Chronic diseases and multi-morbidity
-a conceptual framework for countries in health transition

T Oni1,2, N McGrath3, R BeLue4, P Roderick3, S Colagiuri5, N Levitt6

1. Clinical Infectious Disease Research Initiative, Institute of Infectious Diseases and Molecular Medicine, University of Cape Town, South Africa. 2. Centre for Infectious Disease Epidemiology Research, School of Public Health, University of Cape Town, South Africa. 3. Academic Unit of Primary Care and Population Sciences, University of Southampton, United Kingdom. 4. Department of Health Policy and Administration, Pennsylvania State University, United States of America. 4. Boden Institute, University of Sydney, Australia. 6. Department of Medicine, University of Cape Town, South Africa.

Abstract

The burden of non-communicable diseases (NCD) is rising, particularly in low and middle-income countries that are undergoing rapid epidemiological transition. In sub-Saharan Africa, this is occurring against a background of existing infectious chronic disease epidemics, particularly HIV and tuberculosis (TB) and the increasing prevalence of multi-morbidities at younger ages than previously encountered.

The co-existence of both infectious and NCD morbidities within an individual necessitates a re-thinking of models of healthcare delivery and data to inform health care policy and planning in order to provide an adequate primary care response to the ongoing health transition. Our manuscript proposes a new conceptual framework for countries in health transition that takes multiple morbidity into account, simultaneously considers multiple perspectives and incorporates disease interactions, and patients and healthcare worker perspectives to inform health system priorities for healthcare delivery, in countries undergoing epidemiological transition.

HEALTH TRANSITION AND MULTIMORBIDITY

Many low and middle-income countries (LMICs) are undergoing rapid epidemiological transition. The burden of non-communicable diseases (NCD) is rising particularly in LMICs. In sub-Saharan Africa, this is occurring against a background of existing infectious chronic disease epidemics, including HIV and tuberculosis (TB).

Given these colliding epidemics, the prevalence of co-existing multiple morbidities within an individual is rising, and occurring in younger age groups compared to developed countries. This is likely to increase further over time with improving health care services, but may be unevenly distributed across socio-economic status due to differential access to care. Furthermore, in high HIV-prevalence countries, the premature ageing effect of HIV, increased access to antiretroviral therapy and longer life expectancy will further contribute to multiple morbidities in younger persons.

The increasing prevalence of multi-morbidity (MM) necessitates a re-thinking of models of healthcare delivery and data to inform health care policy and planning in order to provide an adequate primary and secondary care response to the ongoing health transition. Several studies have proposed frameworks for exploring MM. These include examining the interaction between chronic diseases and the psychosocial environment (1), understanding patient workload (2) and incorporating knowledge of patient coping mechanisms and self-management skill requirements (3). Specifically, we propose that MM should be considered in terms of interactions between the patient, clinical, psychosocial, health care provider and health system characteristics. We illustrate our proposed model using South Africa as a case study.
The global burden of disease study demonstrated that in Southern Africa, while HIV and TB rank 1st and 4th in the top ten causes of morbidity respectively, 50% of the causes of morbidity are non-communicable; cerebrovascular disease is ranked 7th and diabetes is ranked 8th (4). In South Africa, whilst HIV-related mortality is decreasing, mortality from diseases of the circulatory system; neoplasms; endocrine, nutritional and metabolic disease are increasing (5). Cerebrovascular disease and diabetes are the 5th and 6th leading causes of mortality in South Africa, and TB and HIV are ranked 1st and 7th as causes of death in 2010, respectively (5).

The first ever South African National Health and Nutritional Examination Survey (SANHANES) was conducted in 2012. Results showed a multiplicity of NCD risk factors, high self-reported levels of morbidity and an increase in the prevalence of risk factors compared to the 2003 South African Demographic and Health survey (6). In response to these results, the report recommended strengthening the NCD strategy and the creation of a task force to address the clinical management of NCD.

South Africa is developing a National Health Insurance (NHI) scheme, a financing system that aims to provide equitable essential healthcare to all. The focus in the first 5 years of implementation is on health system strengthening and a significant overhaul of the existing health system delivery structures will be required. The proposed changes relate to infrastructure development, information management, and quality improvement with a focus on improving patient experience. The piloting of this scheme, in addition to plans for re-engineering of the primary health care system, and the proposed SANHANES task force provide a good opportunity to re-examine models of health care delivery.

We propose evaluation of the management of chronic diseases (including prevalent infectious chronic diseases such as HIV) using a framework that takes into account population health transition and MM within individuals. The proposed conceptual framework (Figure 1) incorporates clinical, patients, healthcare provider perspectives, informing health system priorities for healthcare delivery.

CONCEPTUAL FRAMEWORK

Disease-disease interaction
Due to the complexity of managing several chronic disease that co-exist and sometimes interact within an individual, MM can be explored by examining disease-disease interactions, with respect to clinical manifestation, screening and diagnostic algorithms, susceptibility, and prognosis. In addition, MM sometimes cluster as a result of shared risk factors (e.g. obesity, diabetes and hypertension), or as complications of other diseases (e.g. chronic kidney disease leading to cardiovascular disease and vice versa; and depression developing after chronic disease diagnoses). In this regard, more data to better understand the population-specific epidemiology of the interactions between disease-specific morbidities, for example between TB/diabetes and hepatitis B/obesity/alcohol, would be informative.

Patient perspective
The cumulative complexity model developed by Shippee et al seems a good framework by which to understand the patient perspective on MM in LMIC (2). The model envisages two interacting concepts of workload and capacity. Patient workload describes the demands on patients of managing their MM (including polypharmacy, self care, behaviour change, clinic visits) and how this fits with their daily disease independent responsibilities (2). Set against this is the capacity to cope, which reflects the impact of MM on physical and mental functioning, pre-existing health literacy and family and social support. Increasing MM may lead to a vicious spiral of increasing workload reduced capacity and inappropriate or ineffective actions. The burden of MM is generally higher in the urbanized poor who often have a lower capacity to deal with ill health. The workload/capacity balance and patient input...
into their overall self-care, contribute to patient prioritization and choices. We propose that consideration of patient-centered experiences should include understanding factors that influence coping mechanisms, patient choices and prioritization; as well as better measures to assess workload and capacity. A key component of the South African NHI scheme is improving the quality of patient experience when accessing health care. Our framework proposes that consideration of the patient-centred experiences should include understanding factors that influence patient choices and prioritization when multiple morbidities co-exist.

**Health provider perspective**

Patients' medical needs are more intensive and demanding when they have multiple chronic diseases. Consequently, management decisions are a process of trade-offs, dependent on the health provider’s ability to deal with a multiplicity of co-morbidities. In addition, issues arise around role delineation between specialists and generalists and how to coordinate care at the primary, secondary and tertiary levels of healthcare. Therefore it is important that evidence from clinical and patient perspectives inform care of complex patients; however the generation of evidence is often challenging as many interventional studies and guidelines do not explicitly address MM and patients with MM are often excluded from trials. Furthermore, training of health providers should be responsive to these changes in population health. A view of achievable health goals, shared by health provider and patient, is desirable to enhance patient satisfaction adherence and respect for patient choices and clinical decisions alike.

**Health system perspective: monitoring and evaluation**

The Direct Observed Therapy (DOT) short-course framework for TB management has demonstrated that a standardized electronic information management system is crucial to facilitating effective monitoring and evaluation of chronic disease management systems and interventions. The key tenets of this framework are political commitment, passive case-finding, effective treatment, a standardized monitoring and evaluation system and uninterrupted drug supplies. An effective and standardized electronic information management system is crucial to facilitating effective monitoring and evaluation of chronic disease management systems and interventions. This includes standardized indicators to measure single- and multi-morbidity. The Western Cape province of South Africa conducts annual chronic disease audits to assess progress towards identified targets. This includes an audit of facility equipment, management, and individual disease management targets. Whilst lessons learnt from audits and the DOTs framework provide a starting point for examination of the health system model, these approaches do not sufficiently integrate other perspectives. Of note, the patient perspective, including the acceptability of interventions that take management of morbidities out the health facilities and into the home, should be incorporated into the monitoring and evaluation of health system policy and interventions. In addition, the monitoring of equity in health services and the impact of MM and health system changes would be vital to reduce inequity gaps.

The current vertical chronic disease specific health system requires re-consideration in a setting of a high prevalence of MM. There has been increasing discussion about the need to integrate chronic infectious and non-communicable diseases although successful demonstration remains limited at this point. We propose extending the concept of integration to incorporate patient perspectives that take into account the complexity of social determinants of health. We also advocate the importance of incorporating the health provider perspective into informing the structuring of the health system including human capacity to improve management and outcomes of chronic diseases.

**CONCLUSION**

In order to reach the target of a 25% reduction in mortality due to NCD by 2025 set at the 65th World Health Assembly, innovative strategies will be required. These will require taking into consideration changing patterns of morbidity and the increasing prevalence of MM at younger ages than previously encountered, particularly in LMIC where rapidly urbanizing poorer
populations are arguably more susceptible to MM and the adverse outcomes that can result. Our proposed conceptual framework recommends incorporating disease-disease interactions, patient and health provider perspectives into the re-engineering and evaluation of health systems to optimize health outcomes of a population undergoing demographic, epidemiological and health transition.

**AUTHOR CONTRIBUTIONS**
TO was responsible for conceptualizing and drafting this manuscript. All authors were involved in the writing and editing of the manuscript.

**CONFLICT OF INTEREST STATEMENT**
The authors have no conflicts of interest to declare.

**ROLE OF FUNDING SOURCES**
TO is supported by a Carnegie Corporation Postdoctoral Fellowship, a Harry Crossley Senior Clinical Fellowship and the Southern African Consortium for Research Excellence. NMcG is supported by a Wellcome Trust fellowship grant (# WT083495MA). NL receives funding from the Department of Health, Medical Research Council and National Research Foundation, South Africa, as well as the World Diabetes Foundation. She is principal investigator on research grants to University of Cape Town from the United Health Company, USA, the National Heart Lung and Blood Institute of NIH. USA and Medtrons Foundation, USA. This work is partly funded by a research development fund from the Worldwide Universities Network. The funders had no role in the design and writing of this manuscript.

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Figure 1

Disease-disease Interaction

Effect of multiple diseases on:
- Susceptibility and risk of HIV/TB (incl. role of shared risk factors*)
- Diagnosis and clinical manifestation of TB
- Diagnosis and clinical manifestation of NCDs
- Complications and treatment outcomes of HIV/TB/NCDs (incl. impact on shared target/end organs**)

Patient Perspective

Effect of multiple chronic diseases on:
- Disease-independent workload
- Treatment load
- Resilience and capacity
- Patient prioritization of morbidities

Health system

- How to integrate these perspectives and interactions to influence chronic care management and outcomes
- Incorporating clinical, patient and provider priorities into patient engagement with the health system

Health Provider Perspective

Health care worker capacity to deal with high patient load and complexity
Health provider role delineation

*Risk factors including:
  - Energy balance and obesity
  - Smoking
  - Alcohol and substance abuse

**Target organs including:
  - Kidneys
  - Brain
  - Heart