PACE-Net: Pacific Europe network for Science and Technology

Project no. : 244510

Deliverable 4.1.4

Report on the expert workshop on Health held in Brisbane (Australia) on July 5-7 2011

Emerging diseases and vector-borne diseases

Work Package 4: Deliverable Report 4.1.4

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Date: 29.09.2011

Website: http://www.pacenet.eu/

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I. General context

1. EU priorities in the field "Health"

According to the European Commission: "Health is a major theme of the specific programme on Cooperation under the Seventh Framework Programme, with a total budget of € 6.1 billion over the duration of FP7. The objective of health research under FP7 is to improve the health of European citizens and boost the competitiveness of health-related industries and businesses, while addressing global health issues".

European-funded health research within FP7 will focus on three pillars:

Biotechnology, generic tools and medical technologies for human health

- **High-throughput research**
  - Detection, diagnosis and monitoring
  - Prediction of suitability, safety and efficacy of therapies
  - Innovative therapeutic approaches and interventions
- **Translating research for human health**
  - Integration of biological data and processes
  - Research on the brain and related diseases, human development and ageing
  - Research on infectious diseases
  - Research on major diseases: cancer, cardiovascular disease, diabetes/obesity, rare diseases, and other chronic diseases
- **Optimising the delivery of health care to European citizens**
  - Translation of clinical outcome into clinical practice, including better use of medicines
  - Quality, efficiency and solidarity of health care systems
  - Enhanced health promotion and disease prevention
- **Other actions across the theme include:**
  - Support for health research
  - Responding to EU policy needs"[1]

Travel, urbanization of human populations and an expanded geographical distribution of the vectors of some pathogens are factors which have contributed to the emergence and re-emergence of many infectious diseases. While many of these are not endemic in Europe, thousands of exotic infections are introduced into Europe annually with travellers and there have been several recent examples of these pathogens establishing European cycles of transmission e.g. Chikungunya virus in Italy and dengue in France. Changing climatic conditions are predicted to increase the distribution, around the Mediterranean region, of mosquitoes like *Aedes albopictus* which are an excellent vector for a wide range of arboviruses. By funding health research in the Pacific, the EU is helping to reduce the burden of disease in an impoverished region of the world while, at the same time, reducing the risk of transmission of disease from this region and into Europe.

[1] ftp://ftp.cordis.europa.eu/pub/fp7/docs/health-research_leaflet_en.pdf

2. South Pacific situation summary

The Pacific region is confronted by many chronic, emerging and neglected health-related issues which are responsible for preventable morbidity and mortality[2] (Gani, 2009).

Several factors contribute to the inability of the Pacific Island nation states to contain or reduce the burden of disease among their people, including:

- *Social and cultural transition to modern lifestyle (persistence of NCDs)*

The decline in subsistence farming, more sedentary jobs and increased reliance on imported foods of poor quality and nutritional value have contributed to the substantial and growing problem of obesity, and the associated cardiovascular diseases and diabetes. Tokelau, Nauru and American Samoa are at the top of the list of countries with the highest percentage of obese people in the world, with more than 93 percent of the population overweight or obese. In American Samoa, Tokelau and the Marshall Islands, more than 40 percent of adults aged 25 to 64 years old have diabetes (Russell, 2011). Despite investment in the development of National Plans of Action for Nutrition (NPANs) and interventions to promote healthy eating and physical activity, nutritional status appears to show little improvement (Hughes and Lawrence, 2005).

- *Urbanization, industrialization (impact on the environment)*

Rapid economic development has brought about urbanization and industrialization, but without any integrated environment management strategies. The modernization of agricultural technology and practices has led to an increased use of chemicals, mostly without any regard for the recommended doses and frequency of use. The development of mining and manufacturing industries, also contributes to the release of persistent organic pollutants (POPs). POPs include some organo-metals, such as methylmercury; lipophilic halogenated organics, such as dioxins, polychlorinated biphenyls, chlorinated pesticides, and polybrominated flame retardants and perfluorinated compounds used as repellents. These compounds are resistant to degradation both in the environment and in the human body and accumulate in the food chain (Carpenter, 2011; Arnold *et al.*, 2007). Waste management (including hazardous waste) is still an unresolved problem in many islands, and domestic and industrial waste pollutes the environment increasing the risk of sanitation-related diseases.

- *Insufficient water supply and sanitation (persistence/emergence of CDs)*

Barely 50 percent of Pacific islands population has access to sanitation, and less than 20 percent has access to drinking water piped to households. Moreover, there are major differences in the provision of sanitary services (improved water supply and sanitation) among nations with low (<US$18,000/person-year) but similar economic success (Arnold et al., 2011).

- *Fragile environment and limited natural resources (sensitive to climate change)*

[2] http://www.wpro.who.int/southpacific/sites/ccd/

Pacific Island countries are particularly exposed to burdens from climate-sensitive health outcomes. Extreme weather events, like floods, are associated with an increased risk of water borne infectious diseases, notably diarrhoeal diseases and leptospirosis. Disruptions of the coral reefs (cyclones, coral bleaching) result in an increased incidence of ciguatera poisoning (Chinain et al., 1999). As a consequence of global warming the distribution and abundance of mosquito species transmitting human pathogens, like malaria, dengue and lymphatic filariasis, are expanding (Mills et al., 2010).

- *Lack of workforce skills and resources to prevent and manage these issues*

The lack of financial and human resources has become a major constraint for many countries in the region, posing a serious obstacle to the promotion of public health. Developing countries in the Pacific region are in different stages of economic development and have health systems of varying efficiency. For the very poor, outreach of adequate basic health services is still a challenge with a lack of infrastructure and appropriate technology. For others, the issue is making, appropriate, cost effective, policy choices on resource allocation to address persistent, emerging and neglected health issues.

Non-Communicable diseases

Non-communicable diseases due to westernised diets, lack of activity, alcohol and tobacco are having a significant impact on the health of Pacific Islanders. It is unlikely that the health budgets of any Pacific Island nation state will ever be able to tackle these problems if the causes go unchecked. While these NCDs are the hallmark of poor and vulnerable groups in many societies, the social structures of Pacific societies provide an excellent framework to tackle these diseases. This is an area in need of operational research rather than yet another study to quantify the burden of these diseases.

Communicable diseases

Communicable diseases are an important cause of morbidity and mortality in the Pacific and , historically, have resulted in huge epidemics e.g. measles 1875, 1903, 1911; influenza 1918-1921; Ross River virus 1979-80 (Aaskov et al., 1981). Smaller outbreaks of dengue at a national level occur on an almost annual basis. These are occurring against a background of common communicable diseases that also occur in most other regions of the world.

Some examples of important infectious diseases in the Pacific are:

- **Dengue**, which is caused by the four dengue virus serotypes that are transmitted by mosquitoes. The epidemiology of dengue in the Pacific region is characterized by sustained transmission of a single dengue virus serotype and the regular occurrence of severe outbreaks (Li et al., 2010), usually accompanying the arrival of a different serotype. Once introduced into the Pacific region, mostly from dengue endemic countries in Southeast Asia, dengue viruses then rapidly disseminate throughout the Pacific islands (Cao-Lormeau et al., 2011).

- **Typhoid fever** is caused by ingestion of food or water contaminated with *Salmonella typhi* bacteria. This, potentially fatal, disease is endemic in many Pacific Island countries, and often at some of the highest incidences in the world. Prevention depends on clean water and good sanitation accompanied by public education in hand and food hygiene.
- **Leptospirosis** is caused by a bacteria belonging to the genus *Leptospira*. It is carried by animals such as rodents and pigs and transmitted through breaks in the skin of persons exposed to contaminated water or mud. Epidemics of leptospirosis occur regularly in the region, particularly during the rainy season (Berlioz-Arthaud et al., 2007; Daudens et al., 2009).
- **Acute Rheumatic Fever** (ARF) is an inflammatory disease that occurs following a *Streptococcus pyogenes* infection, such as strep throat or scarlet fever, and affects principally young children between age 6 and 15 years. Rheumatic Heart Disease (RHD), caused by the long-term damage of the heart muscle or heart valves after several ARF, is the most serious, and potentially lethal, complication of ARF. The estimated global median prevalence of RHD in children aged 5-14 years in the South Pacific is 7.6 per 1 000 [95% CI, 2.5 – 13.5] which is among the highest in the world.
- **Ciguatera** is a communicable, but not infectious, disease which is caused by the ingestion of fish contaminated with biotoxins produced by *Dynoflagellates and Cyanobacteria* (Chinain et al., 2010; Villeneuve *et al*., 2011). While it can be fatal it unusually is associated with chronic morbidity. Pacific countries like French Polynesia have some of the highest incidences of this disease in the world.

II - Workshop methodology for setting health research priorities for the Pacific

1. Issues mapping and priorities mapping exercise

There are significant and well recognised health issues in the Pacific region, such as diabetes and heart non communicable diseases, the cause of which is well known. Furthermore, research into malaria (where it occurs in the Pacific), HIV AIDS and tuberculosis has significant support from a range of bilateral and multilateral agencies. The Health Thematic Workshop therefore attempted to prioritise health issues for which *research is required in order to reduce the burden of existing disease or to prevent emerging or re-emerging diseases and for which existing research support is weak or non-existent.*

2. Rationale of health threats in the Pacific area

Water-borne diseases

As communities in the region industrialise and westernise, increasing proportions of the populations are to be found in large urban centres. In the absence of adequate planning and

resources, the residents of these centres often lack a safe water supply or adequate sanitation. To supply the food needs of these urban dwellers, more domestic animals are being farmed, there is far greater use of chemicals in mining and to increase agricultural yields and access to food is moving from the garden to the supermarket. In many cases, regulation and monitoring of chemical use and disposal is weak or non-existent and the quality of the water supply, even in large urban communities, often is uncertain. As products coming from the ocean (fish and shellfish) still remain a staple of islanders' diet, there is an ever increasing risk of poisoning due to the ingestion of marine products contaminated with bio-toxins.

The three projects proposed are intended to identify water-borne health threats in order to be able to address them.

Vector-borne diseases

Malaria, and possible drug resistance, remains a threat in Melanesia and this issue is the subject of a number indigenous and international research programs.

Dengue is a constant and growing threat and there is little evidence that present mosquito control programs are having any significant effect in reducing the burden of this disease. The situation with filariasis is similar. To the surprise of most regional Arbovirologists, Chikungunya virus has entered the Pacific region and established cycles of transmission in New Caledonia. Ross River virus transmission also appears to have re-commenced in at least one Pacific Island nation.

The ability of a number of Pacific mosquito species to transmit regional arboviruses has not been tested and so the risk of the introduction of even more exotic arboviruses remains un-assessed. There is no systematic regional study of what effect climate changes are having on mosquito species in the Pacific.

Finally, specific characteristics of Pacific island nations such as their relative geographic isolation and natural containment offers great opportunities for testing and implementing strategies for the sustainable control or elimination of vectors and the prevention of vector-borne infectious diseases.

Neglected diseases and future threats

The recent introduction of Chikungunya virus and the constant re-introduction of dengue viruses into the Pacific is a clear demonstration of the ease with which pathogens are introduced into, and spread around, the Pacific. There also is the likelihood of the introduction of bacteria with ever changing patterns of antibiotic resistance. This problem will be compounded by the ever increasing use, and poor regulation, of antibiotics in commercial poultry, and other domestic animal, production. Rheumatic fever and its associated chronic disease is a neglected and increasing threat to the health of many Pacific Islanders.

Non-communicable diseases

The Pacific faces a growing problem with diabetes and heart diseases linked to obesity. It is

anticipated that societal changes will exacerbate this issue and may have a significant impact on other non-communicable diseases. However, there appears to be insufficient ***long term*** monitoring and analysis of health trends in order to identify early changes or to monitor the effectiveness of interventions in any meaningful way.

III – Outcome of the workshop

1. Most important priorities for the Pacific

The research topics and projects relevant for the South Pacific area are summarized in the following table:

Table 1: Most important research priorities for the South Pacific

Topic	Project
Water	• Environmental contaminants (pollutants: heavy metals, fertilizers, herbicides and insecticides; contaminants of natural origin: marine biotoxins, mercury) • Leptospirosis • Water-borne diarrhoeal diseases
Vector-borne diseases	• Novel, evidence based, monitoring and surveillance of the diseases and their vectors (i.e. strengthen regional capacity in medical entomology, classical, and molecular taxonomy, population sampling and monitoring, vector competence evaluation) • Effect of climate and environment • Vector capacity to transmit regional pathogens • Novel approaches to vector control
Neglected diseases and future threats	• Zoonotic diseases • Emerging arboviral threats • Food safety • Anti-microbial resistance • Acute Rheumatic fever
Non-communicable diseases	• Health in transitional communities • Monitoring and analysis of health trends • Evaluation of interventions

2. Recommendations

The Health Thematic Group also recommends that all research proposals addressing the issues identified should provide clear plans for how the research will contribute to local capacity building, (including training, infrastructure, equipment, and education) to estimates of the burden of the disease being studied, to identification of environmental and societal drivers, to the development of policy to support possible interventions, to the methodology for evaluating any interventions and that the research will ensure community engagement and/or community adhesion to these programmes.

IV - Provisional calendar

1. Experts consultation and validation of the report draft version

This report has been drafted by John Aaskov (QUT), Morgan Mangeas (IRD) and Fadhila Le Meur (PACE-Net Project manager) and was circulated among all experts of the workshop panel until October 30th at the latest. The final report will be then submitted to the EC by the end of November 2011.

2. EC contacts

Guided by Mr Armand Beuf (PACE-Net project officer) a delegation should meet the concerned thematic Directorates in order to introduce the SICA proposals and the topics that should be prioritized in the Pacific region. This initiative should be developed in March 2012, during the project second bi-regional platform in Brussels.

V - Appendixes

1. Selected bibliography

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Appendix 2: List of experts to the PACE-Net workshop on "Health" in Brisbane, July 5-7 July 2011

First name	Last name	Organisation & Contact	Key Interests	Short bio
John	AASKOV	Queensland University of Technology (Australia) j.aaskov@qut.edu.au	- Mosquito borne viral diseases - Diagnostics, - Vaccines - Quality Assurance for diagnostic serology laboratories	They are a WHO Collaborating Centre for Arbovirus Reference and Research and have collaborated with institutes in Asia and the Pacific for more than 25 years in arbovirus research The team has developed diagnostic assays for Ross River and dengue virus infections that have been turned into global commercial products. They have participated in the human clinical trials of Japanese encephalitis and Ross River virus vaccines. They developed the Ross River virus vaccine..
John	ATTARD KINGSWELL	Environmental Health Directorate Malta mhi@gov.mt	– Monitor and regulate any environmental issues that may impact on Public Health – Contaminations arising from different sources (including air, water, ground, food and building materials)	In September 2007 I was appointed as the first ever director responsible for the Environmental Health Directorate under the Ministry for Health in Malta. The Environmental Health Directorate leads programmes that promote the attainment of the highest standards of public health and hygiene by addressing risk factors associated with environmental hazards. The Directorate is responsible for safeguarding the health and well being of the public through the enforcement of legislation derived from the European Union, National and international legislation. The Directorate addresses environmental issues within the scope of legislation.
Melanie	BANNISTER-TYRRELL	Australian National University (Australia) Melanie.Bannister-Tyrrell@anu.edu.au	- Dengue fever and climate variability/change in far north Queensland - Climate change effects on malaria and other infectious diseases - Methodological issues in assessing climate change impacts on infectious diseases	Research assistant in the Environment, Climate and Health theme at the National Centre for Epidemiology and Population Health, Australian National University. Investigates impacts of climate change on human health; subtopics include temperature, weather and air quality; infectious diseases; drought, drying, rural/remote health; food yields, nutrition health; and adaptation strategies. Other topics in the Environment, Climate and Health theme include: UV radiation and other environmental effects on immune function; urban environments and health; and environmental change, sustainability and social stability.
Hervé	BOSSIN	ILM (Institut Louis Malardé) hbossin@ilm.pf	- South Pacific - Mosquito-borne diseases - Mosquito bio-ecology - Sustainable vector control	Institut Louis Malardé (ILM) is a French Polynesian Biomedical Research Center based in Tahiti, French Polynesia. The Medical Entomology and Parasitology Laboratory at ILM is conducting a range of basic and operational research activities against insect pests of medical importance (biting midges and mosquito

			- Area-wide integrated pest management	vectors of diseases) that affect French Polynesia and other Pacific Island Countries (PICs). Our field and lab-based research focuses on the development of innovative, integrated, area-wide approaches for the sustainable control of mosquito-borne diseases such as lymphatic filariasis, dengue and chikungunya. French Polynesia and its many islands form a unique natural laboratory perfectly suited for such high impact field research. Our laboratory is involved in the development and field evaluation of novel mosquito control approaches, including *Wolbachia*-based vector population elimination and/or replacement. Transgenic approaches are also being considered for combating both *Aedes aegypti and Aedes polynesiensis,* the two main disease vectors affecting French Polynesia and most of the PICs.
Eric	D'ORTENZIO	Institut Pasteur, New Caledonia edortenzio@pasteur.nc	- Emerging Infectious Diseases Epidemiology - Chikungunya - Dengue - Leptospirosis - Rheumatic Fever and group A streptococcus diseases.	Our Infectious Diseases Epidemiology Unit conducts research on the epidemiology and control of infectious diseases of public health importance in New Caledonia and has collaborative research links in others Pacific countries. The research ranges from ecological studies investigating explanations for population differences in disease transmission, through cohort and case-control studies of disease aetiology, evaluation of health programmes, mathematical modelling of infectious diseases and burden of diseases. Research is conducted on a wide range of infections, including: dengue, chikungunya, leptospirosis, rheumatic fever (consequence of an infectious disease with group A streptococcus), tuberculosis, respiratory diseases. Staff includes medical and statistical epidemiologists. There is considerable interest in methodological work, including research on statistical methodology, transmission models, immuno-epidemiology.
Allison	IMRIE	University of Western Australia imrie@cyllene.uwa.edu.au	- Infectious diseases - Dengue - Molecular epidemiology - Immunopathogenesis - Arboviruses	Our work aims to define the nature of dengue virus-specific immune responses, in Pacific Islanders. We have initiated studies in Hawaii and French Polynesia and recruited study participants with histories of previous dengue virus infection. Our approaches include molecular epidemiological studies to understand the movement of viruses among populations, and to gain an understanding of disease and epidemic virulence, and assessments of immuno-pathologic mechanisms which may contribute to the severe forms of dengue illness.
Vaira-Irisa	KALNINA	Institute of microbiology and virology, Riga Stradins University	- Virology and Antivirals - Molecular biology - Epidemiology of infectious	MD,PhD. V. Kalnina works at Riga Stradins University,1992-2009:State Public Health Agency, Head of Methodology Department (2008-2009)and Head of Virology Laboratory (1992 – 2007**);** 1966-1992. Latvian Academy of Sciences,

		vaira.kalnina@rsu.lv	diseases and Pandemics - Influenza viruses	Institute of Microbiology, senior researcher.
Van-Mai	LORMEAU	ILM (Institut Louis Malardé) mlormeau@ilm.pf	- Epidemiology, molecular epidemiology and genetic evolution of dengue virus - Intra-host genetic diversity of dengue virus in the human and the mosquito - Field and laboratory tools for the detection and surveillance of arboviruses - Pathogenesis of dengue virus infection - Impact of environmental factors on the epidemiology and genetic evolution of mosquito-transmitted pathogens in island countries	The Research Laboratory in Medical Virology at Institut Louis Malardé is interested in arboviruses surveillance and dengue virus (DENV) research in French Polynesia (FP) for more than 30 years. Currently, our main research activities are focused on the epidemiology, molecular epidemiology and genetic evolution of DENV in FP and Pacific Island Countries. We are particularly interested in the impact of epidemiological, eco-biological (climate, endemic mosquito species) and sociological factors on DENV microevolution. We are also conducting studies addressing the dynamics of DENV genetic diversity in the infected host (human and mosquito). Otherwise, as part of "arboviruses surveillance system" in FP, our lab is in charge of implementing and up-dating laboratory tools for the detection of mosquito-transmitted viruses (qRT-PCR, ELISA). In the expectation to improve the surveillance of arboviruses in the whole Pacific region, we recently initiated a Pilot study on the use of filter paper cards for the surveillance of DENV serotypes circulating in Pacific Island Countries. Our main collaborators are: *Institut Pasteur de Nouvelle Calédonie (New Caledonia), Queensland University of Technology (Australia), University of Hawaii (Hawaii), CNR des arbovirus - Institut Pasteur de Paris (France), Institut de Médecine Tropicale du Service de Santé des Armées (France), IRD (New Caledonia).*
Morgan	MANGEAS	IRD Espace morgan.mangeas@ird.fr	- Spatial and temporal modelling - Dengue outbreaks - Stochastic processes - Environment and health - Climatic change	Currently heading the research unit ESPACE-DEV at the Research Institute for Development in New-Caledonia: 12 members, 3 scientific fields (modelling, remote sensing, and social sciences). For one year, in 2007, Assistant Professor at the University of New-Caledonia in the ERIM team, course on "applied mathematics and computer sciences". Senior researcher at IRD since 2003, working on knowledge discovery, spatial information in environment. Career start as a researcher at IFSTTAR (transport and security research) in France in 1999 just after a position of visiting researcher at the University of Colorado in 1996. Application fields cover ecosystem modelling and disease dynamic modelling.
Graham	MACKERETH	Health Intelligence Team, Health Programme, ESR graham.mackereth@esr.cri.nz	- Communicable disease surveillance and data integration - Outbreak investigation	The ESR Health Programme undertakes reference laboratory services, surveillance, outbreak investigation, and research associated with a public health laboratory, including researching new technologies for use in laboratory science, research into disease trends, such as influenza in people and pigs.

			- Public Health laboratories - Communicable and environmental health research - Zoonotic diseases	Health Intelligence team I coordinate assists the Ministry of Health to prevent and control communicable diseases by providing: · surveillance for prevention and control; · integrated data management; · support with public health policy development; · sector training and education; · partnerships and communication; and · emergency response activities. The Health Intelligence team: provides the Ministry and Public Health Units (PHUs) with specialist advice and analytical services on communicable disease on an on-demand basis; maintains high quality programmes in laboratory surveillance of a range of pathogens, notifiable diseases, sexually transmitted infections, influenza and outbreaks; provides for the assessment and surveillance of infectious, communicable, and environmental exposures. The staff mix reflects this and includes: environmental scientists, epidemiologists, public health physicians, biostatisticians, (geo)informaticians, social scientists.
Lohi	MATAINAHO	University of Papua New Guinea lohi.matainaho@upng.ac.pg	- Biology - Chemistry - Medicine	Prof. Dr. Lohi T. Matainaho is the head of the pharmacology department at the School of Medicine and Health Sciences, University of Papua New Guinea. He focuses on researching new medicines from marine and forest resources. PNG is one of the most bio-diverse places on the planet and this richness could yield new drugs to treat illnesses like cancer and tuberculosis.
Manju	RANI	Western Pacific Regional Office World Health Organization ranim@wpro.who.int	- Health systems research especially on service delivery models - Maternal and child health - tobacco control and non-communicable diseases - Governance and management of health research - Health information systems and program evaluation.	Dr. Manju Rani is Senior Technical Officer for Health Research Policy at the WHO Regional office for the Western Pacific. She received her medical degree (MBBS) from Delhi University in India, and PhD degree in public health from Bloomberg School of Public Health, Johns Hopkins University in USA. She has worked on wide ranging public health issues including reproductive health, tobacco control, health inequities, and health service delivery. Between 2004 and September 2010, she was a scientist in Expanded Program of Immunization at WHO Regional Office for Western Pacific. Between 2001 and 2004, she worked on several assignments at World Bank including publication of World Development Report (2004) "Making Services Work for Poor". She held several management and supervisory position in the pubic sector in India between 1993 and 1998.