occupational screening for lead exposure among industrial workers should continue to be performed as well.

3. Once children or adults have been identified with an elevated blood lead level, healthcare providers and local health departments should continue to follow guidelines and regulations for the reporting and management of confirmed blood lead levels as outlined by Virginia Department of Health in a timely manner. See attached for a copy of Virginia regulations and guidelines for lead reporting and case management.

4. VDH recommends that all women of child bearing age, pregnant women, and children less than six years of age in Virginia have their blood tested for lead. By doing so, they can then

make more informed decisions with their health care providers on whether to increase the frequency of blood lead testing and determine the need for other testing such as for nutritional deficiencies. If blood lead testing is not done by a personal health care provider, the test results need to be shared with their health care providers for follow-up recommendations.

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Attachments:

1. Figures and Tables.
2. Commonwealth of Virginia State Board of Health Regulations for Disease Reporting and Control.
3. Virginia Guidelines: Testing Virginia Children for Lead Exposure.
4. Sources of Lead and Steps to Reduce Exposures.

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Attachment 1: Figures and Tables.

Figure 1: Average Blood Lead Levels by Age Group Between 2013-2017 in Portsmouth, VA

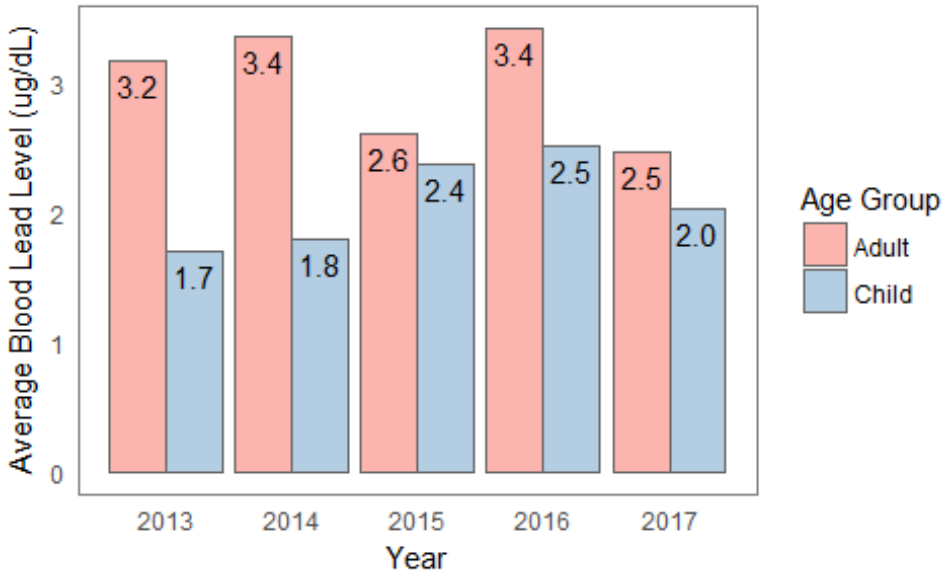

Figure 2: Number of Blood Lead Cases Between 2013-2017 in Portsmouth, VA*

*No cases of elevated blood lead levels were reported in 2013.

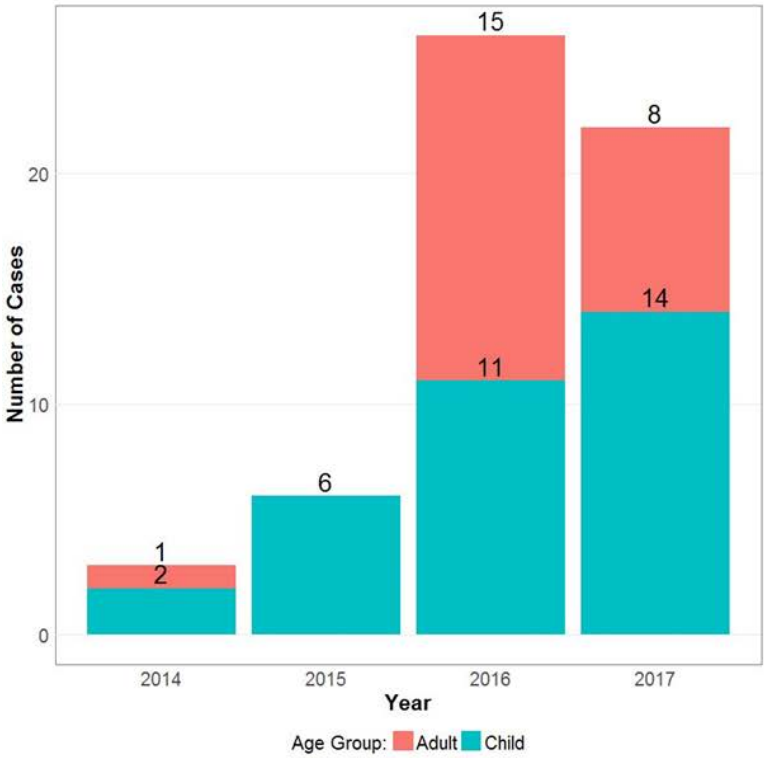

Figure 3: Blood Lead Levels of Confirmed Cases In Portmouth, VA Between 2013-2017*

*No cases of elevated blood lead levels were reported in 2013.

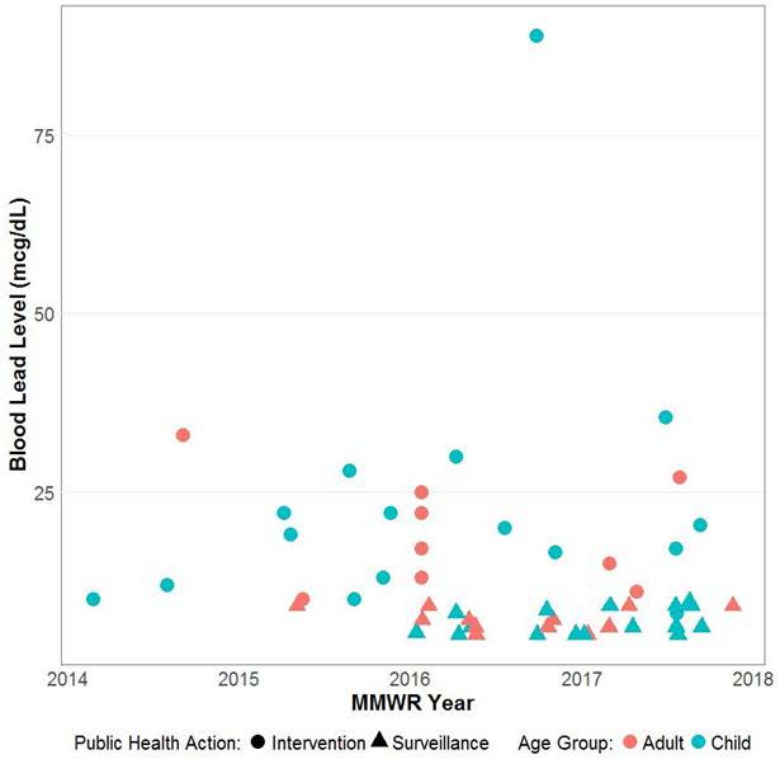

Table 1: Lead Results Received by VEDSS for the City of Portsmouth Between 2013–2017 (n = 3,168)											
Blood Lead Levels	2013 (n = 585)		2014 (n = 591)		2015 (n = 634)		2016 (n = 707)		2017 (n = 651)		Total
	Child	Adult	Child	Adult	Child	Adult	Child	Adult	Child	Adult	
0–4.9 µg/dL	512 (88%)	50 (9%)	487 (82%)	73 (12%)	499 (79%)	93 (15%)	535 (76%)	105 (15%)	466 (72%)	140 (22%)	2,960 (93%)
5–9.9 µg/dL	12 (2%)	6 (1%)	12 (2%)	8 (1%)	16 (3%)	3 (0%)	18 (3%)	17 (2%)	15 (2%)	11 (2%)	118 (4%)
10–14.9 µg/dL	1 (0%)	2 (0%)	4 (1%)	5 (1%)	4 (1%)	0 (0%)	6 (1%)	5 (1%)	5 (1%)	5 (1%)	37 (1%)
15–19.9 µg/dL	0 (0%)	0 (0%)	0 (0%)	1 (0%)	4 (1%)	4 (1%)	4 (1%)	4 (1%)	4 (1%)	1 (0%)	22 (1%)
20–44.9 µg/dL	0 (0%)	2 (0%)	0 (0%)	1 (0%)	10 (2%)	1 (0%)	10 (1%)	2 (0%)	2 (0%)	2 (0%)	30 (1%)
> 45 µg/dL	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (0%)
Total	525 (90%)	60 (10%)	503 (85%)	88 (15%)	533 (84%)	101 (16%)	574 (81%)	133 (19%)	492 (76%)	159 (24%)	3,168

Table 2: Average Blood Lead Levels (µg/dL) for the City of Portsmouth and Virginia – 2013–2017						
Year	Children (Age < 16 Years Old)		Adults (Age ≥ 16 Years Old)		All Ages	
	Portsmouth	Virginia	Portsmouth	Virginia	Portsmouth	Virginia
2013	1.71 (n = 525)	1.71 (n = 66,877)	3.18 (n = 60)	2.49 (n = 8,463)	1.86 (n = 585)	1.79 (n = 75,479)
2014	1.81 (n = 503)	1.80 (n = 69,915)	3.36 (n = 88)	2.43 (n = 8,865)	2.04 (n = 591)	1.87 (n = 79,228)
2015	2.37 (n = 533)	1.77 (n = 74,936)	2.61 (n = 101)	2.62 (n = 7,831)	2.41 (n = 634)	1.85 (n = 83,387)
2016	2.53 (n = 574)	1.75 (n = 75,483)	3.43 (n = 133)	3.18 (n = 7,613)	2.70 (n = 707)	1.88 (n = 84,045)
2017	2.03 (n = 492)	1.72 (n = 70,108)	2.47 (n = 159)	3.01 (n = 7,582)	2.14 (n = 651)	1.84 (n = 78,988)
Five Year Average	2.10 (n = 2,627)	1.75 (n = 357,319)	2.96 (n = 541)	2.73 (n = 40,354)	2.25 (n = 3,168)	1.84 (n = 401,127)

Table 3: Incidence Rate per 100,000 of Lead Exposure Cases for the City of Portsmouth and Virginia 2013–2017						
Year	Children (Age < 16 Years Old)		Adults (Age ≥ 16 Years Old)		All Ages	
	Portsmouth	Virginia	Portsmouth	Virginia	Portsmouth	Virginia
2013	0.0	9.9	0.0	0.6	0.0	2.5
2014	9.8	15.9	1.3	0.4	3.1	3.5
2015	29.2	13.6	0.0	0.4	6.2	3.0
2016	54.3	57.6	20.0	8.4	27.3	18.1
2017*	69.2	72.0	10.7	6.2	23.1	19.2
* 2016 Population data used as the denominator for incidence rate calculation						

Table 4: Lead Case Characteristics	Total Cases (n = 57)		Child Lead Cases (n = 33)		Adult Lead Cases (n = 24)	
	n	%	n	%	n	%
Sex						
Male	42	74	19	58	23	96
Female	15	26	14	42	1	4
Age (in years)	Mean: 19 Median: 5 Range 1–75		Mean: 3 Median: 2 Range: 1–5		Mean: 42 Median: 37 Range: 20–75	
0–3 Years	24	42	24	73	–	–
4–6 Years	9	16	9	27	–	–
7–15 Years	0	0	0	0	–	–
16 and Older	24	42	–	–	24	100
Race						
American Indian/Alaska Native	0	0	0	0	0	0
Asian	0	0	0	0	0	0
Black or African American	30	53	16	48	14	58
Native Hawaiian or Pacific Islander	0	0	0	0	0	0
White	16	28	10	30	6	25
Unknown	11	19	7	21	4	17
Zip Code						
23701	13	23	4	12	9	38
23702	8	14	4	12	4	17
23703	7	12	2	6	5	21
23704	15	26	13	39	2	8
23707	14	25	10	30	4	17
Year						
2013	0	0	0	0	0	0
2014	3	5	2	6	1	1
2015	6	11	6	18	0	0
2016	26	46	11	33	15	63
2017	22	39	14	42	8	33
Lab Value Ranges	Mean: 13.4 Median: 9 Range: 5–89		Mean: 14.7 Median: 9 Range: 5–89		Mean: 11.5 Median: 9 Range: 5–33	
0 µg/dL–4 µg/dL	0	0	0	0	0	0
5 µg/dL–9 µg/dL	33	58	18	55	15	63
10 µg/dL–14 µg/dL	7	12	4	12	3	13
15 µg/dL–19 µg/dL	6	11	4	12	2	8
20 µg/dL–44 µg/dL	10	18	6	18	4	17
> 45 µg/dL	1	2	1	3	0	0

Attachment 2: Commonwealth of Virginia State Board of Health Regulations for Disease Reporting and Control.

"Lead, reportable levels" means any detectable blood lead level in children 15 years of age and younger and levels greater than or equal to 5 μg/dL in a person older than 15 years of age.

PROTOCOL FOR IDENTIFICATION OF CHILDREN WITH ELEVATED BLOOD LEAD LEVELS

12VAC5-90-215. Schedule and criteria for and confirmation of blood lead testing and information to be provided.

A. Schedule for testing.

Every child shall be tested to determine the blood lead level at 12 months and 24 months of age if the health care provider determines that the child meets any of the criteria listed in subsection B of this section. Children 25 months through 72 months of age who present for medical care and meet any of criteria of subsection B of this section shall also be tested if they have either not previously been tested for blood lead level or were previously tested but experienced a change since testing that has resulted in an increased risk of lead exposure based on the criteria listed in subsection B of this section.

B. Criteria for testing.

1. The child is eligible for or receiving benefits from Medicaid or the Special Supplemental Nutrition Program for Women, Infants and Children (WIC);

2. The child is living in or regularly visiting a house, apartment, dwelling, structure, or child care facility built before 1960;

3. The child is living in or regularly visiting a house, apartment, dwelling, structure, or child care facility built before 1978 that has (i) peeling or chipping paint or (ii) recent (within the last six months) ongoing or planned renovations;

4. The child is living in or regularly visiting a house, apartment, dwelling, or other structure in which one or more persons have blood lead testing yielding evidence of lead exposure;

5. The child is living with an adult whose job, hobby, or other activity involves exposure to lead;

6. The child is living near an active lead smelter, battery recycling plant, or other industry likely to release lead;

7. The child's parent, guardian, or other person standing in loco parentis requests the child's blood be tested due to any suspected exposure; or

8. The child is a recent refugee or immigrant or is adopted from outside of the United States.

C. Exceptions.

A child who does not meet any of the schedule or criteria provided in subsection A or B of this section is considered to be at low risk, and testing is not required but may be conducted at the discretion of the health care provider. The testing requirement shall be waived if the parent, guardian, or other person standing in loco parentis of a child objects to the testing on the basis that the procedure conflicts with his religious tenets or practices.

D. Confirmation of blood lead levels.

Blood lead level testing shall be performed on venous or capillary blood. Tests of venous blood performed by a laboratory certified by the federal Centers for Medicare & Medicaid Services in accordance with 42 USC § 263a, the Clinical Laboratory Improvement Amendment of 1988 (CLIA-certified), are considered confirmatory.

Tests of venous blood performed by any other laboratory and tests of capillary blood shall be confirmed by a repeat blood test, preferably venous, performed by a CLIA-certified laboratory. Such confirmatory testing shall be performed in accordance with the following schedule:

1. Within one to three months if the result of the capillary test is at or above the CDC's reference value and up to 9 micrograms of lead per deciliter of whole blood (µg/dL).

2. Within one week to one month if the result of the capillary test is 10–44 µg/dL.

   The higher this test result, the more urgent the need for a confirmatory test.

3. Within 48 hours if the result of the capillary test is 45–59 µg/dL.

4. Within 24 hours if the result of the capillary test is 60–69 µg/dL.

5. Immediately as an emergency laboratory test if the result of the capillary test is 70 µg/dL or higher.

E. Information to be provided.

As part of regular well-check visits for all children, the health care provider shall make available to parents, guardians, or other persons standing in loco parentis information on the dangers of lead poisoning, potential sources of lead and ways to prevent exposure, and a list of available lead-related resources. When blood lead level testing is performed, the health care provider shall share the child's blood lead level test result with the child's parent, guardian, or other person standing in loco parentis and report to the local health department in accordance with the requirements of 12VAC5-90-80.

Attachment 3: Virginia Guidelines – Testing Virginia Children for Lead Exposure.

VIRGINIA GUIDELINES

TESTING VIRGINIA CHILDREN FOR LEAD EXPOSURE [1]

ALL MEDICAID ENROLLED CHILDREN ARE REQUIRED TO BE TESTED AT BOTH 12 AND 24 MONTHS OF AGE

To determine risk for other children:
Blood lead levels shall be obtained in children at ages 12 ***and*** *24 months of age if they meet ANY one of the criteria noted in the box below. In addition, children over the age of 24 months up to 72 months of age who have not previously been tested and meet ANY one of the criteria in the box below, or experienced a change since testing that has resulted in an increased risk, shall also be tested.*

1. Eligible for or receiving benefits from Medicaid or WIC;
2. Living in or regularly visiting housing or child care facility built before 1960;
3. Living in or regularly visiting housing built before 1978 with peeling or chipping paint or recent (within the last 6 months), ongoing or planned renovations;
4. Living with or regularly visiting housing in which one or more persons have evidence of lead exposure;
5. Living with an adult whose job or hobby involves exposure to lead;
6. Living near an active lead smelter, battery recycling plant, or other industry likely to release lead;
7. The child's parent or guardian requests the child's blood be tested due to any suspected exposure;
8. Recent refugee, immigrant, or child adopted from outside the U.S.

- *Take careful history regarding possible lead exposure at each well-child visit, and provide lead poisoning prevention materials.*
- *Testing may be performed by venipuncture or capillary. Filter paper collection methods are also acceptable and often more convenient for the family if performed in the provider's office.*
- *The use of a CLIA-waived lead testing device approved by CDC and the FDA may be used as a "screening" test, and any level above5 µg/dL needs to be confirmed by submitting a venous sample to a CLIA-approved laboratory.*

SCHEDULE FOR OBTAINING A CONFIRMATORY SAMPLE [1]

SCREENING TEST RESULT (µg/dL)	PERFORM CONFIRMATORY TEST
5–9	Within 1 to 3 months
10–44	Within 1 week to 1 month (the higher the screening test, the sooner the confirmatory test)
45–59	Within 48 hours
60–69	Within 24 hours
≥ 70	Immediately as an emergency lab test

NOTE: *There is no safe lead level, and providers should communicate with parents/guardian any detectable results, and use best medical judgment to assess each child and coordinate follow up testing and care coordination. A venous sample is required for environmental investigations at levels of 20 ug/dL or persistent or rising 15–19 µg/dL.*

GUIDELINES FOR MANAGEMENT OF CHILDREN WITH CONFIRMED BLOOD LEAD LEVELS ≥ 5µg/dL [2, 3, 4]

BLOOD LEAD LEVEL (µg/dL)	ACTION	TIME FRAME
5–9	**Child's healthcare provider**: • Provides educational materials to include dietary and environmental information • Monitors blood lead level with follow up test	Within 3 months
10–14	**Case manager coordinates with child's healthcare provider:** • Provides educational materials to include dietary and environmental information • Perform nursing assessment • Follow-up blood lead testing within 30 days to assure not rising • Refer for WIC and social services, if needed	Within 30 days
15–19	Above actions, **plus**: • Proceed according to actions for 20–44 µg/dL if: A follow-up blood lead is 15 or above, or the blood lead level is increasing	Within 2 weeks
20–44	Above actions, **plus**: • Coordinate a timely environmental investigation	Within 1 week
45–69	Above actions, **plus**: • Consider chelation	Within 48 hours
70 and above	Above actions, **plus**: Hospitalize child and begin medical treatment (chelation therapy as appropriate) immediately. **Contact Emergency Lead Healthcare 866-SOS-LEAD (866-767-5323) for consultation and assistance**	Immediate, Within 24 hours

References (Attachment 3)

1. § 32.1-46.1 of the Code of Virginia. Board to establish protocol for identification of children with elevated blood-lead levels.

2. 12VAC5-90 et seq.; Regulations for Disease Reporting and Control (12VAC5-90-215. Schedule and criteria for and confirmation of blood lead testing and information to be provided).

3. Centers for Disease Control and Prevention. *Preventing Lead Poisoning in Young Children.* August 2005.

4. Virginia Lead Elimination Work Group Medical/Education Committee; Recommendations. February 2016.

5. Centers for Disease Control and Prevention, Advisory Committee on Childhood Lead Poisoning. *Low Level Lead Exposure Harms Children: A Renewed Call for Primary Prevention.* January 4, 2012.

Attachment 4: Sources of Lead and Steps to Reduce Exposures

Lead can be found in many products and locations. Lead-based paint and contaminated dust are the most widespread and dangerous high-dose source of lead exposure for young children [CDC 2013].

Lead exposure can occur from one or more of the following:

Indoor

Paint – Ingesting paint chips primarily found in homes built prior to 1978 and on older toys and furniture

Dust – Ingesting dust (from hand-to-mouth activity) found in older homes (built prior to 1978) or tracked in from contaminated soil

Water – Drinking water containing lead that comes from corrosion of older fixtures, from the solder that connects pipes, or from wells where lead contamination has affected the groundwater

Tableware – Eating foods from imported, old, handmade, or poorly glazed ceramic dishes and pottery that contains lead. Lead may also be found in leaded crystal, pewter, and brass dishware

Candy – Eating consumer candies imported from Mexico. Certain candy ingredients such as chili powder and tamarind may be a source of lead exposure. Candy wrappers have also been shown to contain some lead

Toy Jewelry – Swallowing or putting in the mouth toy jewelry that contains lead. This inexpensive children's jewelry is generally sold in vending machines and large volume discount stores across the country

Traditional (folk) Medicines –Ingesting some traditional (folk) medicines used by India, Middle Eastern, West Asian, and Hispanic cultures. Lead and other heavy metals are put into certain folk medicines on purpose because these metals are thought to be useful in treating some ailments. Sometimes lead accidentally gets into the folk medicine during grinding, coloring, or other methods of preparation

Outdoor

Outdoor Air – Breathing lead particles in outdoor air that comes from the residues of leaded gasoline or industrial operations

Soil – Ingesting dirt contaminated with lead that comes from the residues of leaded gasoline, industrial operations, or lead-based paint

Other

Hobbies – Ingesting lead from hobbies using lead such as welding, auto or boat repair, the making of ceramics, stained glass, bullets, and fishing weights. Other hobbies that might involve lead include furniture refinishing, home remodeling, painting and target shooting at firing ranges

Workplace – Ingesting lead found at the workplace. Jobs with the potential for lead exposure include building demolition, painting, remodeling/renovation, construction, battery recycling, radiator repair, and bridge construction. People who work in a lead

Multiple factors (demographic and socioeconomic status, living in older houses, and contact with contaminated air or soil) are associated with lead exposure. Specifically, those factors include the following:

- Children less than 6 years of age [Rowden et al. 2011]
- Women of child bearing age (Between 15 and 44) [Shannon et al. 2005]
- African Americans and Hispanics [Bernard et al. 2003, CDC 2013b, Jones et al. 2009]
- People who live in homes built before 1978[Bernard et al. 2003; CDC 2013]
- People who rent [Schleifstein 2011]
- People born in Mexico [Dixon et al. 2009; USEPA 2013]
- Those with a Poverty Income Ratio (PIR) less than 1.24 [CDC 2013, Jones et al. 2009]
- Living in an area with a population density that is urban [Mielke et al. 2010]
- Living in specific regions of the U.S. (i.e., Northeast >* Midwest> South> West) [Lee et al. 2005]

It is important to determine the construction year of the house or the dwelling where your child may spend a large amount of time (e.g., grandparents or daycare). In housing built before 1978, assume that the paint has lead unless tests show otherwise. The following steps can be taken to reduce potential lead exposures

- **Have your children tested for lead beginning at 9 months to one year of life.**
- **Provide a healthy diet for your child that is rich in iron, calcium and vitamin C, and with appropriate levels of fat based on age.**
- **Regularly wash children's hands, especially before eating.** Always wash their pacifiers, drinking bottles and toys before they use them.
- **Regularly wet-mop floors and wet-wipe window components.** Because household dust is a major source of lead, parents should wet-mop floors and wet-wipe horizontal surfaces every 2–3 weeks. Windowsills and wells can contain high levels of leaded dust. They should be kept clean. If feasible, windows should be shut to prevent abrasion of painted surfaces or opened from the top sash.
- **Make sure your child does not have access to peeling paint or chewable surfaces painted with lead-based paint.** Do not try to remove peeling paint yourself! If there is peeling paint in your home, call the health department for help on how remedy this. If you rent, report peeling paint to your landlord. It is your landlord's responsibility to properly take care of this problem.
- **Pregnant women and children should not be present in housing built before 1978 that is undergoing renovation.** They should not participate in activities that disturb old paint or in cleaning up paint debris after work is completed.
- **Create barriers between living/play areas and lead sources.** Until environmental clean-up is completed, parents should clean and isolate all sources of lead. They should close and lock doors to keep children away from chipping or peeling paint on walls. You can also apply temporary barriers such as contact paper or duct tape, to cover holes in walls or to block children's access to other sources of lead.

- **Remove shoes before entering your home and ask others to do the same.**
- **Prevent children from playing in bare soil; if possible, provide them with sandboxes.** Parents should plant grass on areas of bare soil or cover the soil with grass seed, mulch, or wood chips, if possible. Until the bare soil is covered, parents should move play areas away from bare soil and away from the sides of the house. If using a sandbox, parents should also cover the box when not in use to prevent cats from using it as a litter box. That will help protect children from exposure to animal waste.
- **Let tap water run for one minute before you start using it.**

References (Attachment 4)

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