

Emergency Health Management at a South African University

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Abstract—Response to the public health-related emergencies is analysed here for a rural university in South Africa. The structure of the designated emergency plan covers all the phases of the disaster management cycle. The plan contains elements of the vulnerability model and the technocratic model of emergency management. The response structures are vertically and horizontally integrated, while the planning contains elements of scenario-based and functional planning. The available number of medical professionals at the Rhodes University, along with the medical insurance rates, makes the staff and students potentially more medically vulnerable than the South African population. The main improvements of the emergency management are required in the tornado response and the information dissemination during health emergencies. The latter should involve the increased use of social media and e-mails, following the Taylor model of communication. Infrastructure must be improved in the telecommunication sector in the face of unpredictable electricity outages.

Keywords—Public health, Rural university, Taylor model of communication.

I. INTRODUCTION

RHODES University (RU) has one campus located in Grahamstown, South Africa and its student population fluctuates between 6500 and 7000 [1], [2]. At the same time, there are around 1200 staff members [2]. The geographical area is rural in character with the nearest city; Port Elizabeth is situated 140km away [3]. Floods and droughts have occurred in the Makana Municipality recently which Grahamstown is a part of [4], [5]. These disasters have damaged the road [5] and housing infrastructure [6]. They have also led to water rationing by the local government [7]. Water outages and microbial contamination of potable water are widespread [8], [9]. At the same time, the Eastern Cape Province where the campus is situated is prone to tornadoes and severe thunderstorms [10]. All of these emergency situations or disasters have significant public health implications.

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Given the relative geographical isolation of the RU Campus, most of the disaster and emergency management activities in its vicinity are likely to be handled by the local government. However, around 50% of the South African municipalities did not have the mandated disaster management structures in place by 2011 [11]. A dedicated disaster management officer has been appointed in Grahamstown, but the Fire Department is still in charge of most of municipal disaster management functions. Under such conditions, the efficiency of the local government response could be delayed depending on the type of emergency situation and the expertise available in the fire-and-rescue services [12]. Recent studies indicate that floods can increase the probability of the infectious disease outbreaks from *Clostridium tetani*, *Vibrio cholerae* and *Campylobacter jejuni* in the flooded areas [13]. Droughts place a high disease burden on the adolescents [14]. On the other hand, water outages can lead to skin and eye infections [15]. These facts, along with the climatic disasters in the area, are relevant to the management considerations of health emergencies and their impacts on the RU students and staff.

Emergency health management in a particular geographical area will strongly depend on the level of the medical infrastructure development which in turn will have a substantial influence on the population's health vulnerability [16]. To assess the status of the RU facilities, the medical infrastructure vulnerability index (*MIVI*) was calculated according to (1).

$$MIVI = 1000 \times \frac{N(\text{medical staff})}{N(\text{students}) + N(\text{staff})} \quad (1)$$

The definition of the *MIVI* is based on the derivations from previous international studies on the subject [16]. In the numerator of (1), $N(\text{medical staff})$ is the total number of medical doctors and nurses providing care to the RU community. The original definition includes the number of doctors only in the numerator of (1). However, there is a significant shortage of medical practitioners in the South African Healthcare system [17]. Thus nurses are often the primary and the only healthcare staff in many facilities in South Africa. Thus the students and staff at RU are highly likely to be provided with healthcare by a nurse instead of a medical doctor, i.e. the relevant number of nurses is included in the definition of the *MIVI*. In the denominator of (1), $N(\text{students})$ is the total number of postgraduate and

undergraduate students studying at RU, while $N(\text{staff})$ is the total number of academic and non-academic staff who worked at RU. A sum of these two terms will represent the entire RU population. The coefficient of 1000 converts the *MIVI* values into the units of number of medical professionals per 1000 population members of the RU community [16].

In 2011, RU housed 6750 students and 1200 staff. The RU Healthcare Centre (RUHC) employed one part-time medical doctor and four fulltime nurses. Thus the *MIVI* value for RU Campus is equal to 0.63 medical professionals per 1000 population members. The hospital-based healthcare in the Makana Municipality Area, where Grahamstown is located, is provided by Settlers' Hospital. The hospital is operated as a public-private partnership and is located approximately 3km from the RU Campus. It provides healthcare to 80390 citizens [18]. At the same time, it has a relevant staff of 171 medical doctors and nurses [19]. Therefore the *MIVI* value for the Makana Municipality is 2.12 medical professionals per 1000 inhabitants, while the *MIVI* for the Eastern Cape Province stands at 1.79 per 1000 citizens. The same value for the entire territory of South Africa is equal to 1.64 per 1000 citizens in South Africa. This indicates that the RU Healthcare infrastructure and population are medically more vulnerable than the provincial and national populations. Their vulnerability is further increased by the insolvency of the Provincial Health Department [20]. This makes a prompt and efficient public health response to a health-related emergency on campus unlikely.

Only 10.5 to 27.3% of the South Africa population had medical insurance coverage in the 2011 calendar year [20]. Thus the RUHC is the primary healthcare provider for a large part of the university's staff and students. The primary healthcare function and the vulnerability discussed in the previous paragraph are likely to put high pressure on the RUHC staff and its resources. Thus if a health-related emergency takes place on campus, the university community will face sizeable public health risks. To manage these, a designated emergency management plan has been developed for the RU campus. Its structure, health management implications and current challenges in implementation are examined in this the first of two articles. The second article focuses on the hygiene habits of the RU students and resulting public health challenges are analysed.

II. RU EMERGENCY MANAGEMENT PLAN (RUEMP)

The RUEMP was formerly approved the RU structures on 30th June 2009 [2]. Phases of an emergency are outlined in section 1.1 of the RUEMP, together with stages of the emergency management response [2]. These correspond to the following phases of the disaster management cycle: to limit or decrease the risks and hazards, logistical planning with respect to disaster/emergency response, the actual disaster/emergency response by the university structures and efforts to restore the pre-emergency/pre-disaster status quo [2]. Section 1.3 of the RUEMP defines two types of emergency situations, namely the "crisis of person" and "crisis of property" [2]. The former category contains the injuries/deaths and the infectious disease

outbreaks [2], i.e. the emergency health management will deal with the crises of person. Assumptions in section 1.3 imply that the RU Emergency procedures should sustain the emergency and disaster response independently of outside assistance for one or two days after a particular event [2].

According to section 1.4, the total land area of the RU Campus is equal to 240 hectares with around 60 hectares covered by buildings [2]. The building stock constitutes a total of 205 buildings, with 50 student residences and 14 family apartment buildings. No major industrial facilities are located in the vicinity of the campus [2]. In section 2.2, the management team for a disaster or an emergency situation is outlined and its members include: "the Vice-Chancellor and Deputy Vice-Chancellors, the Registrar of Finance and Operations (TRFO), Director of the Estates Division, Manager of the Campus Protection Unit (CPU; Campus police), Director of the Communications and Marketing Division, Director of the Information Technology Division, Director of Residential Operation, Director of the Human Resources Division, the Dean of Students and Deans of all six Faculties" [2].

The geographical position of Grahamstown and the location of the University present some disaster related risks that could potentially occur. The disaster risk analysis of Grahamstown indicates that the top three disaster risks originate from fires, epidemics and storms [21]. However, a significant public health risks originate from water outages as these occur in the area 3 or more times a year [8], [22]. Between 1998 and 1999, seven tornadoes hit the Eastern Cape causing approximately 11.5 million USD in damages [23]. The worst tornado in the history of South Africa was also recorded in the Eastern Cape, namely on Mount Ayliff in 1999, resulting in 21 deaths [10]. Understanding of tornadoes and the related risks has been shown to be limited among the local population [24], [25]. As a significant portion of the students and staff at RU come from the Eastern Cape Province, the comprehension of the relevant risks might be limited among the student body. Electricity outages occur around once a month in Grahamstown. Thus the RUEMP must react to these emergency management challenges

The TRFO is chairperson of the Management committee and he / she takes the lead in the University's response to all emergencies. This person declares an emergency situation / disaster and its severity level, directs the institutional response and manages any evacuation (section 2.2.2) [2]. The Director of the Estates Division (which controls the university's infrastructure) is the Emergency Manager (EM) and names the Emergency Response Group (ERG), i.e. the selection of university employees that will perform the necessary disaster response / recovery activities (section 2.2.3) [2]. The Manager of the CPU takes charge of the safety and security on the RU campus during an emergency [2]. Their responsibilities include coordination of the university activities with outside disaster / emergency response/civil defence personnel and the security / functionality of the communication lifelines [2]. If the EM becomes unable to perform his/her duties, then the Manager of the CPU takes over the respective roles [2].

Sections 2.2.5 and 2.2.6 describe the roles of the Directors of the Communication/Marketing Divisions and the Information Technology Division [2]. The former is the avenue of contact between the RU and the relevant stakeholders (media, parents, etc.), while the latter takes charge of the emergency website (crisis.ru.ac.za) and its updates. Statement(s) to outside stakeholders is/are prepared by the Management team and relayed to the target groups by the Directors of the Communication / Marketing Division [2]. The Director of the IT Division is also responsible for meeting all of the RU's IT needs during the particular disaster / emergency situation [2]. Other members of the Management Team perform duties as required by the actual emergency / disaster situation and related activities (RUEM, 2011). Employees of the University are discouraged to communicate with the media outlets directly, as the Communication and Marketing Division takes charge of this [2].

Section 3 describes the mechanism of the emergency / disaster response by RU which is carried out by the ERG [2]. The respective control centre is located in the CPU headquarters and it maintains a constant link to the Management Team (section 3.1) [2]. The EM is the only person authorised to relocate such a centre [2]. The Estate Division takes the lead in the preparedness, recovery and response to all emergency situations (section 3.2) [2]. Their personnel forms the core of the ERG, together with staff from the "CPU, Building Maintenance, Building plans and campus space management, Electrical section, Engineering section, Grounds & Gardens and information Technology" (section 3.2) [2]. The EM directs the response and coordinates any activities of the University personnel in support of the fire-and-rescue services and the police (section 3.2.1) [2]. At the same time, members of the ERG provide technical and any other assistance in disaster/emergency affected areas (section 3.2.2) [2].

A crucial role is also played by the Safety, Environmental and Health Officer of RU (SHE) who maintains an emergency contact database for the entire campus (section 3.2.3) [2]. This staff member is also the reporting officer for any major incidents involving injuries to the South African Department of Labour (section 3.2.3) [2]. The emergency contact database is assembled in collaboration with the Heads of Departments (HODs) in question who appoint the Emergency Management Coordinators for the respective buildings on campus (section 3.3.1) [2]. The HODs also take charge of the training for staff in essential emergency procedures such as fire fighting; and information about building evacuation procedures for the students (section 3.3.1) [2]. Dissemination of the information about an ongoing or pending emergency is done by the HOD in coordination with the ERG members (sections 3.3.1-3.3.2) [2].

Section 3.3.3 outlines the basic emergency functions of the RU staff members with first aid training and the personnel working in the RUHC [2]. The first-aiders need to be familiarised with the location of the respective kits in different parts of the campus. They must also pass an accredited training course on first aid as they are designated to perform

the emergency medical services until the qualified outside personnel have reached the disaster location [2]. The RUHC and the RU Counselling Centre provide support / staff when needed to during a disaster / emergency situation [2]. Any counseling activities take place in conjunction with HODs and the Dean of Students [2]. Every employee of RU should carry around a card summary of procedures to follow after the onset of an emergency situation or disaster [2]. The preparation of such a card resides with the Communication and Marketing Division (section 3.3.6) [2].

A strategy meeting takes place in the Communication and Marketing Division immediately after the onset of an emergency (section 3.4.1) [2]. Simple, but comprehensive and constantly updated communiqués to key stakeholders are prepared and disseminated promptly [2]. Crucial representatives from the RU community are informed first and phone calls are successively placed to the outside stakeholders, e.g. parents (section 3.4.1) [2]. The IT Division is responsible for maintenance of the emergency infrastructure, such backup generators and batteries which are located among others, in the School of Journalism and the IT Division (section 3.4.2) [2]. The switch to the emergency website is done by the Head of the IT division, considering specifics of the particular emergency situation (section 3.4.2) [2]. Primary routes of communication within and outside of the university include the crisis website, the Emergency command centre telephone line and the local radio stations (section 3.4.3) [2]. The secondary routes encompass e-mail, mobile phone networks and other relevant tools (section 3.4.3) [2]. Several phone numbers, i.e. the emergency command centre and the university switch board, should function even if the telecommunication infrastructure of the entire campus is offline (section 3.4.3) [2].

Evacuations from buildings follow standard operating procedures as required by the South African legislation (section 3.5.1) [2]. If a campus-wide emergency situation occurs, then the respective evacuation commences at the decision/order of the EM or the TRFO (section 3.5.2) [2]. Coordination between the Rhodes officials and the local government is the key factor is determining whether the emergency has passed and if students and staff can return to campus (section 3.5.2) [2]. Section 4 describes the response to a fire emergency and it follows the standard and internationally-accepted operating procedures for this type of emergency [26]. Section 5 covers the first type of emergency which occurs often in Grahamstown and will have significant public health implications at RU, i.e. water outage [8]. This part of the RUEMP starts with a list of the emergency phone numbers for infrastructure and the CPU in the case of a water outage [2]. Section 5.1.1 contains the location of the emergency water supplies, such as 3 boreholes and 36 rainwater tanks [2]. Some water-saving measures, e.g. waterless toilets, should be implemented by the Estates Division around campus (see section 5.1.2) [2].

The EM provides the TRFO with up-to-date information during a water outage and they also manage the communication via a university-wide e-mail list twice a day

about the status of the water outage (see section 5.2.2) [2]. The Building Maintenance personnel need to be informed of a water outage first using the relevant numbers in the RUEMP (section 5.2.3) [2]. The Manager of this division then informs the CPU and the Emergency Response personnel (see below). The Manager of Building Maintenance dispatches plumbing personnel to affected locations and instructs them to switch to borehole supply upon need (see section 5.2.3[2]. The Estates Division must be placed on high alert during a water outage and delivery of water to critical locations around campus during an outage (see section 5.2.4) [2]. Communication about an outage must reach the necessary individuals throughout the residence system and wardens and sub-wardens play a central role in this context (see section 5.2.5) [2].

All employees of RU report a water outage in a particular part of the campus to the building maintenance or the CPU as soon as possible (see section 5.2.7) [2]. The coordination on a particular building is provided by the Building Emergency coordinator and they liaise with the Estates Division to guarantee that backup facilities are operational (see section 5.2.6) [2]. In particular, the building coordinator must conduct inspections of sufficient volume of rainwater in the harvesting tanks on a monthly basis (see section 5.2.6) [2]. The water collection equipment for transport during an outage must be available and they must instruct staff about the water saving facilities, etc. during and outage (see section 5.2.6) [2]. The TRFO keeps in constant contact with the EM and updates the Vice-Chancellor and other designated/relevant members of the Management Team (see section 5.3) [2]. In conjunction with other components of the response apparatus, such personnel declare a campus-wide emergency (see sections 2.2.2 and 5.3 for details) [2].

Section 6 contains a basic definition of a tornado and the general emergency response protocol for this type of disaster [2]. Limited guidelines and procedures/preventive measures for individual students or staff are indicated here. The driving force in emergency management is a tornado advisory issued by the South Africa Weather Service (an outside authority) [2]. RU's response to a telecommunication outage is summarised in section 7 [2]. If the scope of the telecommunication failure is widespread, then the Manager of the CPU is required to dispatch guards with two-way radios to the buildings where the infrastructure went offline (section 7.1.1) [2]. This way an up-to-date communication should be guaranteed during the telecommunication outage. The Manager of the CPU is also required to maintain constant communication with the IT Division (section 7.1.1) [2]; and the EM who then coordinates the response to the disaster (section 7.1.2) [2].

The EM notifies the TRFO and sends out an e-mail list message to the staff of the university informing them about the outage and the affected areas (section 7.1.2.) [2]. They coordinate ERG activities to assist the IT Division and the CPU as well (section 7.1.2) [2]. The IT Division activates the Emergency Response Network and conducts the required damage assessment (section 7.1.3) [2]. Their personnel contact the telecommunication service provider and ensure that the

Communication and Marketing and the IT Division remain operational (section 7.1.3.) [2]. Subsections 7.1.4-7.1.6 instruct the building coordinators, the university community at large and the Management team to keep the communications lines open using alternate means, e.g. cell phones and the wireless internet networks [2]. A response to an electrical outage is listed in section 8, along with the critical infrastructure and the location of critical backup generators [2]. Electricity from these sources maintains housekeeping and communications, but not health services at present [2].

Section 9 deals with a bomb threat on RU Campus and early notification of the CPU is critical to activate the Emergency Response Network in collaboration with the EM (section 9.1.1) [2]. The CPU further establishes the perimeter to isolate the affected building and notifies the outside response services such as the police, fire and rescue (section 9.1.1) [2]. The roles of the EM and the members of the Emergency Response network follow the usual emergency procedures as outlined in other sections of the RUEMP, but also isolate and disconnect the water and electricity supply to the affected buildings (sections 9.1.2 and 9.1.3) [2]. Section 10 is concerned with the University's response to a hazardous material spill and the response mirrors that in section 9 [2]. The SHE Officer coordinates clean up from the disaster and reports any injuries to the Department of Labour (section 10.1.3) [2]. At the same time, individual academic departments must have protocols need to be in place for dealing with hazardous situations (section 10.1.4) [2].

The death of a student or an employee is considered as an emergency in section 11 [2]. The CPU is responsible for gathering the details of the incident and the Counselling Centre is on stand-by to assist students (section 11.1.2) [2]. A standard emergency management protocol is to be followed by the members of the Emergency Response Network and the Management team (sections 11.1.3 and 11.2) [2]. The Dean of Students oversees the notification process and liaises with the Counselling Centre about the mental health needs of the RU Community (section 11.2.1) [2]. They also take charge of the hospital visits and delegation thereof (section 11.2.1) [2]. If the deceased is a staff member then the notification process and the same duties become the competence of the Dean of the respective faculty (section 11.1.3) [2]. The Communication Division disseminates the news to the internal and external concerned parties (section 11.2.4) [2].

Violent crimes or a life-threatening injury are dealt with according to sections 12 and 14 [2]. The CPU gathers evidence and initiates the necessary emergency response (sections 12.1.1 and 14.1.1) [2]. The RUHC personnel perform a physical examination of the victim or the injured and if necessary arrange for examination by a medical doctor (sections 12.1.2 and 14.1.2) [2]. This department also guarantees administration of prophylactic therapy upon need (section 14.1.2) [2]. The Counselling Centre has responsibilities similar to those listed in section 11.2.1 (sections 12.1.3 and 14.1.3) [2]. Members of the RU community are encouraged to apply steps from section 14.1.4 in protection of the assault victim [2]. All general guidelines

of the RUEMP still apply. The Dean of Students activates the Emergency Response Network in collaboration with the EM if a student had been assaulted (sections 12.2.1 and 14.2.1) [2], as does the Human Resources Division in the case of a staff member (section 14.2.2) [2]. The SHE officer reports the life-threatening injury to the Department of Labour within seven days of the incident (section of 12.1.4) [2].

If an infectious disease outbreak occurs on the RU Campus, the CPU activates the Emergency Response Network and keeps an open communication channel to the Dean of Students (section 13.1.1) [2]. The RUHC personnel have the following responsibilities (section 13.1.2) [2] to implement infectious disease control policies, to conduct awareness campaigns about the risks and transmission mechanisms, to procure and maintain reserves of the necessary protective supplies, to drive the steps in order to contain the extent of the outbreak, to inform the regional State Health Authorities and Settlers' Hospital, to isolate the infected patient and oversee the treatment until the infectivity of such a patient has dropped to zero; and to provide updates about the extent of the given outbreak to the Dean of Students.

The Management Team is responsible for maintaining the continuity of the university's operations and to devise and implement a campus-wide infectious disease response plan (section 13.2) [2]. The response team needs to be named for an infectious disease outbreak and a clear accountability roster must be put in place (section 13.2) [2]. Coordination mechanisms have to be developed between the RU emergency responders and the local office of the South African Department of Health (section 13.2) [2]. Continuous updates of the RUEMP section 13 are needed in the context of the outbreaks that have occurred (section 13.2) [2]. The Dean of Students is responsible for the development of alternative methods of instruction so that the course delivery is not compromised by an infectious disease outbreak (section 13.2.1) [2]. The same office and the Human Resources Division are to make sick leave arrangements for students and staff (sections 13.2.1 and 13.2.2) [2]. Similar duties and response procedures must be developed by/for the Communications and Marketing Division (section 13.2.3) [2]. Analogical response procedure is outlined in section 15 for a mental health incident [2].

III. CRITICAL EVALUATION OF THE RUEMP AGAINST INTERNATIONAL EMERGENCY MANAGEMENT STANDARDS

The development of the hazards register and the risk profile of RU are going to be determined in part by the scientific and teaching activities taking place on its campus; and the possible emergency situations arising from everyday university activities. Therefore the type of hazards, risks and emergency situations that must be considered in the development of the RUEMP will include chemical spills, fires, electricity problems, outbreaks of infectious diseases; and others often observed in a university environment [27]. At the same time, the problems with water and sewage infrastructure have been reported in Grahamstown [8]. Analogical situation has been recorded for floods and droughts which are common in the

geographical area of the RU campus. The notions of "vulnerability of places" as "a combination of hazard exposure and social response within a specific geographic area" are relevant in this context [16]. This means that the geographical location and infrastructure development level in the Makana Municipality will have a strong influence on the emergency management profile and requirement on the RU Campus.

The response procedure to most of the hazards originating from scientific and teaching activities will be based on the relevant national legislation and thus procedures for dealing with them will follow a fairly standard format, e.g. fire evacuation plans. Under such conditions, a clear command structure can be expected to be followed in the emergency planning [28]. This is in fact the case at RU through the definition of the roles of the Management Team, the TRFO, the EM, the Emergency Response Network and the CPU, as well as their mutual relationships. The top-down approach is usually aimed at understanding the 5-10 most important risks or hazards [29]. In this way, the top management communication and planning is stimulated [29]. There is also ongoing exchange of ideas and development of policies on the nature and handling of emergency situations and risks [29]. The (university) management decisions will then be made in the context of the existing and constantly developing risks [29]. Thus the top-down approach to emergency/disaster management clearly forms the basis of the emergency management at the RU campus.

Another feature of the top-down approach is that it is considered appropriate for the RU campus based on the clearly identified hazards (section 2 for details). The backup facilities exist in certain areas, e.g. the rainwater tanks are widely distributed around campus (section 5.1.1 for details). The RUEMP contains the elements of the technocratic model of emergency management as it follows the "command and control approach" [30]. At the same time, the policy is also flexible due to periodical updates and the proactive approach to water outages and epidemic planning (sections 5 and 13) [2], [31]. Coverage of all aspects of the disaster management cycle, i.e. prevention, preparedness, response and recovery indicates a holistic approach to emergency management (see section 1.1) [2]. Thus the RUEMP contains elements of the vulnerability model emergency management [32].

Taking the types of hazards and the response to them, the RUEMP is a mixture of scenario-based and the functional emergency planning in accordance with section 1-6 of the U. S. Federal Emergency Management (FEMA) guidelines [33]. The emergency management structure is clearly outlined from the TRFO, through the Manager of CPU and the EM (section 2.2.2 for details). The response structure through the interaction of the Management Team, the TRFO, the EM, the ERG, the Emergency Response network, and the CPU are clearly defined. Thus the RUEMP is vertically and horizontally integrated in accordance with section 1-6 of the FEMA guidelines [33]. Its section must also address phases of the emergency response, namely "prevention, protection, response, and short-term recovery" as indicated in section 3-2 of the FEMA guidelines [33]. The RUEMP takes into account

the rural location of RU and clear indications of the preventive actions in the cases of water outages (section 5 for details) and infectious disease outbreaks (section 13 for details). Thus the structure of the RUEMP adheres to the international emergency management standards.

Section 2-5 of the FEMA guidelines states that an emergency management plan must be appropriate to the local conditions [33]. The disaster risk analysis of Grahamstown indicates that the top three disaster risks originate from fires, epidemics and storms [21]. However, significant public health risks originate from water outages as these occur in the area three or more times a year [8], [22]. Between 1998 and 1999, seven tornadoes hit the Eastern Cape causing approximately 11.5 million USD in damages [23]. The worst tornado in the history of South Africa was also recorded in the Eastern Cape, namely in Mount Ayliff in 1999, resulting in 21 deaths [10]. Understanding of tornadoes and the related risks has been shown to be limited among the local population [24], [25]. As a significant portion of the students and staff at RU come from the Eastern Cape Province, the comprehension of the relevant risks might be limited among the student body. Electricity outages occur around once a month in Grahamstown. Thus the RUEMP must react to these emergency management challenges.

Aims for emergency management are clearly specified for the electricity outage, water outage and outbreaks of infectious diseases, as stated in sections 5, 7 and 13 of the RUEMP [2]. This is in accordance with the FEMA guideline section 1-3 [33]. One exception is the infectious disease response protocol for RU campus which will be discussed in the second part of this study (see Part II for details). The fire evacuation drills take place on campus and the fire-fighting courses are run off campus two to three times a year; and the fire department participates actively in at least one of the drills. All equipment is audited annually and the first-responder training is regularly renewed through the local and certified organisations such as St. John's Ambulance. The building emergency coordinators are appointed and participate in the regular drills and other emergency management function as assigned in the RUEMP [2].

Section 3.3.3. of the RUEMP states that the Division of Communication and Marketing was in charge of preparing a card containing all relevant emergency phone numbers for dissemination to the RU staff and students [2]. Page 27 of the RUEMP and the university and emergency websites outline the emergency procedures [2], [34]. The card is posted on each floor of every building on campus, but not available for the personal use by staff. The relevant contacts are also available online [35]. After an emergency situation has occurred, the affected population is most likely to use online resources to obtain relevant information [36]. Thus the above-mentioned links should be made visible on the official RU website, as well as the emergency website crisi.ru.ac.za. At the same time, the text of the RUEMP should be re-worded in section 3.3.3 to place focus at online resources as the primary source of emergency management information. A targeted

awareness campaign about the retrieval of the information should follow.

Limitations are present in the case of the telecommunication failure (section 6 of the RUEMP) and the tornado warnings (sections 7 of the RUEMP) [2]. This becomes clearly apparent after comparison of the text of these sections with the section 1-4 of the FEMA guidelines [33]. With the former, the problem originates from the following factors. Firstly, the RU provider was switched from the state-owned telecommunications company to an internet-based service in 2012. This can result in an increased frequency of telecommunication failures at the RU campus as they are linked to electricity outages and these take place around once every five weeks in Grahamstown. Once the power supply is interrupted, most of the telephone network at the RU campus goes offline. Under such circumstances, the RU staff and students use most of the landline emergency extensions on campus, as these are operated from the office-based phone work stations. To combat this, an increased focus of the RUEMP should be placed on mobile phone networks which are already in place and section 7 should be amended accordingly. In this way, clear messages about the given emergency situation can be sent to the RU population. This in turn will contribute to reducing any potential damages and detrimental health effects amongst the staff and students.

Section 6 must be modified to include a register of the areas within each of the residences and campus building where the students and staff can take cover if a tornado strikes the RU campus [37]. Awareness campaign will have to be run and the RUEMP text modified about the health and safety risks originating from tornadoes. The backup generators are in place at the IT Division and the School of Journalism as state in section 3.4.2 of the RUEMP [2]. Therefore the communication and online presence of the university will be maintained during the electricity outages. However, improvements must be made in the case of the RUHC and thus the emergency health management functions of the university might be compromised during an electricity outage. Any mental health issues are likely to be dealt with using the RU resources as the Counselling Centre is fully operational and provides continuous support to the students' and staff. At the same time, the RU Department of Psychology has many clinical and practising psychologists on staff.

The Bibliography section of the RUEMP indicates that the disaster and emergency plans of six international colleges/universities from the USA were used as references in the development of the policy [2]. The student numbers in these institutions range from 2300 for the Felician College and to more than 50000 students with University of Florida and the Texas A&M University (see the relevant websites at www.felician.edu; www.ufl.edu and <http://www.tamu.edu/about/index.html>). Student numbers in these universities are comparable or larger than those at RU, but all of them are located mostly in metropolitan areas. Thus the reference models used in the development of the RUEMP might not be the most appropriate ones. On the other hand, the RUEMP is similar in scope and structure of the emergency

response policies from rural universities in the USA with similar student numbers [37]. It is true that the local disaster / emergency management and response structures are in place and fully-functional in the USA and not in South Africa (see Introduction). Therefore the vulnerability of the RU campus and its population in emergency situations will be higher than the international standard, in spite of the Rhodes Universities structures functioning perfectly during an emergency.

Charvat [31] stated that the university emergency management plan must contain the following elements: “to establish an effective planning process, to establish cross-institutional teams to build support, to use all-hazards planning to anticipate changing needs; to include a crisis communications component and to maintain a phased and progressive planning cycle”. Based on the discussion, the RUEMP contains all these elements and can be deemed appropriate for the university settings. However, student organisations and outside stakeholders should be consulted for feedback on the RUEMP [31]. This is currently not the case at RU due to several reasons. Firstly, disaster management capacity is limited in the Eastern Cape and so useful outside feedback is unlikely to come from local sources. On the other hand, national institutions such as the National Disaster Management Centre in Pretoria can be consulted for useful feedback and so this should be conducted in the near future. The Student Representative Council has been involved in running several health-related campaigns such as HIV-testing between 2010 and 2012. A wider engagement of the Management Team and student body should be stimulated in the area of emergency management. The communication component is discussed in the next section.

IV. COMMUNICATION STRATEGY AND THE PROPOSED IMPROVEMENTS

The last significant water outage took place at the RU campus between the 25th and 31st October 2012. Rotten smell and brown colour of the water were reported by the university establishment through the dedicated e-mail list. Tap water samples were subsequently taken at nine sites around the RU campus. Sampling was done using the methods published previously [8]. The faecal coliform (FC) concentrations were enumerated using the m-FC agar (Merck Ltd., Johannesburg, South Africa) as outlined in already published literature [9]. The FC concentrations below 0 Colony-forming units per 100mL (CFUs/100mL) were recorded at 4 of the nine sampling sites. At two other sites, the FC levels ranged from 1 to 3CFUs/100mL. The FC concentrations exceeded 145-300CFUs/100mL at the three final sampling sites. According to the South African Water Quality guidelines for domestic use, the tap water at the majority of the RU campus posed low to high risk to human health, if the students or university staff used it for drinking, washing or cooking [39].

Updates about the situation were communicated to the RU community through the dedicated email list in line with the RUEMP, in accordance with section 5.2.2 of the policy [2]. At the same time, a parallel telephone channel was utilised between the TRFO through the members of the Management

Team, hall wardens, residence wardens and sub-wardens; and ultimately students. This indicates that the secondary communication channels were activated and used in accordance with section 3.4.3 of the RUEMP [2]. Despite these communication channels reaching students and university staff on ground, misinformation exacerbating the actual level of risk was widespread on the RU campus. Similar situations were observed during previous water crises [38]. Thus the communication strategy of the RUEMP is analysed more in detail below.

The model of the emergency communication at the RU campus is similar to the North American Emergency Communication system as outlined on pages 29-31 of a previously published analysis on the subject [40]. The details of this system are outlined in Fig. 1. The data gatherers are members of the ERG, such as the Grounds and gardens staff or members of CPU, who are on the ground and provide real-time data to the EM or the TRFO. The relevant communication channel is represented by two-way radios or cellular phone communication. The TRFO evaluates the situation in question and contacts the members of the Management Team (section 5.2.2). After such an evaluation has taken place, the TRFO or the EM is responsible for drafting comprehensive update for the stakeholders. This is then sent via e-mail (the channel) to the IT Division moderator (the relayer) and published through a dedicated communication channel, i.e. a specialised e-mail list twice a day (section 5.2.2). The target audience includes the staff members and the student body of RU.

The above-mentioned system and the telephone communication described in the previous paragraphs can be deemed standard under the emergency management conditions. Relevant details can be found on page 32 of a relevant publication [40]. However, misinformation is rife at the RU campus and so the emergency communication system is prone to static, i.e. the right message does not reach the laymen. This indicates that the emergency management communication component of the RUEMP needs to be updated. Novel communication tools and models need to be considered in this context. The Taylor basic communication model is depicted in Fig. 2. In this model, the sender is a qualified emergency management professional who has all the up-to-date information about the progress of a disaster or an emergency [41]. They prepare a short, but to the point-message about the emergency situation in question. The target audience is the laymen affected by the unfolding emergency [41]. Channel represents the method used to delivery of the message to the target audience.

Recent data about fires in California indicate that most of the population in the affected areas tends to used social media and alternate information sources for updated data about an emergency [36]. The availability of relevant data and their timely dissemination to the emergency management responders and the target audience is going to be one of the critical factors of a successful communication strategy.

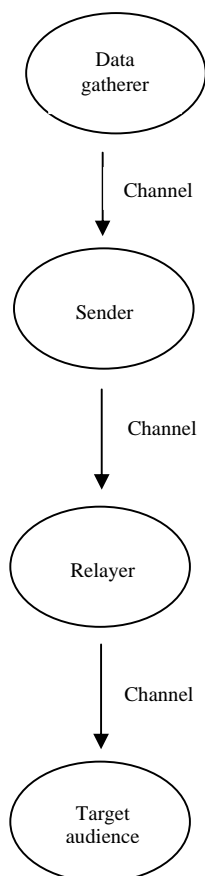


Fig. 1 Temporary emergency communication system in the USA (reproduced from [40], p. 29)

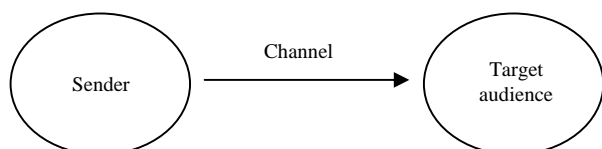


Fig. 2 The Taylor Basic Communication Model [41]

Therefore it is proposed by the authors to start conducting monthly water quality tests at the RU campus. The measured parameters should be in line with national standards and so the following battery of tests was chosen pH, turbidity and the concentration of E. coli [39]. Sampling points will be chosen based on the analysis of the water supply schematics at RU campus. The results dissemination will be performed first using a new mailing list to include the members of the Management Team and the Safety, Health and Environmental Officer. The members of the list will be allowed to comment on the data and a statement about the results and the public health concerns/ measures to be taken will be prepared. Once agreement has been reached on the text of the statement, message will be sent out the final statement will be sent out to the dedicated e-mailing list, the students section of the RU website and a newly developed and dedicated site on Facebook or Twitter.

V. CONCLUSIONS

The RUEMP contains good response mechanisms to water outage, however was developed from strategies for international universities located in Metropolitan areas. More should be done to accommodate the fact that RU is located Grahamstown is a small rural town with limited capacity in terms of equipment and personnel. Improvements in the effective dissemination of the health-emergency information are necessary at the RU campus. Involvement of additional stakeholders is necessary to improve the RUEMP sections, mainly on the life-threatening injury. This should follow the Taylor model of communication and should focus in increased use of social media and the mobile phone networks. More detailed examination of the infectious disease transmission and response protocols are examined in the second of these two articles.

ACKNOWLEDGMENT

The authors would like to thank the Rhodes University Research Committee was funding the work in part (Grant no. 35215/2012).

REFERENCES

- [1] Rhodes University Calendar Rhodes University, Grahamstown, South Africa, 2011.
- [2] Rhodes University Emergency Management Plan (RUEMP). Estates Division, RU, Grahamstown, South Africa, 2011.
- [3] South African Explorer Available at: http://www.saexplorer.co.za/south-africa/distance/grahamstown_distance.asp (website accessed on 14th November 2012), 2011.
- [4] Provincial Gazette Extraordinary Premier's Notice: Declaration of the Provincial State of Drought. No. 2192. Bhisho: Eastern Cape Provincial Government, South Africa, 2009.
- [5] South African Weather and Disaster Observation Service. N2 between Grahamstown and PE has collapsed due to flooding. Available at: <http://sawdis1.blogspot.com/2012/10/n2-between-grahamstown-and-pe-has.html> (website accessed on 14th November 2012), 2012.
- [6] Grahamstown Now Record rains wreak havoc. Available at: <http://www.ghtnow.co.za/stories/view/record-rains-wreak-havoc> (website accessed on 14th November 2012), 2012.
- [7] Grahamstown Now. Water restrictions now in place in Grahamstown. Available at: <http://ghtnow.co.za/stories/view/water-restrictions-now-in-place-in-grahamstown> (website accessed on 14th November 2012), 2009.
- [8] C. D. Luyt, W. J. Muller, R. Tandlich. Low-cost tools for microbial quality assessment of drinking water in South Africa. *HealthMed*, vol. 5(6) Supplement 1, pp. 1868-1877, 2011.
- [9] R. Tandlich, C. D. Luyt, W. J. Muller. Project No. K8/806: Progress report as 2nd deliverable. Project report submitted as a deliverable to the Water Research Commission in April 2010, Pretoria, South Africa, 2010.
- [10] D. M. Pyle. Severe convective storm risk in the Eastern Cape Province of South Africa. *PhD thesis*, RU, Grahamstown, South Africa, 2006.
- [11] South African Local Government Association. Disaster Risk Management Status Assessment at Municipalities in South Africa, Pretoria, South Africa, 2011.
- [12] B. M. Zuma, C. D. Luyt, T. G. Chirenda, R. Tandlich. Flood disaster management in South Africa: legislative framework and current challenges. Published in the Peer-reviewed Proceedings from the 2012 International Conference on Applied Life Sciences (ICALS2012) Konya, Turkey from 10th until 12th September, pp. 127-132 (ISBN 978-953-51-0725-5), 2012.
- [13] C. D. Luyt, W. J. Muller, B. S. Wilhelmi, R. Tandlich. Health implications of flood disaster management in South Africa. Published in the peer-reviewed proceedings of the 18th Annual Conference of the International Emergency Management of Society held in Bucharest,

- Romania from 7th until 10th June 2011, pp. 376-385 (ISBN: 978-9-49-029704-6), 2011.
- [14] Z. Xu, P. E. Sheffield, W. Hu, H. Su, W. Yu, X. Qi., S. Tong (2012). Climate change and children's health-A call for research on what works to protect children. *International Journal of Environmental Research and Public Health* 9(9): 3298-3316.
- [15] L. Y. Huang, Y. C. Wang, C. M. Liu, T. N. Wu, C. H. Chou, F. C. Sung, C. C. Wu. Water outage increases the risk of gastroenteritis and eyes and skin diseases. *BMC Public Health* vol 11, pp. 726, 2011.
- [16] S. Kumpulainen. Vulnerability concepts in hazard and risk assessment. Natural and Technological Hazards and Risks Affecting the Spatial Development of European Regions (Philipp Schmidt-Thomé, Ed.). Geological Survey of Finland, Special Paper 42, pp. 65-74, 2006.
- [17] K. Kautzky, S. Tollman. A Perspective on Primary Health Care in South Africa. Available at: http://www.hst.org.za/uploads/files/chap2_08.pdf (website accessed on 25th February 2013), 2008.
- [18] Statistics South Africa. Municipal facts sheet (census 2011 data products). Available at: <http://www.statssa.gov.za/Census2011/Products.asp> (website accessed on 14th February 2013), 2012.
- [19] Makana Wetpaint. Staffing at the Settlers' Hospital in Grahamstown. Available at: <http://makana.wetpaint.com/page/Settlers+Hospital> (website accessed on 10th February 2013), 2013.
- [20] NSP Review. Corruption in the Eastern Cape. Available at: <http://www.nspreview.org/2012/12/04/corruption-in-the-eastern-cape/> (website accessed on 14th March 2013), 2012.
- [21] South African National Department of the Treasury. Integrated Development Plan: Cacadu District Municipality – 2010 Review. Available at: <http://mfma.treasury.gov.za/Documents/01.%20Integrated%20Development%20Plans/2010-11/03.%20District%20Municipalities/DC10%20Cacadu/DC10%20Cacadu%20-%20IDP%20-%20Part%209%20of%209%20-%201011.pdf> (website accessed on 3rd December 2012), 2011.
- [22] Kowie Catchment Campaign. Independent monitoring of Grahamstown's microbial tap water quality. Available at: <http://www.kowiecatchmentcampaign.org.za/WaterQuality.html> (website accessed on 3rd December 2012), 2011.
- [23] H. Van Niekerk, G. Sampson Hell Season or par for the Course: Tornadoes over the Eastern Cape 1998/99 Season, Internal Report Number OB/17, South African Weather Bureau, Pretoria, Republic of South Africa, 1999.
- [24] S. K. Mgquba. Changing perspectives: from "the natural" to "the vulnerable" and towards disaster management. *BSc Honours thesis*, University of the Witwatersrand, Johannesburg, South Africa, 1999.
- [25] F. Wood. The snake in the sky: Tornadoes in clay and local narrative in the Hogsback-Alice area. *Critical Arts Journal* vol. 14(2), pp. 79-95, 2000.
- [26] National Fire Protection Association. Standard on Disaster/Emergency Management and Business Continuity Programs Available at: <http://www.nfpa.org/assets/files/pdf/nfpa1600.pdf> (website accessed on 18th November 2012), 2007.
- [27] Boston University. Boston University Research Compliance - Environmental Health & Safety: Emergency Response Planning. Available at: <http://www.bu.edu/ehs/management-plans/emergency/> (website accessed on 18th November 2012), 2012.
- [28] Heijmans, A. (2009). The social life of community-based disaster risk reduction: origins, politics and framing. Available at: <http://abuhc.org/Publications/Working%20Paper%2020.pdf> (website accessed on 15th November 2012), 2009.
- [29] A. Brodeur, M. Pergler. Top-down ERM: a pragmatic approach to managing risk from the C-suite. McKinsey Working Papers on Risk, Paper 22, McKinsey & Company, Washington, DC, USA, 2010.
- [30] K. J. Tierney. Facing the Unexpected: Disaster Preparedness and Response in the United States. "Where Do We Go From Here?" Joseph Henry Press, Washington DC, USA, p. 259, 2001.
- [31] S. Charvat. College and University Disaster Planning: New Guidelines Based on Common Industry Principles and Practice. Available at: <http://www.higheredcenter.org/files/documents/college-disaster-planning.pdf> (website accessed on 25th February 2013), 2013.
- [32] B. W. Blanchard. Higher Education Project. Available at: http://training.fema.gov/emiweb/downloads/highedbrief_course2.ppt (website accessed on 5th February 2013), 2005.
- [33] Federal Emergency Management Agency. Developing and maintaining emergency operations plans: Comprehensive preparedness guide (CPG) 101 version 2.0. Federal Emergency Management Agency, Washington DC, USA, 2010.
- [34] Standing Instruction for Emergency at RU Campus. Available at: <http://www.ru.ac.za/estates/safety/emergencymanagementplan/standinginstructions/> (website accessed on 3rd March 2013), 2011.
- [35] Emergency Contact Numbers for RU (2011). Available at: <http://www.ru.ac.za/campusprotection/importantcontacts/emergencynumbers/> (website accessed on 3rd March 2013), 2011.
- [36] J. Sutton, L. Palen, I. Shklovski. Backchannels on the Front Lines: Emergent Uses of Social Media in the 2007 Southern California Wildfires. Published in the Peer-reviewed Proceedings of the 5th International ISCRAM Conference, held in Washington, DC, USA, May 2008.
- [37] Slippery Rock University. Emergency Operations Plan. Available at: <http://www.sru.edu/administration/UniversityOffices/emergency/Pages/EmergencyManagement.aspx> (website accessed on 25th February 2013).
- [38] Water crisis hits Makana. Available at: <http://www.grocotts.co.za/content/water-crisis-hits-makana-09-07-2010> (website accessed on 14th February 2013), 2010.
- [39] Department of Water Affairs and Forestry. South African Water Quality Guidelines, Vol. 1 (Domestic Water Use), Pretoria, South Africa, 1996.
- [40] R. M. Kepner (2010). Efficiency of the emergency alert system. PhD thesis, Washington State University, Pullman, WA, USA.
- [41] M. S. Taylor, W. Waung, M. Banan. Basic Data Communication Model, Internetwork Mobility The CDPD Approach. Available at: <http://www.google.co.za/url?sa=t&rct=j&q=Taylor%2C+M.+S.%2C+Waung%2C+W.%2C+%26+Banan%2C+M.+%281996%29.+Basic+Data+Communication+Model%2C+Internetwork+Mobility+The+CDPD+Approach.&source=web&cd=1&ved=0CCwQFjAA&url=http%3A%2F%2Fciteseerx.ist.psu.edu%2Fviewdoc%2Fdownload%3Fdoi%3D10.1.1.99.1957%26rep%3Drep%3Dtype%3Dpdf&ei=mv4YUd3kOeG00AXi1oHQDg&usq=AFQjCNFfanPV4yoFD3o5HAs7SaVn-Zyd9Q> (website accessed on 11th February 2013), 1996.

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