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QWeCI

Quantifying Weather and Climate Impacts on Health in Developing Countries

D1.3.a – Review document for governmental and NGO planners concerning state-of-the-art knowledge concerning climate driver impact on target disease incidence and present climate vulnerabilities for endemic and epidemic incidence according to these relationships

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Introduction

The original title for this deliverable is a very wide and comprehensive look at diseases and their relation with climate in the range of countries which we can assume are the target countries of the QWeCI project namely Senegal, Ghana and Malawi. Whilst the title is a grand challenge it is too broad to be addressed within one deliverable. Further an initial review of the literature shows that the tie up between the climate and reports of diseases and their incidence if available are very few and far between for the countries in question. Indeed it is difficult to see if such a question posed by the title can be tackled with the current literature available. Therefore this deliverable will report on the recent (last eight years or so) selected literature that has any connection with climate or an observed seasonal cycle that has been published in the medical, medical related and selected environmental journals. We will also only look at infectious diseases and not other chronic conditions that may in turn be triggered or impacted on by the environment and climate drivers. The initial question posed by the title is best answered, now with hindsight, through the development of the pathogens database and its automated data acquisition and data mining capabilities; this is a role set out in the DoW for WP1.1 and this investigation will be carried out through the next 6 to 12 months. This will allow use to target malarial and Rift Valley fever publications and genomic sequences through the data base and link them to the climate envelop of those sites (where and when detailed location information is given in the papers). This review will only consider infectious diseases which are either only found in the tropics or are much more prevalent in those climates compared with Europe and further it will concentrate on vector borne diseases.

In conducting the literature search it was interesting that the recent literature has many papers on a number of the neglected tropical diseases. The Neglected Tropical Disease are defined by the WHO as:- Buruli Ulcer, Chagas disease (American trypanosomiasis), Cysticercosis, Dengue/Severe dengue, Dracunculiasis (guinea-worm disease), Echinococcosis, Fascioliasis, Human African

trypanosomiasis, Leishmaniasis, Leprosy, Lymphatic filariasis, Onchocerciasis, Rabies, Schistosomiasis, Soil transmitted helminthiasis, Trachoma, Yaws and most but not all of the diseases listed occur within Africa. This shows the need to consider diseases wider than those covered by the project in a simple overview document of recent work and literature eon infectious disease in the target countries. There were also a number of papers on tick borne diseases, which is an area of interest to QWeCI. It was pleasing to note that a number of the papers were from groups within the wider project partner associations involved in QWeCI e.g. IPD in Dakar, or papers were from groups known to partners in the project for example work carried out in Malawi at the Malawi-Liverpool-Wellcome Trust Clinical Research programme. Although this Malawi Liverpool Wellcome Programme is not a QWeCI partner, contact has been made with the Programme Centre in Blantyre before and during the QWeCI project.

As a final introductory point some of the literature is driven by diseases that are contracted by tourists especially from Europe and present to European medical services on return from the QWeCI target countries. These are not, for example, cases of malaria that are too frequently common in European tourists returning from the tropics or HIV for which there is a heightened awareness. But for infectious diseases that are rarely, or if ever seen, in most European health systems. Although the responsibility for tourists lies with their own domicile health services for both prevention and if the disease is contracted its treatment. It is important that the target countries in QWeCI are away that such events can lead to scare stories in the media that may damage tourism revenue for QWeCI target countries. An awareness campaign within the European tourist industry that organises holidays in the target countries and other European government organisations should be considered for information purposes. It may be that local in region health services were not fully aware of the possibility of infection for some of the diseases. Of course no campaign can overcome the reckless tourist that decides not to undertake prevention of disease transmission.

Methodology

Papers were accessed when searched for using PubMed and Web of Science. As we wanted to keep focussed, mostly, within the medical or medical associated literature; most of the papers where found through PubMed. Of course many of the same papers occur when searching on the two indices.

The search terms were kept simple, firstly the term 'disease *country* climate' was used followed by 'disease *country*'; where *country* was in turn Senegal, Ghana and Malawi. The second more general search term produces 5 to 10 times more papers than the term when climate was included which again points to the lack of integration of climatic factors in most projects and publication from research working on infectious diseases. Some of the papers were more general in their geographical extent than the single country in the search. These papers were included as long as they covered relevant region of Africa or had one of the target diseases namely malaria and Rift Valley Fever. Given the scale of effort given for a project deliverable this cannot be seen as a definitive review but nevertheless it raises some interesting studies. The studies reviewed are wider than the diseases targeted by QWeCI but could have the techniques developed in QWeCI applied to understand their connection with regional climates especially seasonal factors i.e. the extent and nature of the wet and dry seasons for that locality.

Results

In this section the papers are grouped mostly by disease sub-headings will be used where appropriate.

Malaria

The largest collection of papers found came under the area of malaria – this may in part been due to the climate orientated search although the second search stage not using climate also came up with a large number of malaria papers. Not all the papers that came up are included, in this review, as some are too clinical in their approach with no reflection of the society or of the environments in which the people are living to be included in this QWeCI project review.

Malawi

Mathanga et al. (2011) have a good review of malaria control activities today and over the last 10 years. They found 43% of children 6 months to 5 years in the community were infected. Although it notes that there have been few studies on malaria vectors and their dynamics in Malawi although does recognise two comprehensive reviews from the early 2000s. The 2005-2010 Strategic Plan (in Malawi Ministry of Health) is committed to getting interventions (including bed nets and indoor residual spraying to 85% coverage with the groups at risk. It highlights the work of Malawi's International Centre for Excellence in Malaria Research (ICEMR). They note that malaria is still one of the leading causes of morbidity and mortality in Malawi and interdisciplinary

teams are needed to tackle the problem. Thigpen et al. (2011) worked on association between malaria infections, HIV and helminthic infection which followed work in other parts of Africa on these type of co-infections but they found conflicting results as to the role of helminthic infections and their impact on malaria infections.

Senegal

Thwing et al. (2011) report on the nationwide distribution of long-lasting insecticide-treated nets to children under five, this occurred in 2009 with the distribution of 2.2 million nets. Most, over 90%, of the nets remained in the household of those not there over 70% had been given away and none sold. The campaign allowed the Roll Back Malaria target of 80% coverage set for 2010 to be surpassed.

Ghana

The environmental factors associated with the distribution of Anopheles gambiae were studied by de Souza et al (2010). They found that An. gambiae S form was associated with high malaria prevalence. Owusu-Agyei et al. (2009) investigated malaria in the forest-savannah transitional zone of Ghana examine the prevalence of malaria in children who they found of average that 58% were infected with the percentage rising in younger children below the age of five where 64% were infected. This younger age group was also found to have up to seven malaria attacks per year. The main vectors were found to be An. funestas and A gambaie and an effective inoculation rate (EIR) of an average 269 infective bites for each person per annum. Klinkenberg et al (2006) working in Accra and Kumsai looked at prevalence rate in the urban areas in children less than five years and more than 6 months. In Accra the average prevalence was 14.8% with a range of 6% to 22%. In Kumasi the prevalence was much lower at 8.6% ranging for 2% to 33%. The results were counter to expectation as Accra is a much bigger city and the closeness of the rural fringe in Kumasi was thought to have made infection more common even though an number of the Kumasi sample sites were near the rural edge of the city. This heterogeneity of malaria in urban areas which is far greater than seen in rural areas means that it study design and implementing control programmes need to undertaken with some prior knowledge of the prevalence distributions. An earlier study in Kumasi by Afrane et al. (2004) looked at the impacts of urban irrigated agriculture on malaria transmission in Kumasi. More malaria was found in areas of peri-urban and urban agriculture than in non-agriculture urban locations. In Kumasi the areas of urban agriculture are found in valleys which may be an additional reason why more malaria and more mosquitoes are found in these areas.

Rift Valley Fever

Relatively few RVF papers came up many of them that did were of course working in the Ferlo region of Senegal with many based near or around Barkedji which is the site used in the QWeCI project. The search did not take into account papers from east Africa on RVF as this is not the focus of this project. An early paper on RVF from the region is that by Zeller et al. (1997). At Barkedji they found RVF virus in Aedes vexans and Ae. ochraceus whilst they mention epizootics in East Africa are associated with increased rainfall at this time they did not know the trigger for the outbreaks in Senegal. Wilson et al (1994) worked on the presence of RVF antibodies in the blood samples taken from nomadic Peul people who heard animals especially cattle. They found RVF antibodies were in 22% of the population who provided samples for analysis. Other studies up to the time of this paper, 1994, from other countries in Africa found the percentage of people with antibodies for RVF of between less than 10% to less than 1% so the samples here Senegal show a high percentage of contact with RVF virus, almost a quarter with antibodies in their blood. Although Kenyan herdsmen from an area of where RVF is endemic can have a 40% rate of antibodies within in their cohort. These two early papers show that little was known about RVF in the region in the mid 1990s but subsequent and ongoing work in the Senegal has added much to the knowledge base. The QWeCI project is the latest project to add more information and furnish more in the way of climate modelling information than previous studies.

Tick and Flea Borne

A relatively large number of tick borne disease papers came through in the search. An area of secondary investigation in QWeCI is to look at tick borne diseases but seeing the number of paper it look to be an emerging area of interest within the wider research community.

Parola (2011) Rickettsia felis (a bacterium of the spotted fever group) which is transmitted by the cat flea ad is now known to the so-called flea-borne spotted fever. The work presented was undertaken in Senegal and Kenya. Etter et al. (2011) discuss African swine fever and the role of the soft tick during the outbreak in Senegal in 2006. Cutler (2010) writes a general review of tick borne relapsing fever caused by Borrelia bacteria transmitted by ticks Ornithodoros spp. in West Africa the infection is primarily zoonotic. Mediannikov et al (2010) looked at Coxiella burnetii a bacteria pathogen in humans and ticks in rural Senegal. This bacteria causes Q-fever which is a worldwide zoonosis transmitted by the soft tick, Ornithodoros sonrai and hard ticks . When Q-

fever brings sever disease they can include pneumonia, hepatitis and endocarditis. In Senegal Q fever should be considered an emerging disease and local veterinary and health care workers should be made aware of this disease.

Other vector borne infectious diseases

West Nile fever is transmitted by mosquitoes and caused by a flavivirus. The transmission cycle involves birds as amplifying hosts before the virus is passed back via mosquitoes to other animals including humans and horses. Chevalier et al. (2007) use sentinel chickens to study the transmission dynamics of the virus in the Sahel and their work was centred on Baredji, in the Ferlo region of Senegal. Again the pond systems and their dynamics are the focus of the study with Culex and Aedes mosquitoes the most likely to transmit the virus.

Non-vector borne infectious disease

Everett et al (2011) examine invasive Streptococcus pneumonia in Malawi. This condition accounts for 9% of all deaths in developing countries. It is widely thought to be seasonal and this study confirms that it is more prevalent during the older dryer months and that since 2005 this relationship has become more established. Schistosomiasis strictly speaking is not vector borne as the snail plays the role of the intermediate host. People are infected when they come in to contact with parasite during the free swimming stage of the parasites life cycle, when they are in water at lake edges often associated with fishing or access to boats for fishing or other activity. Some work carried out in the The Brong–Ahafo Region region of Ghana (S.C.K.Tay, pers comm.) by one of or partners at KNUST, Kumasi. They have found that 46(0.44%) out of 10534 patients were found to have urinary schistosomiasis in the hospital they sampled while 963 (60.2%) out of 1600 pupils were found to have urinary schistosomiasis in the school that was sampled. Prevalence of urinary schistosomiasis in the Sunyani Regional Hospital was very low (0.44%) with some months registering prevalence of 0.0%. The vast difference in prevalence rate can be attributed to the fact that majority of the people who access health care at the Sunyani Regional Hospital, live in Sunyani where out of a population of about 80,245, 5488 individuals have access to pipe-borne water in addition to about 162 community standpipes (Ghana Water Company, 2007) compared to Atronie which is in the outskirts of Sunyani, with only a few boreholes available. As a result the majority of people in Atronie rely on the stream, Amama for drinking and other domestic activities. Also, the children in Atronie lack recreational facilities compelling most of them to take

to swimming as a form of recreation (S.C.K.Tay, pers comm.).

Other Neglected Tropical Diseases

Zhang et al. (2010) has a brief overview of neglected tropical disease that impacts of sub-Saharan Africa and the type of activities that are required for their control and treatments. Buruli ulcer which is found in the Ashanti region of Ghana and associated with water bodies is reported by Agbenorku et al (2011). This disease puts a significant burden on health serves and requires specialist treatment to repair the damage caused by the ulcers. They found that 43.4% of the cases were children below the age of 14. Most of the cases had late ulcers and required substantial stays in hospital. Early detection and treatment would reduce the severity of the disease and need for costly long hospital stays and treatment. Effort should also be made for prevention of this disease.

Tourist Articles

This section has some papers reporting on returning tourists visiting the target countries have returned home with a disease not seen in Europe and more unusual than people retuning with malaria. In one case it was with a disease that had not been reported in region for some considerable time. Both these papers happen to come be about Senegal and it probably reflects on the size and importance of the tourist industry in Senegal. Pistone et al (2009) report on a group of travellers returned from Senegal in 2006 with chikungunya virus. This was over nine years since the last known outbreaks in the country. Dupouy-Camet et al. (2009) report on cases of trichinellosis acquired in Senegal from eating smoked warthog ham whilst on vacation. They recommend that tourists are informed not to eat rare or raw meat products especially from game meat such as warthog.

Discussion and Conclusions

This initial review has pulled out a greater range of diseases than anticipated although dominated by malaria, other areas especially tick bore disease have also had considerable attention from researchers in recent years. The malaria papers show the levels of the disease burden as still very great in the target countries. In this context it was pleasing to see reported that Senegal had met its RBM bed net target early. The complexity of urban land use on the incidence of urban malaria was highlighted in the work undertaken in Accra and Kumasi. Where both the role of urban

agriculture and particular local topography in Kumasi were noted as factors that impact on malaria incidence. The local topography in Kumasi is quite striking, as I know from my own visit to the QWeCI field sites, with a number deep incised small valleys running across the city and its peri-urban fringe, that do look like ideal mosquito habitats. The RVF work looking back at older papers was interesting to see the knowledge of the RVF in Senegal in the early and mid 1990s to what is known know (papers not reviewed) much of the more recent wok coming from QWeCI partners and their associates. Certainly the early papers did not have very much information on the meteorological controls. Whilst the impact of high rainfall event this has become clearer with time and subsequent publication the QWeCI project is making large strides into this area and starting to quantify these vents and determine their climatology in Senegal and elsewhere in Africa.

The role of tourists is important as it is not good if they arrive home with disease that is not thought to be circulating in the Holiday (QWeCI target country) region. It is up to the tourists to protect themselves from disease transmission and to be aware of prophylaxis, symptoms and treatment for a range of infectious diseases. However, if there were a system where MoHs could be informed of unusual disease appearing within Europe and elsewhere, after holidays in the tropics, it would be useful. Most of these cases are reported through rapid to publish surveillance journals but it is unclear if they are accessed in the target countries. There needs to be awareness beyond malaria and tourists need to be informed through guidebooks and by tour operators of all the precautions they need before travel. The two papers reviewed above came after travel to Senegal and with its developing tourist industry it may need to take note about the importance of these diseases even though they affect a very small number of people. Many European tourists travel with little knowledge of where they are going especially those that take an inclusive package holiday.

In terms of climate controls for some disease that are mentioned above little is known. The role of climate change on the transmission of the pathogen that causes Buruli ulcer is unknown as so little is known about the diseases but the changes in patterns of wetland area will impacts on the disease. Much the same can be said for schistosomiasis which again is associated with lake edges but it has many complex social and ecological factors again which are not well understood.

Overall there is a lot of good research into infectious diseases going on in a wider than QWeCI context in the target countries but its integration with environmental and climate research is non-

existent or very limited. This is not a criticism of the work or the researchers but is more the reflection of the sectorial nature of research funding; even for major societally impacting infectious disease in Africa. Through the integrative nature of a FP project such as QWeCI, we have the interdisciplinary team that can start to make the connections across discipline barriers. QWeCI will deliver products of use to national and regional decision makers and further develop the in region science base and its capacity to continue the work post project.

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