HUMANITARIAN SITUATIONS INCREASE BLACK CARBON EMISSION (SMOKE) RISKS ON GLOBAL CLIMATE CHANGE EFFECTS

Poster No. 324277: Climate Change Implications for Health-Care Waste Incineration Trends during Emergency Situations

Case Study of 2010 Earthquake and Cholera Tragedies in Haiti

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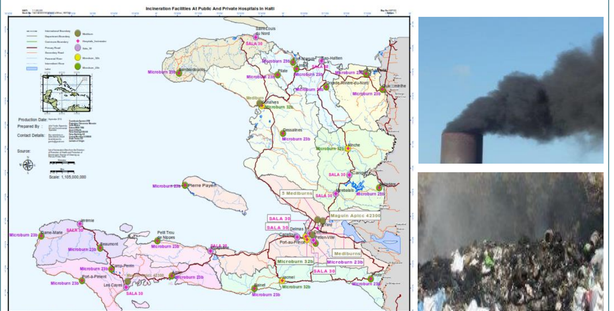
THE PROBLEM

- Higher Smoke or BC emissions in the global South countries; major source of respiratory health risks.
- Climate change potential of SMOKE: The second strongest cause of climate change after CO2.
- The observed lack of air pollution control systems in healthcare waste (HCW) incineration activities and open burning HCW disposal practices in the global South countries including Haiti.



Incinerators without air pollution control system in Haiti & BC emissions/smoke

- Calls for joint efforts in curbing BC emissions as short-lived climate change pollutant. BC emissions although not greenhouse gases absorb solar energy and alter the reflectivity of earth's atmosphere and ice surfaces.
- 1g of BC emissions causes 100-200 more warming than 1g CO2 over 100 years period.
- Increased humanitarian situations in the world.

OBJECTIVES OF THIS STUDY

- To determine whether HCW incinerated weights before and after the January 2010 earthquake and October 2010 cholera disasters in Haiti follow a linear pattern.
- To measure the average smoke densities coming from incineration of plastic and cardboard sharps HCW containers.
- To determine if cardboard HCW sharps containers emit lower BC emissions to the atmosphere during the incineration process, relative to the plastic sharps containers.

RESEARCH QUESTIONS

- Do HCW incinerated weights before and after the January 2010 earthquake and October 2010 cholera disasters in Haiti follow a linear pattern?
- Do the cardboard HCW sharps containers emit lower BC emissions to the atmosphere during the incineration process, relative to the plastic sharps containers?

METHODS

- Quantitative-observational study. Sources of data: (i) MINUSTAH HCW incineration data (**January 2009- December 2013, *n* = 60 months**), (ii) Physical reading of smoke level from incineration activities **(*n* = 10 cycles@30 min).**
- Three smoke readers (Researcher as USEPA certified Visible Emissions Reader) and 2 trained smoke readers participated in data collection. **Ringelmann Smoke Chart** used as data collection tool.
- IRB approval obtained, pilot data collection conducted and SPSS software used for data analysis (**Linear Regression, Independent samples *t-test***).

Quantities of sharps HCW incinerated (kg)	Types of sharps containers used	Initial bottom burner temperature (⁰C)	Final bottom burner temperature (⁰C)	Average Ringelmann smoke number	Average smoke density (%)
14.6	Plastic	389	1095	48.0	**32.0**
	Cardboard box	398	950	21.5	**14.3**
13.7	Plastic	379	1062	43.5	**29.0**
	Cardboard box	389	948	20.0	**13.3**
11.7	Plastic	372	1049	38.0	**25.3**
	Cardboard box	382	952	17.0	**11.3**
10.0	Plastic	378	978	31.3	**20.9**
	Cardboard box	401	916	11.3	**7.6**
8.0	Plastic	377	951	14.7	**9.8**
	Cardboard box	363	896	8.3	**5.6**
5.0	Plastic	389	949	18.7	**12.4**
	Cardboard box	364	879	10.3	**6.9**
3.0*empty	**Plastic**	**388**	**910**	**20.3**	**13.6**

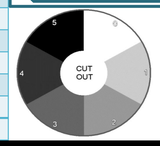
Primary Data: Plastic and Cardboard Sharps HCW Container's Incineration Information

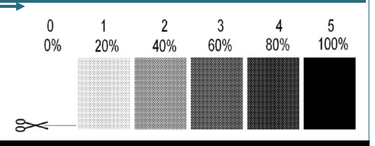
	HCW incinerated weights (kg)				
Months	2009	2010	2011	2012	2013
January	170	590	434	587	777
February	229	627	393	571	461
March	185	343	558	556	419
April	160	254	347	793	497
May	197	382	268	635	406
June	218	298	427	680	159
July	203	114	261	723	473
August	503	140	292	576	292
September	178	704	778	492	292
October	404	795	623	477	421
November	199	437	649	488	718
December	201	527	611	685	223
Total	2847	5211	5641	7263	5138

Note: Secondary Data on Healthcare waste incinerated Weights (kg) by MINUSTAH (2009-2013).

$$Avrg\ Ringelmann\ Number = \frac{Total\ of\ Ringelmann\ Numbers}{Total\ number\ of\ observations}$$

$$Avrg\ Smoke\ Density\ (\%) = (Avrg\ Ringelmann\ Number) \times 20$$





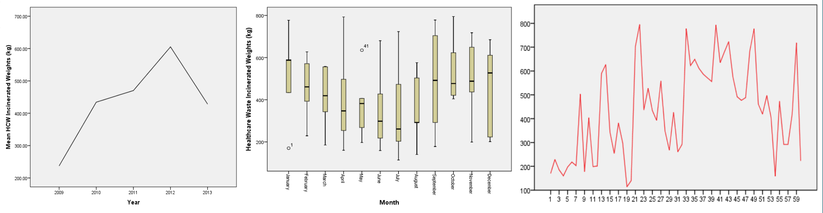
Circle-type and Bar-type miniature smoke charts

RESULTS

- Linear regression analysis of the pattern of HCW incinerated weights revealed a relatively linear pattern (R^2 = 0.164) with fluctuating scenarios (peak sharp rise in 2012 resulting from incineration of expired pharmaceuticals after the emergency).

Model	*β*	*p*	95 % *CI* Lower bound	95 % *CI* Upper bound
HCW Incinerated Weights (kg)	296.017	.000	201.342	390.692
Months Before, During and After the 2010 Earthquake and Cholera Disasters	4.557	.001	1.858	7.256

Note: Linear regression results of HCW incinerated weights (kg) based on months in which they occurred. ***β***= Unstandardized Coefficients, *p* = probability, *CI* = Confidence Interval, R^2 = .164, (*p* = 0.001).



Results of Linear Regression analysis and descriptive statistics depicting the peak incineration periods (the year 2012 and month of September) with a monthly time series model

- Independent samples *t-tests* demonstrated significantly lower smoke emission during the incineration processes of cardboard sharps HCW containers as compared to plastic containers (95 *% CI, p* = 0.003).

Incineration processes of plastic and cardboard sharps HCW containers depicting lower relative smoke density from cardboard sharps containers as compared to plastic containers

Implications for positive social change include provision of quantitative evidence of the benefits of cardboard sharps HCW containers in reducing smoke during incineration activities, potential data for policy formulation, suggestions to review HCW disposal guidelines, and additional research on potential health impacts of emergency HCW disposal and BC emissions.

RECOMMENDATIONS

- HCW incineration smoke in the global South countries be reduced, monitored & regulated.
- WHO revises the emergency HCW disposal guidelines to redefine the specific emergency time span and specify the use of cardboard boxes for lower BC emissions.
- Effective guidelines on logistics and pharmaceutical management during emergency medical missions.
- Revising incineration emission limits for particulate matter (PM) based on locations, the present industrial developments and urbanization rates in the world.
- Health facilities opting incineration treatment method for HCW stop the use of plastic sharps containers.
- Instituting policy guidelines in every country to provide HCW incineration framework including air pollution control systems.
- Avoiding open burning disposal method of HCW.

CONCLUSION

BC emissions are a growing threat to human health and climate change with extreme impacts in the global South countries where over three-quarters of BC emissions are produced. Reducing man-made emergency situations will reduce BC emissions for healthier people and climate.

REFERENCES

Anonymous. (2013). Black carbon takes larger climate role: Second-highest contributor after CO2. News, TCE: The Chemical Engineer, (860), 7.

Bond, T. C., Doherty, S. J., Fahey, D. W., Forster, P. M., Berntsen, T., DeAngelo, B. J., ... & Zender, C. S. (2013). Bounding the role of black carbon in the climate system: A scientific assessment. Journal of Geophysical Research: Atmospheres, 118, 5380–5552, doi:10.100250171

Borrell, B. (2008). Carbon soot print. Natural History, 117(5), 14.

BSI British Standards. (2009). Use of Ringelmann and miniature smoke charts. ISBN 9780580623004

Capital Allergy and Respiratory Disease Center. (2013). Hope for Haiti. Retrieved from http://capitalallergy.com/hope-for-haiti/

Deangelis, K. (2011). Black carbon: The most important ignored contributor to climate change. University of Maryland Law Journal of Race, Religion, Gender & Class, 26(1), 239-270.

IMF. (2008). Staff country report Haiti: Poverty reduction strategy paper.

World Health Organization. (2014a). Climate change and human health. Retrieved from http://www.who.int/globalchange/environment/climatechange-2014-report/en/

World Health Organization. (2014c). Safe management of wastes from health-care activities (2nd edition). ISBN 978 92 4 154856 4

Zakaria, A., & Labib, O. (2003). Evaluation of emissions from medical waste incinerators in Alexandria. Journal of Egypt Public Health Association, 78(3-4) 225-44.

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Special *thanks to my dissertation committee members, the chair, Dr. Patrick Tschida, committee member, Dr. David Anderson, University Research Reviewer Dr. Raymond Thron, the management of United Nations Mission for Stabilization in Haiti (MINUSTAH), Ministry of Public Health and Population (MSPP) in Haiti , British Standards Institution (BSI) and Institutional Review Board (IRB).*