

Methanol poisoning in South-South Nigeria: Reflections on the outbreak response

Nnanna Onyekwere,¹
Ifeoma Nwadiuto,¹
Sylvester Maleghemi,²
Omosivie Maduka,³ Tamuno-Wari
Numbere,¹ Ndubuisi Akpuh,⁴
Esther Kanu,⁴ Ifeoma Katchy,⁴
Ibitein Okefor⁴

¹Department of Public Health, Rivers State Ministry of Health; ²World Health Organization, Rivers State Field Office; ³Department of Preventive and Social Medicine, University of Port Harcourt; ⁴Nigerian Field Epidemiology and Laboratory Training Programme, Nigeria

Abstract

The methanol poisoning outbreak in Rivers State in May 2015, involved 84 persons in five local government areas. An incident management system comprised of an Emergency Preparedness and Response (EPR) committee and the Local Government Area Rapid Response Teams in an Emergency Operations Centre (EOC). The EOC teams conducted case finding activities, line listing, and descriptive analysis, a retrospective cohort study and collection of local gin samples for laboratory investigation. They also coordinated community mobilization and sensitization activities, intervention meetings with local gin sellers, trace back activities and case management. Those affected were male (72; 85.7%) aged between 20 and 79 years. Of the 55 persons whose socio-demographics were obtained, forty-one persons (74.6%) were married, and 23 (41.8%) had primary education. Case fatality rate was 83.3% with an attack rate of 16 per 100,000 persons. Those exposed to ingestion of adulterated gin were six times more likely to develop methanol poisoning than those not exposed RR=6 (1.0-38.5); P=0.0078. It is hoped that this experience has positioned the state for better preparedness towards future outbreaks.

Introduction

Methanol is a colourless, watery liquid alcohol variant found in pharmaceuticals and chemicals such as anti-freeze, paint removers and nail varnish. It is also naturally occurring in humans, animals, and plants

foods such as fresh fruits and vegetables, fruit juices, fermented beverages, and soft drinks containing aspartame. Although similar to ethanol (drinkable alcohol), it is highly poisonous. Methanol poisoning most often occurs from ingestion of methanol-contaminated alcoholic beverages or drinking methanol-containing products accidentally.¹⁻³ The toxic component of methanol is known as methyl alcohol. When ingested in quantities as small as 10 mL, it metabolizes into formic acid which can destroy the optic nerve leading to permanent blindness. Higher doses up to 30 mL can have fatal consequences.⁴

The clinical presentation of methanol poisoning includes low blood pressure, confusion, dizziness, difficult breathing, agitation, coma, blurred vision, blindness, severe abdominal pain, seizures, vomiting, jaundice, bleeding, and death.³ Several outbreaks of methanol poisoning have occurred in recent times. In all these outbreaks case fatality has been very high with the few survivors often suffering irreversible complications such as blindness. Majority of these outbreaks occurred from the ingestion of methanol-contaminated alcohol.⁵⁻¹⁰

The epidemiology unit of the Rivers State Ministry of Health was first notified of suspected cases of methanol poisoning on the 3rd of June, 2015 with a response done within 24 hours of notification. The onset of the outbreak was traced to a local celebration which held in Port Harcourt [Local Government Area (LGA)] (district) on the 30th of May, 2015 involving the ingestion of local gin and a local delicacy of dog meat. Outbreak occurred six weeks after a similar outbreak had first been reported in Odo-Irele in Ondo state in the Western part of the country.¹¹ That outbreak recorded 37 persons-affected, and 27 deaths (case fatality of 73.0 %). The Rivers State outbreak was associated with the ingestion of local gin in five LGAs in the state. According to reports by gin sellers during a meeting with the association, the outbreak had occurred as a result of the scarcity of ethanol which led some local gin producers to make use of methanol as a substitute.

This paper aims to describe the epidemiology and outbreak response to methanol poisoning in the Rivers State outbreak that occurred in June 2015.

Materials and Methods

Setting

Rivers State is one of the 36 states of Nigeria and occupies an area of 21,850 sq. km. According to the 2006 census, the state

Correspondence: Omosivie Maduka, Department of Preventive and Social Medicine, University of Port Harcourt, PMB 5323, Nigeria.
Tel.: +234.8033298096.
E-mail: omosivie.maduka@uniport.edu.ng

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Contributions: NO, IN, OM, SM, and TN conceptualized the research design and wrote up the protocol, OM wrote the first draft of the manuscript. NA, EK, IK, and IO were involved in data collection and writing the second draft of the manuscript. All authors reviewed the drafts and contributed to the final version of the manuscript.

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has a population of 5,185,400, making it the sixth-most populous state in the country. Its capital, Port Harcourt is its largest city and is economically significant as the centre of Nigeria's oil industry. Rivers State is home to many indigenous ethnic groups: Ikwerre, Ibani, Opobo, Eleme, Okrika, and Kalabari, Etche, Ogba, Ogoni, Engenni and others living in 23 local government areas. The state is famous for its vast reserves of crude oil and natural gas and has two major oil refineries, two major seaports, airports, and various industrial estates spread across the land. More than 60% of the country's output of crude oil is produced in the state.

Response Team and preparation for fieldwork

The Public Health Department of the Rivers State Ministry of Health headed by the Director Public Health as the [Incident Manager (IM)], coordinated the response through the state epidemiology unit. With

the support of the [World Health Organization (WHO)] state office team and personnel from the [Nigerian Field Epidemiology and Laboratory Training Programme (NFELTP)] the incident management system and [Emergency Operations Centre (EOC)] used for the management of the Ebola Virus Disease outbreak in 2014 was reactivated. The incident management team also involved the state [Disease Surveillance and Notification Officers (DSNO)], the [Medical officers of Health (MoH)] and LGA DSNO officers of the affected LGAs. The EOC included an [Emergency Preparedness and Response (EPR)] committee and LGA [Rapid Response Teams (RRTs)]. The state epidemiologist was in charge of the EPR committee while members of the LGA RRTs carried out the field work, interviewed suspected cases and took samples of the local gin ingested for laboratory investigation. These all reported to the IM.

Verification of diagnosis and case definition

Diagnosis of acute methanol toxicity was made based on the presentation of cases and epidemiological linkage to ingestion of local gin. Samples of the substance ingested were analysed by the [National Agency for Food and Drug Administration and Control (NAFDAC)] with the result showing methanol concentration ranging from 11.33-312 g/L. Blood samples were also taken from some of the patients who were admitted to hospitals. Analysis showed various degrees of electrolyte derangement and quantities of methanol greater than 20 g/dL. Based on the epidemiology of methanol poisoning a suspected case of methanol poisoning was defined as a person of any age with a history of visual impairment or sudden blindness and vomiting, with or without breathlessness occurring within 48 hours of consumption of local gin in the state.

Case finding activities and descriptive epidemiology

Case finding activities were carried out

by the EOC team members working in the five LGAs from where reports of suspected cases of methanol poisoning had come. Active case search was carried out in all the five LGAs implicated using a simple data collection tool that captured relevant information. Information collected included demographic data such as name, sex, LGA, age, village, town or ward, occupation, followed by the date of onset of symptoms, exposure to local gin ingestion, exposure to dog meat, outcome, date of death and duration of symptoms before death (if dead). This data collection tool was used to create a line listing of all persons who met the case definition was done on an MS Excel spreadsheet which was then analysed with SPSS version 20.

Control measures

Upon notification of the [Federal Ministry of Health (FMoH)], the state EOC EPR committee and LGA RRT instituted some interventions for the control of the outbreak. Public health enlightenment through mass media such as radio jingles and live interviews was done. In addition, a helpline was made available to the public for information sharing. Community mobilization and sensitization was carried out in

the affected LGAs. Series of meetings were held by EPR committee members with the association of local gin sellers for sensitization and to trace the source of the adulterated gin. Case management protocols were adapted and shared. Suspected cases were taken to health facilities for case management based on these protocols. A task force was set up to investigate the source of supply of the adulterated gin and confiscate all such within the period of the health emergency. Government officials pledged to provide some compensation to the families of the victims, and rehabilitation of those who had lost their sight.

Results

Descriptive epidemiology

A total of 84 cases were tracked and line listed over the 16 days of the outbreak in Rivers State. The most number of cases and deaths occurred on the 4th day of the outbreak while both the 5th and 6th days recorded 100% case fatality (Figure 1).

In addition, out of 23 LGAs in the state five LGAs (21.7%) were implicated in the occurrence of cases of methanol poisoning

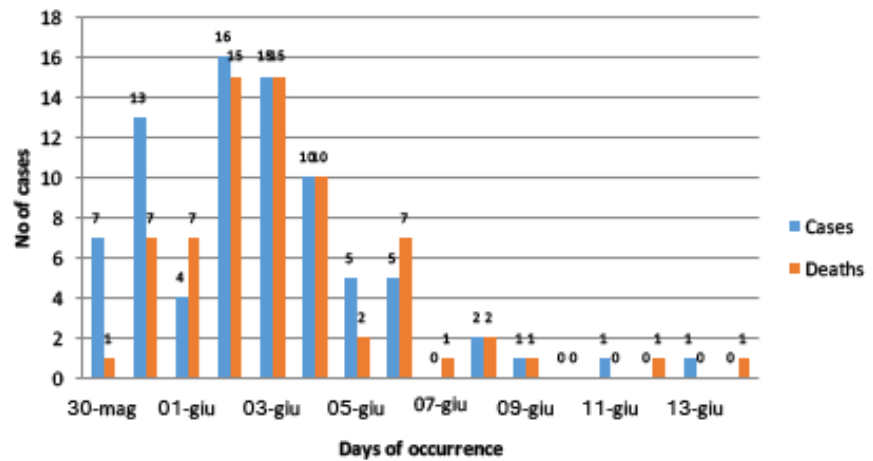


Figure 1. Occurrence of cases and deaths during the outbreak period.

Table 1. Distribution of cases and deaths according to affected local government areas (LGAs) in the state.

Affected LGAs	No. Cases (%)	Total Population* (Population at risk**)	Attack Rate (per 100,000 persons at risk)	No. of deaths (%)	Case fatality (%)
Ahoada	5 (6.0)	285,116 (75,270)	7	5 (7.1)	100.0
Bonny	26 (31.0)	237,299 (62,647)	40	25 (35.7)	96.2
Gokana	32 (38.1)	261,570 (69,054)	12	23 (32.9)	71.9
Obio-Akpor	15 (17.9)	535,800 (141,451)	11	11 (15.7)	73.3
Port Harcourt	6 (7.1)	618,456 (163,272)	4	6 (8.6)	100.0
Total	84	1,938,241 (511,696)	16	70	83.3

*From the 2006 National population census; ** calculated as 26.4% of population representing life time alcohol use in Nigeria (R).

between 30th of May and 14th of June 2015. Gokana LGA contributed the most number of cases; 32 (38.1%) while the highest number of deaths occurred in Bonny LGA; 25 (35.7%) with case fatality rates being highest in Bonny and Port Harcourt LGAs. The overall case fatality rate was 83.3% (Table 1). The overall attack rate for the five affected LGAs was 16 per 100,000 persons at risk

with Bonny LGA accounting for the highest attack rates (40 per 100,000 persons at risk). A spot map shows the greatest clustering of cases in Gokana LGA (Figure 2).

The age and sex distribution of the 84 cases line listed revealed that the majority of cases were male (72; 85.7%) while the majority of persons affected were aged between 30 and 69 years (62;73.8) with the

highest contribution from among those aged 40-49 years (26; 31.0%) (Table 2).

The team was able to retrieve other socio-demographic information from only 55 of the 84 cases. Analysis of this showed that 41 (74.6%) of cases were married, 23 (41.8%) had a primary level of education while majority practiced fishing (17; 30.9%) and farming (11; 20.0%) as their occupation (Table 3).

The commonest presenting symptoms for these cases were blindness (34%), vomiting (24.5%) and respiratory distress (17%) (Figure 3). The only survivor from Bonny LGA regained his sight after two weeks.

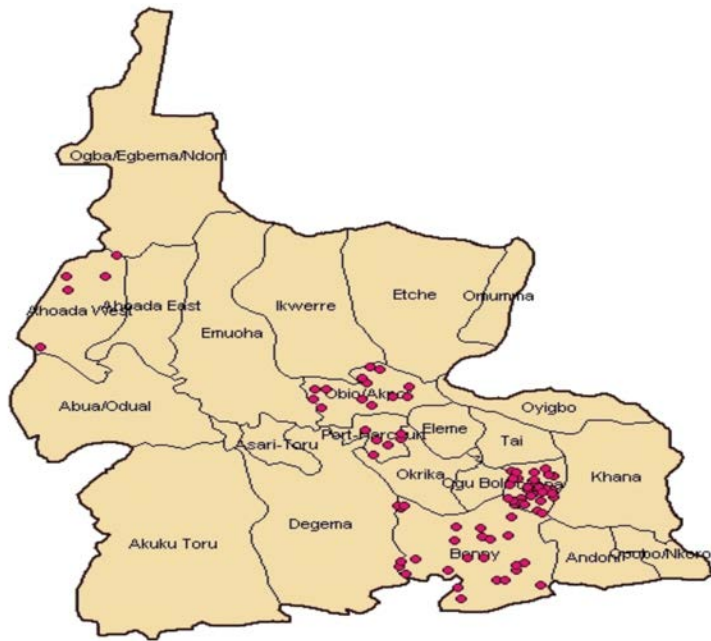


Figure 2. Spot map of distribution of cases of methanol poisoning in Rivers State, Nigeria 30th May to 14th June 2015.

Table 2. Age and Sex distribution of cases of methanol poisoning.

Variables	Number	Relative frequency (%)
Age (years)		
20-29	4	4.8
30-39	18	21.4
40-49	26	31.0
50-59	18	21.4
60-69	6	7.1
70-79	3	3.6
NR	9	10.7
Sex		
Male	72	85.7
Female	12	14.3

NR: age was not specified.

Table 3. Other Socio-demographic characteristics of the cases across the five affected local government areas (LGAs) in Rivers State, 2015.

	Ahoada (n=4); n (%)	Bonny (n=11); n (%)	Gokana (n=23); n (%)	Obio-Akpo (n=15); n (%)	Port Harcourt (n=2); n (%)	Total (n=55); *n (%)
Marital Status (n=55)						
Single	0 (0)	2 (22.2)	3 (13.0)	5 (33.3)	2 (100)	12 (21.8)
Married	3 (75)	9 (97.8)	20 (87.0)	9 (60.0)	0 (0)	41 (74.6)
Separated/Divorced	1 (25)	0 (0)	0 (0)	1 (6.7)	0 (0)	2 (3.6)
Educational Level (n=55)						
None	2 (50)	3 (27.2)	4 (17.4)	0 (0)	2 (100)	11 (20)
Primary	1 (50)	6 (54.6)	11 (47.8)	5 (33.3)	0 (0)	23 (41.8)
Secondary	1 (50)	2 (18.2)	8 (34.8)	8 (53.3)	0 (0)	19 (34.6)
Tertiary	0 (0)	0 (0)	0 (0)	2 (13.4)	0 (0)	2 (3.6)
Occupation (n=55)						
Fishing	0 (0)	7 (63.6)	10 (43.5)	0 (0)	0 (0)	17 (30.9)
Farming	3 (75)	0 (0)	8 (34.8)	0 (0)	0 (0)	11 (20)
Business	0 (0)	0 (0)	0 (0)	6 (40)	0 (0)	6 (10.9)
Petty trading	0 (0)	3 (27.3)	5 (21.7)	0 (0)	0 (0)	8 (14.6)
Security	0 (0)	1 (0.1)	0 (0)	4 (26.7)	1 (50)	6 (10.9)
Manual labourer	0 (0)	0 (0)	0 (0)	0 (0)	1 (50)	1 (1.8)
Native doctor	1 (25)	0 (0)	0 (0)	0 (0)	0 (0)	1 (1.8)
None	0 (0)	0 (0)	0 (0)	5 (33.3)	0 (0)	5 (9.1)

*Socio-demographic data was retrieved from only 55 of the 84 cases

Analytic epidemiology

Following the findings of the descriptive epidemiology, a hypothesis that those exposed to suspected adulterated gin were more likely to develop methanol poisoning was formulated. This hypothesis was tested via a retrospective cohort study carried out among 24 persons in Gokana Local Government Area of Rivers State. The contingency table below Table 4, showing exposure to local gin as exposure variable and development of features of methanol poisoning as outcome variable, revealed that those exposed to ingestion of adulterated gin were six times more likely to develop methanol poisoning than those not exposed group RR=6 (1.0-38.5); P=0.0078

The findings for the trace-back investigation to identify the source of the adulterated gin revealed that 5 out of the six identified local gin retailers (83.3%) was traced-back to the common source of Nembe Water-side in Port Harcourt..

Discussion

The outbreak of methanol poisoning in Rivers State is the second documented outbreak of methanol poisoning in Nigeria. There is no documented evidence of methanol poisoning occurring before 2015.

This outbreak of methanol poisoning in Rivers State was significantly larger and more widespread than the earlier outbreak in Ondo state.¹¹ However, it remains a relatively small outbreak in comparison to recent outbreaks in other countries such as Kenya, Libya, Czech, and Iran.^{6,10,12} In both the Ondo and Rivers state outbreaks, the cause of the outbreak was traced to ingestion of local gin contaminated with methanol. This is consistent with the findings in other outbreaks.^{5-7,9,10,12-14}

Case fatality from methanol poisoning is usually high. This was especially so for the Rivers state outbreak which recorded the highest case fatality of all documented recent outbreaks.^{5-7,10-12} This high case fatality may have been caused by late presentation of many of the suspected cases, poor knowledge of the management of methanol poisoning among health workers and unavailability of antidotes to acute methanol.^{4,12,13,15,16} Furthermore, this outbreak affected five local government areas. The widespread nature of the outbreak proved challenging to the EOC and RRTs. The outbreak thus lasted a total of sixteen days, just like the earlier outbreak in Ondo state and similar to other recently documented outbreaks.

The success factors in the control of this outbreak relate to the rapid response of the

epidemiology unit of the state supported by the NFEPLP and WHO within 24 hours of the initial notification. The NFEPLP brought their skills in contact tracing and active case search to bear on the outbreak response. The efforts of the EPR task force aided by state security personnel who did the trace-back and confiscation of methanol and the efforts of the social mobilization teams who provided health awareness and prevention information through a variety of strategies also contributed to the successful control of the outbreak within sixteen days.

However, the outbreak response could have fared better. Control efforts were limited by initial denial by persons suspected to have ingested local gin, lack of cooperation by the members of the association of local gin producer and inadequate funding to sustain control efforts particularly public enlightenment programmes. Security concerns hindered trace-back efforts as trace-back teams were unable to access the source of the contaminated gin due to the prevalence of community clashes and local gangs in the area.

We recommend that coordination and partnership be maintained between the SMOH and other partners through regular meetings to review surveillance data. Mock exercises mimicking outbreak scenarios should be conducted to gauge the readiness of other LGAs to respond to similar outbreaks. Investments should be made in the training of relevant individuals such as health workers, security agencies and laboratory personnel for outbreak response and surveillance. Finally, surveillance activities need to be improved on both at community and facility levels.

Conclusions

The use of the Incident Management structure for methanol poisoning response is commendable. There are many lessons to learn from this outbreak and its response. It is hoped that this experience has positioned the state for better preparedness towards the possibility of future outbreaks.

References

1. Pohanka M. Toxicology and the biological role of methanol and ethanol: Current view. Biomed Pap Med Fac Univ Palacky Olomouc Czech Repub 2015 May 25
2. The National Institute for Occupational Safety and Health. METHANOL : Systemic Agent. CDC Emergency Response Safety and Health Database

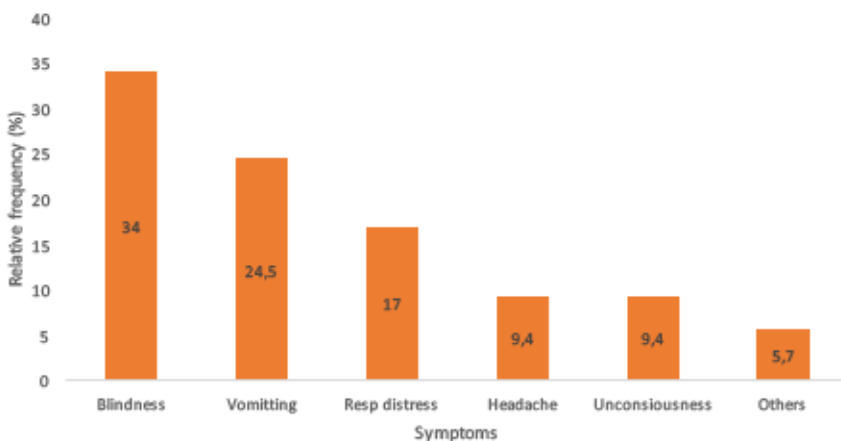


Figure 3. Common clinical symptoms among cases of methanol poisoning in Rivers State May – June 2015 (multiple responses).

Table 4. Retrospective cohort findings for local gin ingestion and occurrence of signs and symptoms of methanol poisoning in Gokana local government areas (LGAs) of Rivers State, June 2015.

Exposure Status	Outcome Status		Total	Risk	P value
	Ill	Not Ill			
Exposed to Local Gin	12	4	16	75%	0.0078*
Not Exposed to Local Gin	1	7	8	12.5%	
Total	13	11	24		

*Statistically significant. Relative Risk: 6; 95% C.I: 1.0-38.5; Risk Difference: 62.5%; Attributable Risk Percentage: 83.3%

- 2015 Available from: http://www.cdc.gov/niosh/ersbdb/emergencyresponsecard_29750029.html
3. U.S National Library of Medicine. Methanol poisoning. Medical Encyclopedia. 2015 Available from: <https://medlineplus.gov/ency/article/002680.htm>
 4. Vale A. Methanol. *Medicine (Baltimore)* 2007;35:633-4.
 5. Brahmi N, Blel Y, Abidi N, et al. Methanol poisoning in Tunisia: report of 16 cases. *Clin Toxicol (Phila)* 2007;45:717-20.
 6. Hassanian-Moghaddam H, Nikfarjam A, Mirafzal A, et al. Methanol mass poisoning in Iran: role of case finding in outbreak management. *J Public Health (Oxf)* 2015;37:354-9.
 7. Hovda KE, Hunderi OH, Tafjord AB, et al. Methanol outbreak in Norway 2002-2004: Epidemiology, clinical features and prognostic signs. *J Intern Med* 2005;258:181-90.
 8. Massoumi G, Saberi K, Eizadi-Mood N, et al. Methanol poisoning in Iran, from 2000 to 2009. *Drug Chem Toxicol* 2012;35:330-3.
 9. Paasma R, Hovda KE, Jacobsen D, et al. Methanol poisoning and long term sequelae – a six years follow-up after a large methanol outbreak. *BMC Clin Pharmacol* 2009;9:5.
 10. Zakharov S, Pelclova D, Urban P, et al. Czech mass methanol outbreak 2012: Epidemiology, challenges and clinical features. *Clin Toxicol (Phila)* 2014;52:1013-24.
 11. Adeyanju D, Fatiregun A, Ekundare-Famiyesin O, et al. Investigation of an Outbreak of Acute Methanol Poisoning in a Southwest State of Nigeria. *Int J Trop Dis Health* 2016;14:1-8.
 12. Rostrup M, Edwards JK, Abukalish M, et al. The methanol poisoning outbreaks in Libya 2013 and Kenya 2014. Choonara I, ed. *PLoS One* 2016;11:e0152676.
 13. Zakharov S, Navratil T, Pelclova D. Fomepizole in the treatment of acute methanol poisonings: Experience from the Czech mass methanol outbreak 2012-2013. *Biomed Papers* 2014;158:641-9.
 14. Zakharov S, Pelclova D, Urban P, et al. Czech mass methanol outbreak 2012: epidemiology, challenges and clinical features. *Clin Toxicol (Phila)* 2014;52:1013-24.
 15. Brent J, McMartin K, Phillips S, et al. Fomepizole for the Treatment of Methanol Poisoning. *Massachusetts Medical Society* ; 2009;
 16. WHO. Methanol Poisoning Outbreaks. 2014. Available from: http://www.who.int/environmental_health_emergencies/poisoning/methanol_information.pdf